CORE-LOGS

SUMMARY INFORMATION;
COMPOSITE LITHOLOGIC COLUMN;
LOGS FOR BOXES 1-354

HAWAII SCIENTIFIC DRILLING PROJECT

PRINCIPAL INVESTIGATORS

D.J. DEPAOLO
UNIVERSITY OF CALIFORNIA, BERKELEY

E.M. STOLPER
CALIFORNIA INSTITUTE OF TECHNOLOGY

D.M. THOMAS
UNIVERSITY OF HAWAII
PREFACE

Core-drilling for the first phase of the Hawaii Scientific Drilling Project (HSDP) took place from October 25 to December 10, 1993 at a site just east of downtown Hilo. A total depth of 3,464 feet (1,056 meters) was achieved with a recovery rate of greater than 90%. In parallel with the drilling, a major effort was undertaken to process the core in essentially real-time. This involved washing, marking, boxing, splitting, photographing, logging, and sampling the core. Keeping up with the highly successful drilling turned out to be a monumental task, but the team of dedicated geologists, most of whom were effectively volunteering their time, managed to do it. This volume represents a major achievement made possible by their dedication and hard work.

The summary lithologic column and the core-logs presented here are key building blocks for the success of the HSDP. They are the primary descriptions of the core. Using them as a framework, we hope that all of the team members can explore and examine what is available for study. They are effectively a road map for navigating the core and provide a common language for communication among the team members.

In the interests of keeping costs down, we have made the annotated digital photographs available here only in black and white at a resolution of 600 dpi. We have printed a few copies in color, but reproduction will be expensive and the resolution is only 300 dpi. If there is demand, we can make the lower resolution color version available. All of the color images (at full resolution), the lithologic column, and the entire log are available via the WWW on expet.gps.caltech.edu (a description is provided on pages 1-2 of this volume). Other information and figures are also available, and if any team members are interested in placing data, queries, or comments on this server for communication with the HSDP team, they should contact paul@expet.gps.caltech.edu.

This document represents an extraordinary effort by many people. The names of the loggers and others that helped with core handling are listed on the following page. Several people, however, deserve special mention. Wayne Campbell played a critical role in the design of the core recovery and handling procedures. He trained everyone in these procedures and oversaw all aspects of the core handling. It is difficult to overstate how much less would have been accomplished had he not been so generous and dedicated. Moreover, he was on-site every day, over the entire two month period of the drilling project. Mike Baker was also on-site every day for the entire two month drilling period. He logged much of the core and along with Wayne Campbell provided continuity and expertise on most aspects of the core handling. In addition, for the past six months, he has put in a major effort putting together this document, including annotation of the digital photographs, developing the Unit Summary, and proofing the logs and photographs. We hope it is obvious, but in case it is not, coming to grips with the information in the 354 core-boxes at the level of detail that is presented here was a monumental task, and Mike is the one who did it. Mike Garcia took on the task of designing the core-logging procedures, of coordinating all of the loggers and their work, and of checking all of the logs. This was an incredible effort. Without his patience, dedication, and willingness to share his remarkable experience with Hawaiian rocks and geology, the logs would be significantly less authoritative and accurate. Paul Asimow had the initiative to put all of this on the WWW, which will make access to the large amount of information presented here much easier for everyone, and will greatly facilitate dissemination of the results of the project. Finally, when everyone else was burned out, Jeri Standfield did most of the corrections on the data base and Sally Newman stepped in and proofread all of the core-logs several times.

This work was supported by NSF Grants EAR91-17588, -18573, and -18691.

Don DePaolo
Ed Stolper
Don Thomas

June, 1994
Loggers*

Mike Baker (MBB, California Institute of Technology)
Nicolas Binard (NB, IFREMER, Brest, France)
Wayne Campbell (WRC, United States Geological Survey, Denver)
Gail Eaton (GFE, University of California, Berkeley-Lawrence Berkeley Laboratory)
Mike Garcia, Chief Logger (MG, University of Hawaii, Manoa)
Tom Johnson (TJ, University of California, Berkeley)
John Lassiter (JCL, University of California, Berkeley)
Brent McInnes (BM, California Institute of Technology)
Bhaskar Rao (BR, University of Hawaii, Manoa)
Ed Stolper (EMS, California Institute of Technology)
Laura Wasylenki (LW, California Institute of Technology)
Laurie Watson (LLW, California Institute of Technology)
Huai-Jen Yang (HJY, Massachusetts Institute of Technology)

Other on-site participants

Dave Clague (United States Geological Survey, Hawaii Volcano Observatory)
Don DePaolo (University of California, Berkeley)
B. Lynn Ingram (Lawrence Livermore National Laboratory)
Judy Journeay (University of Hawaii, Hilo)
Jack Lockwood (JPL, United States Geological Survey, Hawaii Volcano Observatory)
Tari Mattox (United States Geological Survey, Hawaii Volcano Observatory)
Kelly Okano (University of Hawaii, Hilo)
Aaron Pietruzska (University of Hawaii, Manoa)
Don Thomas (University of Hawaii, Manoa)
Frank Trusdell (United States Geological Survey, Hawaii Volcano Observatory)
George Walker (GPLW, University of Hawaii, Manoa)

* Initials and institutional affiliations given in parentheses. The initials are used in the logs to indicate who did the logging on each core box.
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THE HSDP WWW SERVER

All the core photographs, the lithologic column, and the lithologic unit descriptions are presently available to investigators and the public via the World Wide Web (WWW), as explained here. This on-line service provides free, rapid interchange of text, graphics, and/or sound, and is user-friendly and self-explanatory.

What is the WWW?

The WWW is a group of internet-connected computers running programs called servers that distribute information in a format known as Hypertext Mark-up Language (HTML). Anyone with internet access and a client program such as NCSA Mosaic can connect to any server and download HTML documents, which can include text, graphics, sound, and binary programs. HTML allows the embedding of pointers or links to other documents anywhere on the WWW; these links are typically traversed simply by clicking on an appropriate bit of highlighted text in an HTML document. These links give the WWW its web-like quality, and allow such things, for example, as information residing on a computer in Hawaii to be found by connecting to the server at Caltech.

Accessing the WWW and the HSDP web server

To use the resources of the WWW, you need a client program. The most popular program currently available is NCSA Mosaic, available free from NCSA at ftp.ncsa.uiuc.edu. There are versions for Microsoft Windows, Macintosh, and X-Windows. You may also need to obtain suitable graphics display programs (such as JPEGview for Macintosh or XV for X-windows), which Mosaic calls to handle downloaded images (Mosaic also displays images internally, but cannot edit or manipulate them). Once you have downloaded and installed the client program, you can connect to our server by opening the URL (Uniform Resource Locator, the standardized addressing format used by the WWW) "http://expet.gps.caltech.edu".

Information and formats on the HSDP server

Most of the information is presently reached using the Index to Sensitive Maps of the Lithologic Column, which has pointers to the 9 pages into which the column has been split and a table showing the boxes, runs, units, and depths covered by each page. Choosing the appropriate page brings up a picture of the lithologic column in GIF format (Compuserve Graphics Interchange Format; your display program should be able to convert this to other formats). You can download this image by clicking on the text "Download this page", or you can use it as a Sensitive Map, by clicking your mouse on a suitable part of the image. Clicking in one of the pink rectangles representing a Core Box will download the full-resolution color photograph (GIF format, typically 500x700 pixels and about 300 kilobytes) to the graphics viewing program which is linked to your client. You may have to adjust the brightness of the image for optimum contrast on your particular display. Since the images are sent to an external viewing program by Mosaic, the main Mosaic window should still be showing the page of the lithologic core.

At the time of this writing, there are two versions of every photograph available, one with annotations showing lithologic units and points of interest, the other directly off the photo-cd without annotations. You choose which one to download at the Index to Sensitive Maps. The raw images may be withdrawn if there is no interest in them.

The descriptions of the lithologic units, in tabular text format, are obtained by clicking on the lithologic unit numbers in the rightmost column of the Lithologic Column image. Each unit is described in every box in which it occurs, so clicking a lithologic unit number may bring up as many
as 20 descriptions. Find the section corresponding to the Core Box in question for discussion of
the lettered points of interest annotated in the photographs.

The full column, all the photographs, and the lithologic descriptions (as well as a C program for
interpreting the unlabeled description data files as HTML or plain text) can also be downloaded
from simple directories without using the sensitive map system.

**Online Sample Order Form**

The server includes a **sample order form** which investigators can fill out and submit using
Mosaic. The information given is e-mailed directly to the persons at Caltech responsible for dis­
tributing core sample.

**Placing information on the server**

If any investigator wishes to make data or results available to the rest of the HSDP community (and
the world) via the WWW, there are two ways to do this. The preferred way is for you to set up
your own server on a local internet-connected computer, to which a link will be placed on the cen­
tral HSDP server at Caltech. The software needed to do this is also available free from NCSA, and
is called HTTPD. The simpler path is to transmit the information to Caltech and make it part of the
central server, kept on a local disk at Caltech. Contact paul@expet.gps.caltech.edu for details on
either method.

**Questions?**

Any questions, comments, or suggestions should be sent to Paul Asimow,
paul@expet.gps.caltech.edu. This resource exists to facilitate the work of HSDP and any ideas on
improving its utility to the investigators are welcomed.
SAMPLE HANDLING PROCEDURES

General Statement

The NSF Hawaii drilling project (NSF-HDP) will involve primarily the acquisition of continuous cores. This document describes the procedures to be followed for initial sample handling and subsequent splitting, core characterization, and sampling.

During drilling, cuttings may be collected as specified by the on-site Project Manager in consultation with the Science Steering Group. This may be particularly important if continuous coring does not provide adequate samples. Under the direction of the Sample Manager, cuttings will be collected, washed, and placed in properly labeled sample bags. These samples will be transported to the NEHLP core handling facility at Puna for indexing and sampling as required.

Samples of drilling fluid/mud may be collected as specified by the on-site Project Manager in consultation with the Science Steering Group. These samples of drilling mud and additives may provide crucial information on contamination of core and formation fluids. Under the direction of the Sample Manager, these materials will be collected and placed in properly labeled sample bags. These samples will be transported to Puna for indexing, sampling, and storage as required. Attention may need to be paid to preservation of these materials with stabilizing agents and proper storage.

1This document was prepared prior to the start of drilling. Procedures evolved somewhat as the project got underway, and these changes are not reflected here. Wayne Campbell is preparing a revised description of what was actually done, and this will probably be published as a USGS Open File Report.
2Don Thomas or Roland Lawrence, who will share responsibility for interfacing with the drilling contractor at the drilling site.
3Don DePaolo, Ed Stolper, Don Thomas.
4Wayne Campbell (USGS Core Research Center).
At the Drilling Site

Since coring will be conducted using wire-line techniques, handling and curation procedures begin when the core-barrel liner is removed from the hole. An on-site Project Manager will be present or available at the drilling site at all times.

Removal of the core from the core barrel

Based on experience gained from the State of Hawaii's SOH project, it is assumed that project personnel do not have to be present to supervise or assist with removal of the core from the core-barrel liner; i.e., this can be left to the drilling crew. However, a schedule will be set up putting one member of our team on-call in case unforeseen circumstances arise; on-call shifts will be 12 hours, and at the start of the project and until it has been determined by the Sample Manager based on experience with the actual drilling crew that it is unnecessary, the on-call team member will be present at the drilling site when cores are recovered.

1. The drilling and coring crew will remove the core from the inner tube and place it in a numbered 12' PVC tray in the on-site core handling shed. When transferring the core sample, care will be taken to avoid disturbance or breaking of the core. Particular care must be taken to place the top of the core at the distinctly marked end of the PVC tray. The PVC trays will be permanently and securely mounted on 6" wide planks to prevent tipping, fitted with end caps, and fitted with PVC covers that can be secured with Velcro straps. Holes for drainage will be drilled at ~1' spacing in the PVC trays. The trays are to be pre-numbered sequentially and one end of each PVC tray will be distinctively marked to indicate the top of the core. The 12' trays will actually be made of two attached 6' lengths that can be detached to facilitate transport from the drilling site. Each of the 6' lengths will have been pre-labeled as section "A" and "B" of a single numbered core, and the tops of each 6' length will have been pre-marked.

2. Each coring run will be given a sequential number starting with the number "R1" for the top of the hole. As soon as the core is received from the drilling contractor, a temporary label with this core run # and the top and bottom driller's depth is filled out with a water-proof felt tipped pen and affixed to the PVC tray.

3. A plasticized Core Recovery Form for each core run will also be filled out by the driller and attached with a clip to the PVC tray. Critical information to be recorded are the core number, driller's start and end depths, a preliminary visual estimate of the length of recovered core, and unusual situations relative to core recovery. Unusual features of particular interest (e.g., charcoal, fossils, glass, etc.) should also be noted.

4. The PVC top will be secured and the core tray will be placed in a safe, secure location at the drilling site.

Transport of cores to Puna

At the start of his shift, the team member who is on-call for the drilling site will go to the drilling site, prepare the cores that have accumulated during the previous shift for transport to the Puna core handling facility, and transport these cores to Puna.

For each core run, the team member will:

5. Verify the labeling of the PVC tray and the information placed by the driller in the Core Recovery Form.
6. The next step is to separate the 12' long PVC tray into its two detachable 6' long trays for transport to Puna. If it is already broken into appropriate lengths, the top half or so of the core will be slid up into the 6' long "A" tray and the bottom half or so will be slid into the "B" tray. If necessary, the core will be broken with a hammer at near its middle to allow this division of the core to be made. A mark with a waterproof marker will be made across the artificial break to indicate the location of the break and the orientation of the two broken fragments, and a notation will be made on the Core Recovery Form that a break was made. End covers will then be secured to the lower end of the "A" tray and the upper end of the "B" tray to keep the core from sliding out of the tray, and the PVC tops will be resecured with the Velcro straps.

7. The trays will be placed in a rack in the bed of a pickup truck. Care should be taken to ensure that the trays are stable and secured for transport to the Puna core handling facility. It may be desirable to separate layers of PVC trays with lengths of 2x4's laying perpendicular to the PVC trays.

8. Once all the core trays have been placed in the truck, the cores and the Core Recovery Forms for these cores will be driven to the Puna core handling facility.
NEHLP (Puna) Handling and Sampling Procedures

It is critical that there be no smoking at the Puna facility, in order to avoid contamination of the cores with phosphorus and rare earths.

All rings should be removed before handling core.

9. The core trays will be removed from the truck and laid out next to the core washing table.

For each core run, the following sequence will be followed:

10. The A and B trays for each core run will be placed on the core washing table. These trays will then be reattached, giving a single 12' long core tray containing the complete core run. The core will be washed carefully and thoroughly using hoses, sponges, brushes, paper towels, etc. as core conditions permit.

11. Unusual features (e.g., delicate glass-bearing sections or ash layers) will be photographed and noted. Special instructions for slabbing are to be noted on the Core Recovery Form (see #19).

12. The core will be aligned and fitted together where possible. Where any ambiguities exist, fracture match points will be marked with symbols (Δ, O, ○, etc.) for visual assistance in fitting of pieces (Figure 1). Rubbly zones will be sealed in plastic bags. The length of recovered core will be measured and this more accurate value will be recorded on the Core Recovery Form. The top of the core being processed will be compared with the bottom of the previous core, and it should be noted on the Core Recovery Form whether these two pieces can be fit together.

13. The core will be marked for up-down orientation. The surface of the core should first be dried with a blow dryer if necessary to facilitate writing on it with water-proof felt tipped pens. Core up/down orientation will be indicated by drawing two parallel lines on the

![Figure 1. Schematic showing aligned core with symbols to indicate how the fragmented core fits together. From USGS Open File Report 89-496.](image-url)
14. Depth relative to the top of the core run will be marked and labeled on the core at one foot intervals with waterproof felt tipped pen (Figure 2). Depth intervals of rubbly zones will be estimated and marked on the enclosing plastic bags with waterproof felt tipped pen; depth markings will continue on the solid core beyond rubbly zones based on these estimates. Each significant fragment of core should have at least one depth marking on it; this may require depth markings more frequently than at one foot intervals in some cases. The RQD will be measured and the value entered on the Core Recovery Form. The RQD defined as the percentage of the core length that is in pieces longer than 10 cm. The measurement is to be done along the double pen marks indicating the up direction.

15. The core will then be broken into ~2.0' segments with a hammer. Again (as in step 12, above; Figure 1), where any ambiguities exist, fracture match points will be marked with symbols (Δ, O, 0, etc.) for visual assistance in fitting of pieces. The core segments will then placed in corrugated plastic core boxes. A Styrofoam block labeled with the core run # and the starting driller's depth for that core run will be placed in the box with the first core segment from that core run just ahead of this segment. Similarly, a Styrofoam block labeled with the core run # and the ending driller's depth for that core run will be placed in the box with the last core segment from that core run just after this segment.

16. After each core box is filled, it will be labeled with water-proof felt tipped pen with the project name, the box #, the core run # (or #'s if the box contains material from more than one core run) and the driller's depth range of the core segment in the box. The boxes have preprinted labels on the cover and two sides of the cover and the bottom; all should be filled out. The information on the box...
label will be added to the Core Box Record Form. The box # will be added to the Core Recovery Form and a Core Box Processing Check List will be begun for the box.

17. After placement in the core box, each fragment of core in the box and the bags of rubble will be labeled with water-proof felt tipped pen according to the core run # and the depth of the top of the fragment relative to the shallowest point of the coring run (e.g., HDP3-4.6 indicates a fragment the top of which is 4.6' down from the shallowest part of coring run #3). Any empty space at either end of the box will be filled with Styrofoam blocks to minimize movement of the core during transport. The top of the box will then be fitted over the box bottom.

18. After the entire core run has been boxed, each filled core box will be placed on the photo table. The box top will be removed and placed adjacent to the bottom of the box in such a way that the box label is visible. A scale and color bar will be placed adjacent to the core box. The entire core box will be photographed for preliminary documentation in case the box is subsequently disturbed. An entry will be made in the 35 mm Photo Log for each photograph.

19. A longitudinal slab along the side of the core (1-1.25" thick) will be made of each core section. This slab will become the Archive Split; the other slab is the Working Split. In general, it will be cut at 180° from the black and red orientation lines.

If a section of core contains special or oriented features that were noted at the drilling site (#3) on initial inspection of the core (#11) that should be preserved within the archive slab, at least in part, they will mark such sections of core for slabbing orientation. The slabbing orientation is to be designated by marking a line with slash marks pointing uphole on the outside surface parallel to the core's axis. The slabbing cut will then be made perpendicular to the plane containing this surface line and the core's axis as illustrated in Figure 3.

20. The Working Split will be replaced in its core box. Any labels or markings obscured or removed during slabbing will be rewritten on the slab. The open core box will be placed under heat lamps until dry.

21. The Archive Split will be placed in core boxes specially provided by the USGS-CRC and to which labels indicating the core run #, the archive box #, and the top and bottom driller's depths have been attached. The archive box # will be entered on the Core Processing Check List. Each fragment of the Archive Split and each bag of rubble will be labeled with water-proof felt tipped pen according to the core run # and the depth of the top of the fragment relative to the shallowest point of the coring run. The up direction will be marked on each fragment and, if they do not appear on the Archive Split, the markings with felt tip pen every foot present on Working Split (see #14) will be put on the Archive Split. A Styrofoam block labeled with the core run # and the starting driller's depth for that core run will be placed in the core box with the first core segment from that core run just ahead of this segment. Similarly, a Styrofoam block labeled with the core run # and the ending driller's depth for that core run will be placed in the box with the last

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5 This may not actually be possible given the positions of the permanent labels on the box top, in which case we will have preprinted labels that we can place at one corner of the box top for this purpose.

6 For delicate or fractured samples, the core may be wrapped in heat-shrink plastic prior to slabbing.
core segment from that core run just after this segment. Any empty space at either end of the box will be filled with Styrofoam blocks to minimize movement of the core. The box containing the Archive Split will then be placed under heat lamps until dry.

Figure 3. Examples of pen marks to indicate slabbing cut orientation. From USGS Open File Report 92-410.

22. When it is dry, the open face of the Archive Split in the core box will be photographed as described in #18. A camera and 35 mm Photo Log will be dedicated to Archive Split documentation.
23. A piece of foam will be placed over the Archive Split to hold it in place, and the core box will be closed and sealed with nylon fiber tape. The Archive Split core box will be placed in a safe, dry place for storage.

24. When it is dry, the open face of the Working Split in its core box will be photographed as described in #18. A camera and 35 mm Photo Log will be dedicated to Working Split documentation. In addition a Polaroid print of each core box will be taken with a dedicated camera; the photograph will be recorded in the Polaroid Photo Log. The Polaroid photo will be placed in the core box.

25. The open face of the Working Split will be videotaped; the image will be scanned smoothly over the core recording as much detail as possible. The box label should be recorded at the start of the recording for each core box. Between each core box recording, 15-30 seconds of blank tape should be recorded to facilitate editing and to prevent overlaps in filming. An entry in the running Video Record Log should be made for each core box recording.

26. The core in each core box will then be logged. Logging will be on standard forms to include those characteristics, readily identified in hand specimen, that will provide guidance in later sampling for project studies. Mike Garcia will be the Chief Logger; as such he is responsible for training the loggers and for reviewing all logs for accuracy and consistency. Logging procedures are described in detail in an Appendix. A checklist of macroscopic features is also provided to ensure consistent and complete descriptions; this checklist is included in the Appendix. Symbols, abbreviations, and lithologic types used in the core log are also given in the Appendix. Immediately after each core box has been logged, the results will be transferred by the logger into a computerized data base.

It is expected that two loggers will be working simultaneously, each on a separate core box. After logging, each core box is closed and transferred to a safe location to await sampling.
On-Site Core Sampling Procedures

A critical aspect of the Science Plan for the Hawaii Drilling Project is the development of a set of reference samples for full geochemical and petrographic characterization. The goal is to provide a comprehensive geochemical data set on the sequential output of the Mauna Kea and Mauna Loa sections present over the depth interval that is cored. To this end, once logging has been complete on each core run, the Sampling Committee will choose intervals of the Working Split from which coarse- and fine-grained working powdered sample for distribution to team members will be prepared; thin section plugs and chips for rapid spot mineral analyses will also be prepared from the same section of core.

In cooperation with the Sample Manager or someone he designates, sections of core selected for sampling will be cut as illustrated in Figure 4. Based on the geometry illustrated in Figure 4, this procedure will preserve two longitudinal sections adjacent to the interior sample for further sampling by P.I.s who wish to prepare their own powders from the sampled region. The Sample Manager shall assign a unique sample number to each sample and make an entry in the On-site Core Sample Record. He shall also make careful records of the interval sampled, nature of the sample, time of collection, and prior handling. Styrofoam blocks will be labeled and placed in the core box in place of removed samples. Labeling of each fragment, powder, thin section, etc. will follow the procedures established for the Creede Caldera Moat Project (illustrated in Figure 5).

The interior piece will first be coarsely crushed. This powder will then be split approximately in half. One half will then be further ground. The coarse and/or fine powders will then be distributed to each P.I. involved in the analytical program; coarse powders will be sent to those investigators that desire mineral separates. One of the fragments adjacent to the interior fragment (see Figure 4) will be cut into oriented blanks for thin sections, then mailed to Caltech, which will arrange for polished thin sections to be prepared. Chips from the sampled interval will also be sent to Caltech for mounting as polished plugs for rapid phenocryst and/or glass analyses; results will be relayed back to the site and placed in the computerized log.

Figure 4. Typical slabbing and sampling cuts.
For each (sub)sample cut parallel to core axis, use letters to distinguish subsamples.

For each subsample cut transverse to core axis, use relative footage (in decimal feet measured from top of core run) of shallowest portion of subsample.

Use "P" plus powder type (e.g., py=pyrite sep., xrd=x-ray diff., etc.) in parentheses designation for powdered subsamples and mineral separations.

Add a mnemonic in parentheses at end of subsample number to indicate end use (e.g., ts=thin section, dp=polished section, etc.).

Cut a notch on the up-side of thin and polished section to preserve orientation of subsamples.

For each new daughter subsample split, add letters and/or relative footage designations to the parent subsample number to generate the new subsample number.

Figure 5. Core sample numbering protocol for the Hawaii Drilling Project. After USGS Open File Report 92-410.
This will be the extent of the organized, formal on-site sampling. However, with the written permission of the Sampling Committee, appropriate P.I.'s may also do on-site sampling as time and facilities permit. This must be done under the supervision of the Sample Manager, who shall assign a unique sample number to each sample, make an entry in the On-site Core Sample Record, and make careful records of the interval sampled, nature of the sample, time of collection, prior handling, name and location of the Principal Investigator, and purpose of sampling.

No samples shall be transferred from one P.I. to another or subsampled by another P.I. without the written permission of the Science Steering Group. If approved, appropriate records of the transfer must be kept by the H.I.G. or USGS-CRC Curator.

**Sample Shipment to Curation Facilities**

After the completion of drilling, all Working Split core boxes will be sealed with fiber tape and/or securely banded/strapped, mounted and secured to one or more palettes, then shipped to the H.I.G. for intermediate-term curation and storage. The H.I.G. will be responsible for the appointment of a Curator and for preserving the integrity of the samples during this period.

After the completion of drilling, the sealed Archive Split core boxes will be securely mounted and secured to one or more palettes, then shipped to the USGS-CRC for long-term curation and storage. No sampling or disturbance of the Archive Split shall occur without the written approval of the Science Steering Group or the ICG until after deaccession. After deaccession, the Archive Split will not be sampled if equivalent samples are available from the Working Split.

**Off-Site Sampling**

For a period of two years following completion of drilling the project samples shall be protected from general distribution to allow Principal and Secondary Investigators to complete their studies. During this time period, qualified P.I.'s may obtain permission to sample specific sections of core from the Sampling Committee. If permission is given, the P.I. may either travel to Caltech (where the Working Split will be curated for this period) to sample the core. No sample may be removed until assigned a unique identification number as described above, and careful records are made on the appropriate forms of the interval sampled, nature of the sample, time of collection, prior handling, name and location of the Principal Investigator, and the purpose of sampling.

At the end of the two year protected period the Science Steering Group shall establish a policy and set of procedures for general distribution of samples to other investigators with the approval of the ICG. The working sample will be securely packed and shipped to the U.S.G.S. Core Research Center (USGS-CRC). In addition, within two years after distribution of samples, all investigators shall return all samples and associated thin or polished sections, analyses, data compilations, etc., to the USGS-CRC Curator to be merged with the Archive Split unless other arrangements are made by the Science Steering Group and the ICG. In the event that written permission is obtained from the Science Steering Group to keep samples at an intermediate sample archive, the NSF retains ownership of these samples and is responsible for decisions on deaccession of such samples. Procedures for archiving drilling samples at the USGS-CRC will follow those in current use for CSDP samples.

**True Depth Determination and Marking**

After geophysical logging is completed, the Logging Contractor will correlate the downhole logs with the core logs to determine the true depth intervals of the coring runs. These depth
determinations will be sent to both the H.I.G. Curator and the USGS-CRC Curator. Scientists working on samples distributed prior to true depth determination will be notified by the H.I.G. Curator (or by the USGS-CRC Curator after transfer of the Working Split to the USGS-CRC) as to the true depth determinations. Samples should not be renumbered after true depth has been determined to reduce confusion and preserve consistency of sample numbering scheme.
LOGGING PROCEDURES

**General statement**

Logging, i.e., the hand-specimen scale description of the core, is critical to the success of the project since it provides guidance for all subsequent sampling and scientific study of the core. Logging was done only on the Working Split and only after slabbing. To ensure the quality and consistency of the core logging, two steps were taken. First, standard forms were used to act as checklists for the descriptions. Second, Professor M. Garcia served as the chief logger and trained all other loggers and reviewed all of the logged core to ensure consistency and accuracy.

Although it was not possible to anticipate everything that was recovered during coring, standardized forms were prepared assuming that nearly all of the rock would be either lava flows, pyroclastics, or shallow intrusive units. The description of procedures that follows assumes that the core to be described comprises such rock types. The logging procedures were modified on-site by Professor Garcia and the loggers as needed; this was particularly important for logging the sediments encountered in the upper parts of the core, for which we were basically unprepared. The procedures we used were based on ODP protocols (Shipboard Scientists Handbook, Ocean Drilling Program, Texas A&M University, ODP Tech, Note No. 3, 1985), procedures used at the Creede Caldera Moat Scientific Drilling Project (USGS Open File Report 92-410), and procedures used to log the SOH cores in Hawaii (USGS Open File Report 92-586).

**Detailed logging procedures**

For each core box, the following procedures were followed. Each logger had available a hand lens, rulers (metric and inches in tenths), a GSA color chart, notes on rock classification, figures showing visually different proportions of phases in two dimensions for help in estimating phase abundances, a clear plastic sheet with grid markings for point counting, and a binocular microscope.

1. A Core Logging Data Entry Form (HSDP-Form 10) was used for the description of the core box. Preprinted on the form were the top and bottom depth of core in the box, the percentage of core recovered, and the RQD (RQD is defined in item 14 of the Sample Handling Procedure, page 14 of this volume). The core logger entered the date the core was logged\(^1\) and his/her name at the top of the form.

2. Each core box had a 3.25" X 4.25" Polaroid (Polacolor PRO 100 film) photo, which was annotated based on features described in the log.

3. The logger reviewed the Core Recovery Form for each of the core runs in the box being logged. These forms contained preliminary observations made by the drillers and the person(s) who washed and marked the core. These observations were incorporated, as appropriate, into the log.

4. The logger compared the top of the core in the box being described with the bottom of the core in the preceding box to determine if there was a change in lithology. If they were continuous, this was noted on the Core Logging Data Entry Form for Box Unit 1. Even in those cases where the core was continuous from one box to the next, each box was logged fully.

5. The core in each box was subdivided into units (numbered from 1 to n, from the top of each box) based on the presence of contacts (based on, for example, abrupt changes in lithology such

\(^1\)Underlined items indicate labeled fields on the Core Logging Data Entry Form.
as phenocryst abundance, grain size, vesicularity; or the occurrence of glassy margins, baked contacts, or sediments). The goal was to identify distinguishable flows rather than subdivisions of a single flow. The unit boundaries were marked on the Polaroid Photo. Top and bottom depths of the unit boundaries relative to the tops of core runs were entered on the Data Entry Form. (Depths relative to the top of each core run had been marked previously on the core in 1 foot intervals.)

6. For each unit in the box, the logger identified the following. (Note that there was a separate page of the Core Logging Data Entry Form for each unit described):

a. The unit was identified as a flow (aa², transitional, pahoehoe, massive), a pyroclastic unit (ash), a hyaloclastite or breccia, or a dike, soil or sedimentary deposit. Comments were entered as appropriate as unit type comments.

b. The total abundance of all phenocrysts in volume % as a percentage of the whole rock sample (including vesicles) was determined by a point count or visually estimate. Values were chosen from the following specific ranges: aphyric (<1%), sparsely phyric (1-2%), moderately phyric (2-10%), highly phyric (>10%). Comments on the overall phenocryst population, such as a homogeneous vs. heterogeneous distribution, grading, etc., were added as appropriate.

c. The phenocryst (>1 mm) mineralogy was described. For each phenocryst phase (olivine, clinopyroxene, plagioclase), its abundance in volume % (<1%, 1-2%, 2-10%, >10%), its average size in mm (<1, 1-5, >5), the typical shape (blocky <3:1:1), tabular (>3:1:1), anhedral, equant), and the presence of alteration phases of the phenocryst phase (iddingsite, clay, calcite, zeolite, silica, pyrite, epidote, gypsum, anhydrite, chalcopyrite, Fe-oxide) were described. Comments on the individual phenocryst phases (phenocryst comments) such as the relationships to other phenocrysts or relationships among alteration phases were added as needed.

d. The color (dry) of the core was determined using the GSA color chart as a reference.

e. The groundmass texture was determined (glassy, microcrystalline, fine-grained (<1 mm), medium-grained (1-5 mm), coarse-grained (>5 mm)). Comments on the groundmass (e.g., grain size changes within the unit) were added as needed (groundmass comments).

f. The vesicle abundance in volume % (<5%, 5-10%, 10-20%, 20-30% and >30%), the average size in mm (<1, 1-5, >5), the shape (spherical, sub-rounded, sub-angular, angular), the aspect ratio (equant, horizontally elongated, vertically elongated, inclined — if inclined, the dip relative to the axis of the core was recorded), and any vesicle fillings (clay, calcite, zeolite, silica, pyrite, epidote, gypsum, anhydrite, chalcopyrite, Fe-oxides) were determined. Comments on the vesicles (vesicle comments) such as their distribution in the unit, the fraction filled, etc., were described. Any miarolitic cavities that were present, including information on their abundance, size, shape, distribution, and fillings, were noted and described.

g. The extent of alteration (abundance in volume %) of the core as a whole (not along fractures, following ODP style) was estimated and entered on the entry form (fresh (<2% altered), slightly altered (2-10% altered), moderately altered (10-40% altered), highly altered (40-80% altered), very highly altered (80-95% altered), completely

²Bold items indicate choices available on a "pop-up" menu in the data base.
altered (95-100% altered) along with the alteration mineralogy (clay, zeolite, silica, pyrite, epidote, gypsum, anhydrite, chalcopyrite). Comments on the alteration such as the distribution in the unit, type (e.g., vein or fracture filling), grain size, etc., were added as needed.

h. The veins and fractures present in the unit were described. Significant ones were noted on the Polaroid Photo. Typical features were described (% present, their orientation, fillings and relationships, etc.). In addition, the extent of fracturing was estimated based on the number of fractures/foot (unfractured; weakly fractured, <4 fractures/ft; moderately fractured, 4-10 fractures/ft; highly fractured, >10 fractures/ft).

i. Any additional comments on the unit were added. When practical, to avoid ambiguity or uncertainty in the future about precisely what was being referred to, any features of interest were noted on the Polaroid Photo. A letter and description was generally given to each feature on the photo (e.g., "A").

j. Finally, the unit was given a rock name. Rock names were based on the IUGS classification system where possible (IUGS subcommission on the systematics of igneous rocks, 1973). For the most part, rock names were based on the abundance and identity of phenocryst phases; i.e., a basalt with 2-10% total phenocryst content with both olivine and plagioclase phenocrysts (but olivine>plagioclase) was called a "moderately plagioclase-olivine phric basalt," following the IUGS style.

When steps 6a-6j were completed for each unit, the core was returned to the box, and replaced in the appropriate rack or storage place. The several pages of the Data Entry Form and the Polaroid Photo were clipped together.

The logger entered the data from the Data Entry Form into the Filemaker Pro 2.1 database immediately upon completion of the log. The original data sheets were filed for reference.

Within a few days, Professor Garcia reexamined the core and reviewed the completed log. Corrections, ambiguities, additions were agreed upon between Garcia and the primary logger, then entered into the Filemaker Pro data base. A completed Core Logging Summary Sheet was printed out and filed.

**Post-logging procedures**

All of the logging was done at the Puna facility within a few days of recovery of the core. Over the next several months, additional tasks were completed.

1. Identified units were numbered sequentially from the top to the bottom of the core (up to this point, they had only been numbered sequentially within each box). There are 227 such identified units. The unit names, positions, thicknesses, and notes are listed in the Unit Summary included in this volume (pages 54-65). Positions of internal flow contacts (e.g., separating overlapping lobes of pahoehoe flows that were parts of a single eruptive unit) are also listed. Depths in the Unit Summary are based on the table of revised depths of the tops of the core runs included in this volume (pages 32-43). These depths are relative to the rotary table on the drill rig; to convert these depths to depths relative to sea level, add 4.22 m (13.8 ft). Although for some purposes it may be necessary to correct to sea level, to avoid confusion, depths should in general be reported without applying this small correction to sea level; when the sea level correction has been applied, this should be clearly stated.

No effort was made to modify the unit boundaries chosen by the loggers, although there was clearly considerable subjectivity in the identification of distinguishable units by the loggers. For
example, some ash or soil layers were called out as separate units, while others were included as parts of larger units. Some internal flow contacts were chosen as unit boundaries, while others were not, and still others were ambiguous or unrecognized.

2. The 35 mm photographs of each core box were developed as Kodak Photo CDs. The intermediate resolution images (768 x 512 pixels) were opened as Canvas documents, and the notations made on the Polaroid photographs were transferred to the Canvas images. (Note that the Photo CDs contain much higher resolution images of each box – 2048 x 3072 pixels – and these can be made available over the internet if there is any interest.) Unit boundaries were added to the photographs as solid lines; internal flow contacts were drawn as dashed lines. The images were stored both as Canvas files (~1 MB each) and in a compressed form (~40-100 KB each). The compressed images are those printed in this volume adjacent to the written logs. The higher resolution (768 x 512 pixels) Canvas images are available on the WWW (converted from 24 to 8 bit color).

3. The logs and digital images were proofed several times and minor changes were made to remove inconsistencies and errors.

4. The composite lithologic column (pages 66-79 of this volume) was constructed to reflect accurately the logs and the Unit Summary. Depths of unit boundaries on the lithologic column are from the Unit Summary. Mauna Loa units are shown in light blue; Mauna Kea units are shown in green; sediments, soils, and ashes are shown in a "peach" color. This color scheme should be used by all team members. Note that the gray-scale of individual basalt units on the lithologic column is precisely proportional to the phenocryst abundance based on the point counts (i.e., darker units are richer in phenocrysts).

Shown graphically to the left of the lithologic column are the top and bottom depths of each core run (in brown), and the top and bottom depths of the core in each core box (in pink) and in each archive box (in cyan). These depths are raw driller's depths, uncorrected for the revised depths to the top of each core run, for incomplete recovery, or for sea level. Note that because the lithologic column is corrected for the revised depths to the top of each core run and because of the procedures used to label the core boxes, there are at some places mismatches of up to several feet between the lithologic column and the indicated depths of the boxes and/or core runs.
## CORE RUN DEPTH LOG

### Table of Core Runs

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## CORE RUN DEPTH LOG

(p. 12)

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**CORE RUN DEPTH LOG**

(p. 13)
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Revised Depths for Top of Core Run (p. 5)

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(p. 10)

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### Unit Summary

**Unit #** | **Unit Name** | **Top** | **Bottom** | **Thickness** | **Notes (including depths to internal contacts)**
--- | --- | --- | --- | --- | ---
1 | moderately plagioclase-olivine phyric basalt | Box# | Core # | Relative depth | True depth (ft) | Box# | Core # | Relative depth | True depth (ft) | 19.2 |
2 | sparsely to moderately plagioclase-olivine phyric basalt | 8 | 5 | 2.8 | 45.2 | 17 | 22 | 3 | 101.3 | 56.1 | R11-3.9 (68.9'), R14-2.4 (75.0')
3 | calcareous sediment (coral rudstone) | 17 | 22 | 3.0 | 101.3 | 17 | 23 | 0 | 101.6 | 0.3 |
4 | calcareous sediment | 17 | 25 | 0 | 101.6 | 17 | 25 | 0.6 | 102.2 | 0.6 |
5 | coral | 18 | 25 | 0.6 | 102.2 | 18 | 25 | 0.8 | 102.4 | 0.2 |
6 | calcareous sediment (matrix to clast supported) | 18 | 25 | 0.8 | 102.4 | 21 | 28 | 2.0 | 112.5 | 10.1 |
7 | matrix supported calcareous sediment | 21 | 28 | 2.0 | 112.5 | 21 | 29 | 1.2 | 115.2 | 2.7 |
8 | calcareous sediment | 22 | 29 | 1.2 | 115.2 | 24 | 31 | 5.4 | 127.4 | 12.2 |
9 | calcareous sediment | 24 | 31 | 5.4 | 127.4 | 26 | 34 | 1.0 | 153.0 | 25.6 |
10 | calcareous sediment (clast-supported) | 26 | 34 | 1.0 | 153.0 | 31 | 40 | 0.5 | 185.5 | 32.5 |
11 | moderately to highly olivine phyric basalt | 32 | 40 | 0.5 | 185.5 | 49 | 65 | 4.6 | 297.4 | 111.9 | R41-3.0 (195.0'), R43-2.7 (201.9')
12 | lithic to vitric volcanioclastic silt (with coral and shell fragments) | 49 | 65 | 4.6 | 297.4 | 49 | 65 | 5.1 | 297.9 | 0.5 |
13 | moderately to highly olivine phyric basalt | 49 | 65 | 5.1 | 297.9 | 51 | 69 | 3.7 | 316.2 | 18.3 | R67-0.7 (303.2')
14 | moderately to highly olivine phyric basalt | 51 | 69 | 3.7 | 316.2 | 55 | 77 | 5.0 | 357.3 | 41.1 |
15 | moderately to highly olivine phyric basalt | 55 | 78 | 0.0 | 357.5 | 64 | 93 | 4.8 | 436.8 | 79.3 | R76-4.8 (362.3'), R86-0.4 (398.0')
16 | highly olivine phyric basalt | 64 | 93 | 4.8 | 436.8 | 67 | 100 | 3.9 | 471.0 | 34.2 |
17 | moderately to highly olivine phyric basalt | 68 | 100 | 3.9 | 471.0 | 71 | 107 | 0.7 | 502.7 | 31.7 |
18 | fine-grained highly weathered volcanic ash | 71 | 107 | 0.7 | 502.7 | 71 | 107 | 0.7 | 502.7 | 0.0 |
19 | aphyric basalt | 71 | 107 | 0.7 | 502.7 | 72 | 108 | 8.5 | 515.7 | 13.0 |
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## Unit Summary

### Unit # | Unit Name | Box# | Core# | Top Relative depth | True depth (ft) | Box# | Core# | Bottom Relative depth | True depth (ft) | Thickness (ft) | Notes (including depths to internal contacts)
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
39 | sparsely olivine phyric basalt | 102 | 149 | 0.0 | 847.0 | 102 | 149 | 3.0 | 850.0 | 3.0 | internal sandy layer (R149-0.7; 847.7); pyroclastic units at base (R149-2.7; 849.7)\n
40 | highly olivine phyric basalt | 102 | 149 | 3.0 | 850.0 | 102 | 150 | 2.5 | 855.5 | 5.5 |

41 | weathered ash | 103 | 150 | 2.5 | 855.5 | 103 | 150 | 3.3 | 856.3 | 0.8 |

42 | aphyric basalt | 103 | 150 | 3.3 | 856.3 | 103 | 150 | 4.1 | 857.1 | 0.8 |

43 | moderately olivine phyric basalt | 103 | 150 | 4.1 | 857.1 | 108 | 157 | 0.0 | 917.0 | 59.9 | soil at top, tentative base of Mauna Loa section |

44 | clay-rich soil | 108 | 157 | 0.0 | 917.0 | 108 | 157 | 1.0 | 918.0 | 1.0 |

45 | sparsely to highly olivine phyric basalt | 108 | 157 | 1.0 | 918.0 | 109 | 158 | 6.6 | 929.4 | 11.4 | tentative top of Mauna Kea section |

46 | aphyric to moderately olivine phyric basalt | 109 | 158 | 6.6 | 929.4 | 110 | 159 | 3.5 | 936.1 | 6.7 |

47 | aphyric to highly olivine phyric basalt | 110 | 159 | 3.5 | 936.1 | 111 | 160 | 8.9 | 951.4 | 15.3 | R160-1.0 (943.5'), R160-3.0 (945.5') |

48 | weathered ash | 112 | 160 | 8.9 | 951.4 | 112 | 160 | 9.1 | 951.6 | 0.2 |

49 | moderately magnetite-olivine-plagioclase phyric basalt | 112 | 160 | 9.1 | 951.6 | 115 | 165 | 5.8 | 993.6 | 42.0 |

50 | aphyric basalt | 115 | 165 | 5.8 | 993.6 | 116 | 166 | 3.1 | 1001.0 | 7.4 |

51 | aphyric basalt | 116 | 166 | 3.1 | 1001.0 | 116 | 166 | 7.7 | 1005.6 | 4.6 |

52 | aphyric basalt | 117 | 166 | 7.7 | 1005.6 | 118 | 167 | 8.0 | 1016.2 | 10.6 |

53 | aphyric to moderately olivine phyric basalt | 118 | 167 | 8.0 | 1016.2 | 119 | 168 | 9.55 | 1028.1 | 11.9 |

54 | sparsely olivine phyric basalt | 119 | 168 | 9.55 | 1028.1 | 120 | 170 | 4.1 | 1039.4 | 11.4 |

55 | moderately to highly olivine phyric basalt | 120 | 170 | 4.1 | 1039.4 | 122 | 172 | 0.0 | 1057.0 | 17.6 |

56 | aphyric basalt | 122 | 172 | 0.0 | 1057.0 | 122 | 172 | 3.0 | 1060.0 | 3.0 | ash infilling fracture near top of flow |

57 | aphyric basalt | 122 | 172 | 3.0 | 1060.0 | 124 | 175 | 1.3 | 1076.7 | 16.7 |
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## Unit Summary

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# Unit Summary (p. 12)

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moderately to highly olivine phyric basalt

12 - lithic to vitric volcanioclastic silt (with coral and shell fragments)
moderately to highly olivine phyric basalt

moderately to highly olivine phyric basalt

moderately to highly olivine phyric basalt

highly olivine phyric basalt

moderately to highly olivine phyric basalt

18 - fine-grained highly weathered volcanic ash
aphric basalt

aphric basalt
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- **133** - R253
- **134** - R255
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- **136** - R258
- **137** - R261
- **138** - R262
- **139** - R264
- **140** - R266
- **141** - R267
- **142** - R268
- **143** - R269
- **144** - R271
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- **174** - R301
- **175** - R302
- **176** - R303
- **177** - R304

**Deposition:**
- **195 - 198:** Moderately to highly olivine phyric basalt
- **199:** Highly olivine phyric basalt
- **200 - 201:** Moderately to highly olivine phyric basalt
- **202 - 203:** Highly olivine phyric basalt
- **204 - 205:** Moderately to highly olivine phyric basalt
- **206 - 207:** Highly olivine phyric basalt
- **208 - 209:** Moderately plagioclase-olivine phyric basalt
- **210 - 211:** Moderately to highly olivine phyric basalt
- **212 - 213:** Ash/soil
- **214 - 215:** Aphyric basalt
- **216 - 217:** Moderately olivine phyric basalt
- **218 - 219:** Highly olivine phyric basalt
- **220 - 221:** Highly olivine phyric basalt
- **222 - 223:** Aphyric basalt

**Other:**
- **R261.5:** Moderately to highly olivine phyric basalt
- **R264:** Highly olivine phyric basalt
- **R266.5:** Moderately to highly olivine phyric basalt
- **R268:** Highly olivine phyric basalt
- **R269:** Aphyric basalt
- **R270:** Highly olivine phyric basalt
- **R271:** Highly olivine phyric basalt
- **R272:** Highly olivine phyric basalt
- **R273:** Moderately to highly olivine phyric basalt
- **R274:** Aphyric basalt
- **R275:** Highly olivine phyric basalt
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- **R277:** Highly olivine phyric basalt
- **R278:** Moderately to highly olivine phyric basalt
- **R279:** Aphyric basalt
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- **R303:** Aphyric basalt
- **R304:** Highly olivine phyric basalt
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**Notes:**
- Highly olivine phyric basalt
- Sparsely olivine phyric basalt
- Aphyric basalt
- Baked soil/ash
- Sparsely to moderately plagioclase-olivine phyric basalt
- Moderately to highly olivine phyric basalt
- Highly olivine phyric basalt
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T.D. (Total Depth)
**BOX UNIT 1:** moderately plagioclase-olivine phyric basalt

**Contacts:**
- Top (t): (R 1-0.0-26.0')(surface flow?)
- Bottom (b): (R--')(continuous with next box)

This is likely the same flow exposed at the surface at the drilling site.

**Unit type:** transitional

Surfaces of caved rubble have fluid/ropy textures; massive portion unknown

**Phenocrysts/Clasts:**
- modestly phyric (2-10%) - homogeneous distribution throughout massive lava portion
- olivine - 1% - 2-3 mm -
  - Spinel inclusions in olivine. Equant to blocky. Smaller crystals (1-2 mm) are equant, larger crystals (4-7 mm) have 2:1:1 length ratio.
- plagioclase - 1-2% - 1 mm - lath-shaped

**Groundmass/Matrix:** microcrystalline

**Color:** N3 dark gray - Structures: - Sorting: -

**Vesicles:** 20-30% - 3-4 mm - rounded - equant to elongate -

Variation in vesicle size: 1-15 mm

**Alteration:** fresh (<2% altered)

**Fractures:** Weakly fractured: 4/2' in massive lava unit; random orientation. Occasional coatings of Fe-oxide present.

**Additional comments:**
**BOX UNIT 1**: moderately plagioclase-olivine phryic basalt

**Contacts:**
Top (ft): (R--)(continuous with previous box)
Bottom (ft): (R--)(continuous with next box)
1.4 ft. of cave from beginning of run 2.

**Unit type:**
massive gradational with transitional flow from box 1.

**Phenocrysts/Clasts:**
- moderately phryic (2-10%) — 300 points counted for modes
- olivine — 1-3% — 2.5 mm — equant —
- range: < 1-5 mm, some are rounded (?)
- plagioclase — <1% — 1 mm — lath-shaped —
- range: < 1-1.5 mm

**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm) — coarser but gradational with above

**Color:** N4 medium dark gray — Structures: — Sorting: —

**Vesicles:** 5-15% — 8 mm — horizontally elongate — 3:1 —
small plagioclase laths line the vesicles
upper portion: 10-15%, lower portion: 5-10%

**Alteration:** fresh (<2% altered) — iron oxide
concentrated along fractures and some vesicles

**Veins:** none

**Fractures:** moderately fractured: -7/1.5 ft

**Additional comments:**
- Object "A" is a 15 mm, open-textured gabbroic inclusion
- 2 cm subangular clast of darker, more highly vesicular material (autolith of flow crust?). Core at the end of run 1 appears to be continuous with core in run 2 below the 1.4 ft of caved material at the top of run 2.
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (R): (R- --)(continuous with previous core run)
Bottom (R): (R--)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%) - homogeneous distribution
- olivine - 2-3% - 3-4 mm - see below -
- spinel inclusions; larger phenocrysts are blocky; smaller phenocrysts are equant
- plagioclase - 1-2% - 1-2 mm - tabular

Groundmass/Matrix: microcrystalline - diktytaxitic
Color: N5 medium gray - Structures: - Sorting: - Vesicles: <5% - 1-5 mm - rounded to subangular - equant to slightly elongate -
- Two populations, group noted above and a smaller diameter population (<1 mm) comprising ~10%. "A"=segregation vesicle, infilling contains small, abundant vesicles and has more coarsely crystalline plagioclase crystals in the groundmass;
- "G" & "J"=deformed vesicles; "G", "H" and "I"=pipe vesicles, minimum diameter=2.5 cm, minimum length=14 cm.
Alteration: fresh (<2% altered)
Fractures: Weakly fractured. Several fractures marked on Polaroid with dips of 'B'=30°, 'C'=10°, 'D'=15°, 'E'=60°, 'F'=0°; minor coating of "dirty" yellow-brown material.
Additional comments:
- Feature "K" is a 6 mm diameter pyroxene-olivine crystal clot. NaCl ppt occurs on most dried surfaces.
BOX UNIT 1: moderately plagioclase-olivine phric basalt

Contacts: Top (ft): (R--) (continuous with previous core run)
Bottom (ft): (R--) (continuous with next core run)

Unit type: massive

Phenocrysts/Clasts:
- moderately phric (2-10%)
- olivine - 1-3% - 2 mm - equant
  - Range in size from 1-7 mm, with sub-mm microphenocrysts also present; small chrome spinel inclusions present in some of the larger olivines
- plagioclase - 2-3% - 1 mm - tabular
  - Size range from <1 mm to 2 mm; microphenocrysts also present

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray

Structures: Sorting:
- Vesicles: <1% large; 10-20% small - 1-5 mm (large); <1 mm (small) - rounded - equant -
- dirtytaxitic texture

Alteration: fresh (<2% altered)

Fractures: Weakly fractured: -9/3.4 ft. Preferred fracture orientation is sub-horizontal. One major vertical fracture present.

Veins: none

F=30° fracture with white coating. G=pipe vesicle; more vesicular than host; contains olivine and plagioclase phenocrysts
H=6° fracture. I=20° fracture.

Rare, small 5-15 mm, open textured gabbroic inclusion. Not annotated on photo but labeled on box.
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (R): (R -->)(continuous with previous core run)
Bottom (R): (R -->)(continuous with next core)

Unit type: massive

Phenocrysts/Clasts:
moderately phyric (2-10%) –
plagioclase – 1-2% – 1-2 mm – tabular –
olivine – 2-3% – 2-3 mm – equant to blocky –
1-7 mm with some multi-grain clusters. Chrome spinel inclusions in some of the larger olivines.

Groundmass/Matrix: microcrystalline –

Vesicles: 1-3% large; 10-20% small; large<<1mm; rounded; equant–
diktytaxitic texture

Alteration: fresh (<2% altered)

Veins: none

Fractures: Weakly fractured: 8/3.5 ft. 4 horizontal, 3 inclined 20-40°, 1 vertical.

Additional comments:
Thin white coating on most surfaces. A,C,F, and G-horizontal fractures partially coated with white mineral. D,E-inclined fractures with white coating. H-vertically inclined fracture with white coating. B-two vertically oriented vesicles overlying zone of vertically-oriented small vesicles. From R4-2.0 to bottom of box, small vesicles are concentrated in thin sub-horizontal lenses (inclined 10-30°). Rare, small 5-15 mm open textured gabbroic clots.
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts:
- Top (t): (R --')(continuous with previous core run)
- Bottom (b): (R --')(continuous with next box)

Maybe coming to bottom of flow unit -- see comments under Unit type

Unit type: massive

Transitional at bottom of box; ropy surface textures and glassy rinds observed on some rubbly pieces at bottom of box.

Phenocrysts/Clasts:
- Moderately phyric (2-10%) -
  - olivine - 2-3% - 1-3 mm - equant to blocky -
  - Olivine phenocrysts contain spinel inclusions; some olivines present as crystal clots.
- Plagioclase - 2-3% - 1-2 mm - tabular -

Groundmass/Matrix: microcrystalline - diktytaxitic; groundmass plagioclase laths decrease in size toward bottom of box

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: <5% to 5-10% - 1-5 mm - rounded - equant to elongated -

B.E.L = segregation vesicles; F = vesicle with rim of infilling melt; H = untitled pipe vesicle; proportion of vesicles increases from <5 to 5-10% down section in the box. Small <1mm vesicles present in massive portion above run 4 - 4.0'; white fillings in region D (photo)

Alteration: fresh (<2% altered -)

Veins: none

Fractures: Weakly fractured: 10/3 ft (not counting rubbly zones I & J); several fractures marked on Polaroid with dips of A = 80°; surfaces have white coating; C = 9°; G = 85°, surfaces have white coating, associated horizontal fractures; K = 30°; M = 30°.

Additional comments:
- Rare, small 5-10 mm gabbroic/crystal clot inclusions.
BOX UNIT 1: moderately olivine-plagioclase phryic basalt

Contacts:
- Top (R): (R -- ) (continuous with previous box)
- Bottom (R): (R5-2.0-45.2') (flow contact)

Glassy fragments and ropy textures found in zone A suggesting proximity to contact, but no distinct lithologic breaks were observed. Contact is probably between R5-2.0 and R5-3.6.

Unit type: transitional
- Ropy surfaces observed on some rubble fragments

Phenocrysts/Clasts:
- Moderately phryic (2-10%) - olivine - approx. 1% - 1-2 mm - equant to blocky - size range 1-4 mm
- Plagioclase - 1-2% - 1 mm - tabular - size range 1-2 mm; microphenocrysts also present

Groundmass/Matrix: microcrystalline to glassy

Color: N2 grayish black - Structures: - Sorting: -

Vesicles: 20-30% - 1 mm - rounded - equant - size range <1 mm - 15 mm. Diktytaxitic texture less developed than in previous box.

Alteration: fresh (<2% altered)
- Some rubble surfaces have thin white to yellowish coating.

Veins: none
Fractures: rubble throughout box

Additional comments:
- A-rubble containing some glassy rinds and ropy textures. B-linear, probably horizontal row of vesicles (orientation uncertain due to small size of rubble). Rare inclusions of small (<1 cm) gabbroic clots present throughout box. Glassy rinds, often with ropy flow texture, present on several rubble fragments. Pipe vesicles present.
**Box #:** 8  
**Cores in box:** 5 8 6 7  

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**LOGGERS:** MBB  
**Date logged:** 10/30/93  
**Checked by:** MG  
**Check date:** 11/3/93  

**Driller’s depth:top [feet]:** 47.0  
**Driller’s depth:bottom [feet]:** 58.3  
**Core type:** PQ  
**Units in box:** 1

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**BOX UNIT 1:** moderately plagioclase-olivine phyric basalt  

**Contacts:**  
- Top (t): (R 5-2.0-45.2') (depositional)  
- Bottom (b): (R--')(continuous with next box)  

Contact is not obvious but probably occurs in the interval R5-2.0 to 3.6 in Box 7. This is a rubbly zone; see description of Box 7.

**Unit type:** massive  

Describes material from top of box to start of run 6; mark “D” in Polaroid photo.

**Phenocrysts/Clasts:**  
- moderately phyric (2-10%)  
- olivine – 2-3% – 2 mm – equant to blocky  
- Some olivines contain spinel inclusions; some of the olivines occur as crystal clots.

**Plagioclase – 1-2% – 1 mm – tabular (>3:1) –**

- Groundmass/Matrix: microcrystalline – hint of a diktytaxitic texture

**Color:** N2 grayish black  
**Structures:** Sorting:

- Vesicles: 10-20% total – 10-20 mm; 2-3 mm – subrounded-rounded; subangular – elongate; equant
- rare grayish-white coatings

- Two populations of vesicles; above descriptions should be read straight across; pipe vesicles present.

**Alteration:** fresh (<2% altered)

**Fractures:** moderately fractured: 6/1.1’. Only measured from top of box to top of run 6.

**Additional comments:**  
See Polaroid photo: “A” = rubbly/caved material probably from 47’ to 62’ depth. Cement filled vesicles; material looks similar to massive material labeled “D” in photo. “B” = rubbly/caved material; some surfaces have a “glassy” appearance. “E” = similar in appearance to “D” but with a slightly higher plagioclase phenocryst content (2-4%). Rare, small 5-15 mm, open textured gabbroic inclusion. Not annotated on photo but labeled on box.
BOX UNIT 1: moderately plagioclase-olivine phryic basalt

Contacts: Top (ft): (R - -) (continuous with previous box)
Bottom (ft): (R - -) (continuous with next box)
Entire box is rubble/cave from depth interval 47-70 ft.

Unit type: rubble/cave

Phenocrysts/Clasts:
- moderately phryic (2-10%)
  - olivine: 1-2% - 1-2 mm - blocky (<3:1:1)
    - Size range 1-9 mm. Spinel inclusions in larger olivines.
  - plagioclase: 1-2% - <1 mm - tabular (>3:1:1)
    - Size range <1-2 mm.

Groundmass/Matrix: microcrystalline

Color: N2 grayish black - Structures: - Sorting: -

Vesicles: 5-15% - 1 mm - rounded - equant -
Diktytaxitic texture. Size range <1-10 mm.
Alteration: fresh (<2% altered)
Veins: none
Fractures: rubble
Additional comments:

Many vesicles are infilled with cement. Rubble/cave is similar in appearance and mineralogy to core from top of box 8 (D from box 8 Polaroid); glass present on some rubble surfaces in run 10 section (1/2 way through this section).
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (It): (R --)(continuous with previous box)
Bottom (It): (R--)(continuous with next box)
Glass rind on core at base of R11 - possible flow contact at R11-3.9.

Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%) - 200 points counted for modes
  olivine - 1-2% - 2 mm - blocky (<3:1:1) -
  Size range 1-5 mm. Spinel inclusions in larger olivines.
- plagioclase - <1% - 1 mm - tabular (>3:1:1) -
  range 1-4 mm

Groundmass/Matrix: microcrystalline -
Color: N2 grayish black - Structures: - Sorting: -
Vesicles: 10-20% - 1-2 mm - rounded - equant -
Several large (>1 cm) vesicles present - bimodal population.
Alteration: fresh (<2% altered) -
Veins: none
Fractures: Moderately fractured: 11/2.5 ft measured for continuous core only (excluding rubble). Thin yellow coating along some fractures.

Additional comments:
A=rubble/cave similar to material from box 9. B=chain of large pipe vesicles. C=60° fracture D=80° fracture E=40° fracture F=30° fracture G=30° fracture H=rubble/cave-some pieces contain cement infilling vesicles, others are "clean" I=small glassy rind at base of continuous core from R11 J=small gabbroic inclusion on far side of core. Fracture filling NaCl present on dried surfaces.

UNIT #2

Driller's depth:top [feet]: 65.5
Driller's depth:bottom [feet]: 70.4
Core type: PQ
Units in box: 1
Box #: 11  
Cores in box: 12, 13, 14

Loggers: BM, LW  
Date logged: 10/30/93  
Checked by: MG  
Check date: 11/3/93

BOX UNIT 1: moderately plagioclase-olivine phryic basalt

Contacts:  
Top (ft): (R --')(continuous with previous box)  
Bottom (ft): (R--'(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:  
moderately phryic (2-10%)  
olivine - 1-2% - 1 mm - see below  
Size variance: <1 to 3 mm. Shape varies from equant small grains to tabular/bloky coarse grains.
plagioclase - <1% - <1 mm - tabular (>3:1:1)  
Size variance: <1 to 1 mm.

Groundmass/Matrix: microcrystalline

Color: N3 dark gray - Structures: - Sorting: -

Vesicles: 10-20% - 1-2 mm - rounded - equant-
Size variance: 1-7 mm

Alteration: fresh (<2% altered) -
Veins: none
Fractures: Rubble throughout. Some fractures contain a creamy to yellowish set of parallel, concentric bands (4 mm apart) of CaCO3.

Additional comments:  
From approx. R12-0.4' to R14-1.0', the core recovery forms indicate that rubble/caved material was sampled in the core barrel.  
Heavily cemented core from R13 to R14-0.5'. Cement sample is contained within a plastic bag.
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (ft): (R--) (continuous with previous box)
Bottom (ft): (R--) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-5% - 1-2 mm - see comment
- range: <1-4 mm, small grains: equant, big grains: tabular, spinel inclusions in big grains
- plagioclase - 1-2% - <1 mm - tabular (>3:1:1)
- range: <1-1 mm

Groundmass/Matrix: microcrystalline

Color: N3 dark gray

Structures: - Sorting:

Vesicles: 10-20% - 1-2 mm - spherical - equant
- Ranging from 10 to <1 mm, mostly within 3-<1 mm; pipe vesicles present.

Alteration: fresh (~2% altered) - Iron oxide
- Concentrated along the 2.4 ft potential flow margin in run 14. Also in some rubble of run 15.

Veins: none

Fractures: weakly fractured: 0'/1.4 ft

Additional comments:
- Glassy zone at R14-2.4; potential flow margin. Glassy fragments in run 15. NaCl ppt.

UNIT #:2
**BOX UNIT 1**: sparsely plagioclase-olivine phryic basalt

**Contacts**: Top (t): (R--)(continuous with previous box)
Bottom (b): (R--)(continuous with next box)

- Note that Box 12 contained rubbly material - no indication of a contact.
- Most of the box contains rubbly material; some of the material has multiple drill cuts.

**Phenocrysts/Clasts**:
- Sparsely phyric (1-2%)
- Olivine - 1-2% - 1-2 mm - equant to blocky
- Spinel inclusions in some olivines; olivine crystal clots also present.
- Plagioclase - <1% - <1 mm - tabular (>3:1:1)

**Groundmass/Matrix**: microcrystalline

**Color**: N2 grayish black

**Structures**: Sorting:

Two populations of vesicles, large size is relatively rare; each entry above describes a single population.

**Alteration**: fresh (<2% altered)

**Fractures**: Due to the rubbly nature of the material, difficult to characterize fractures.

**Additional comments**: NaCl ppt on many surfaces; some of the pieces have light yellow-orange carbonate (acid-test) coating; glass present at R16 at 84;
**BOX UNIT 1:** moderately plagioclase-olivine phyric basalt  

**Contacts:**  
- Top (ft): (R--)(continuous with previous box)  
- Bottom (ft): (R--)(continuous with next box)  

**Unit type:**  
- massive  
- Zone A is rubble/cave. Massive below zone A.  

**Phenocrysts/Clasts:**  
- moderately phyric (2-10%) — closer to 2% than 10%; 200 points counted for mode  
  - olivine — 1-2% — 1-2 mm — blocky (<3:1:1) —  
  - Size range 1-7 mm. Some clusters. Larger olivines contain spinel inclusions.  
  - plagioclase — <1% — 1 mm — tabular (>3:1:1) —  
  - Size range <1-2 mm. Most plagioclases are microphenocryst (<1 mm).  

**Groundmass/Matrix:**  
- microcrystalline —  
- Color: N3 dark gray —  

**Vesicles:**  
- 5-10% — 1-2 mm — rounded — equant—  
  - Rubble is more vesicular than massive core (10-20%). Continuous core section grades from more highly to less highly  
    vesiculated down-section. Size range from <1-3 mm. Between bottom of rubble zone A and R19-4.0 a second population of  
    large (5-18 mm) vesicles is present, becoming more abundant up-section.  

**Alteration:**  
- fresh (<2% altered) —  

**Fractures:**  
- Moderately fractured: 11/2.6 ft in continuous core below zone A. Orientations range from 0-80°. White-yellow coating on  
  top two fractures (B and C). Weakly fractured (R19-2.5 to 4.0) to moderately fractured (>R19-4.0).  

**Additional comments:**  
- Some NaCl ppt along dried fractures. Some glass rings on rubble in zone A, but no lithologic variation above and below this  
  zone (probably same unit). B=10° fracture with white-orange coating. C=5° fracture with white-orange coating.
**BOX UNIT 1**: moderately plagioclase-olivine phyric basalt

- **Contacts**: Top (R); (R --')(continuous with previous box)
  - Bottom (R); (R--'Xcontinuous with next box)
- **Unit type**: massive
- Massive portion is from top of Box 15 to top of run 20 (labeled "A" on photo).
- **Phenocrysts/Clasts**:
  - moderately phyric (2-10%) — olivine>plagioclase
  - olivine — <5% — 2 mm — equant to blocky
  - Spinel inclusions; some olivine crystal clots.
  - plagioclase — 1-2% — <1 mm — tabular (>3:1:1) —
- **Groundmass/Matrix**: microcrystalline
- **Color**: N2 grayish black
- **Structures**:
- **Sorting**: —
- **Vesicles**: 5-10% — 1-2 mm — rounded — equant
- very rare vesicles >5 mm
- **Alteration**: fresh (<2% altered)
- **Veins**: none
- **Fractures**: massive region ("A") is weakly fractured; fractures "D" = 65°, "E" = 20°
- **Additional comments**: NaCl ppt on surfaces. "B" = zone of cave/rubble, pieces have multiple drill cuts; petrographically the material is similar in appearance to the massive zone at the top of the box. Some of the surfaces have a slightly "glassy"/cryptocrystalline sheen. "C" = reappearance of more massive material, similar in appearance to the material in zone "A".

---

**UNIT #2**

---

**Box #**: 15

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>Loggers</th>
<th>Driller's depth:top [feet]</th>
<th>Driller's depth:bottom [feet]</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>MBB</td>
<td>91.3</td>
<td>92.8</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>MG</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Check date**: 11/3/93

---

**Units in box**: 1
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (It): (R --')(continuous with above)
Bottom (It): (R --')(continuous with next box)

Unit type: massive
rubbly at base

Phenocrysts/Clasts:
moderately phyric (2-10%) -
olivine - 2% - 1-3 mm - blocky (<3:1:1) -
Size range <1-6 mm. Occasional spinel inclusions.
plagioclase - 1-2% - <1 mm - tabular (>3:1:1) -

Groundmass/Matrix: microcrystalline to cryptocrystalline -
Color: N3 dark gray - Structures: - Sorting: -

Vesicles: 5-10% - <1 mm - rounded - equant -
<1-2.5 mm with a few large (5-12 mm) vesicles
Alteration: fresh (<2% altered) -
Veins: none

Fractures: Moderately fractured from R21-1.2 to 2.0. Highly fractured from R21-2.0 to 3.8. Orange-yellow coating of some fracture surfaces in highly fractured zone. R22-0.0 to end of box is rubble/cave.

Additional comments:
Some glassy to cryptocrystalline rinds on rubble from zone B (top of Run 22).
### BOX UNIT 1: moderately plagioclase-olivine phyric basalt

**Contacts:**
- Top (ft): (R <sup>-</sup>J) (continuous with previous box)
- Bottom (ft): (R22-3.0-101.3) (flow contact)

**Unit type:** rubble

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 1-2% - 1-2 mm - blocky (<3:1:1)
- plagioclase - 1% - <1 mm - tabular (>3:1:1)
- microphenocrysts

**Groundmass/Matrix:** microcrystalline to glassy

**Color:** N2 grayish black

**Structures:** unbedded

**Sorting:** poorly-sorted

**Vesicles:** 5-10% - 1-2 mm - spherical - rounded

**Rubble grades:** fresh (<2% altered)

**Alteration:** none

**Veins:** none

**Fractures:** rubble

**Additional comments:**
- Hardness = firm. No recovery from runs 23 and 24, and little or no section penetrated.

---

### BOX UNIT 2: calcareous sediment (coral rudstone)

**Contacts:**
- Top (ft): (R22-3.0-101.3) (depositional)
- Bottom (ft): (R23-0.0-101.6) (missing)

**Unit type:** calcareous sediment

**Phenocrysts/Clasts:**
- 5% - 10-50% - large coral fragments, less abundant small (1-4mm) glassy basalt fragments
- coral fragments - 10-50% - >5 mm - sub-angular
- volcanic clasts - 1-2% - 1-5 mm -
- Concentrated on outer margin of core; probably from drilling.

**Groundmass/Matrix:** fine sand - small shells, coral fragments preserved

**Color:** 10 YR 8/2 to 7/4 very pale orange to grayish yellow

**Structures:** unbedded

**Sorting:** poorly-sorted

**Vesicles:** none

**Veins:** none

**Fractures:** rubble

**Additional comments:**
- No recovery from runs 23 and 24, and little or no section penetrated.
BOX UNIT 3: sparsely to moderately plagioclase-olivine phyric basalt

Contacts:
Top (R): (R--')(cave)
Bottom (R): (R--')(cave)

Unit type: rubble
- cave material from top of R25 with basalt and coral fragments

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine = 1-2% - 1-2 mm - blocky (<3:1:1)
- plagioclase = <1% - <1 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
- Color: N3 dark gray
- Structures: unbedded
- Sorting: poorly-sorted
- Vesicles: none
- Alteration: fresh (<2% altered)
- Veins: none
- Fractures: cave/rubble

Additional comments:
- Some glassy rinds present. No recovery from runs 23 and 24 (95.5-104). Caving problems reported after run 22. Basalt is similar to basalt from unit 1 in this box.
- All cave material (not a flow unit).

BOX UNIT 4: calcareous sediment

Contacts:
Top (R): (R 25-0.0-101.6')(missing)
Bottom (R): (R25-0.6-102.2')(depositional)

Unit type: calciclastic
- top of unit between R23 and R29-0.0

Phenocrysts/Clasts:
- >50% - large (several cm) coral fragments
- coral fragments - >50% - >1 cm
- volcanic clasts - 2-10% - 1-5 mm - sub-angular
- found near top of unit

Groundmass/Matrix: medium sand - small shells
- Color: 5Y 6/1 light olive gray
- Structures: unbedded
- Sorting: poorly-sorted
- Vesicles: none
- Alteration: fresh (<2% altered)
- Veins: none
- Fractures: none

Additional comments:
- hardness = firm
### BOX UNIT 1: coral

<table>
<thead>
<tr>
<th>Contacts:</th>
<th>Top (R): (R 25 -0.6 -102.2') (depositional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom (R): (R 25 -0.8 -102.4') (depositional)</td>
<td></td>
</tr>
<tr>
<td>Top of unit defined by layers of calcareous sand to silt-sized material interbedded with pebble-sized subangular coral pieces.</td>
<td></td>
</tr>
<tr>
<td>Unit type:</td>
<td>coral</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
<td></td>
</tr>
<tr>
<td>Groundmass/Matrix:</td>
<td>-</td>
</tr>
<tr>
<td>Color:</td>
<td>N9 white</td>
</tr>
<tr>
<td>Structures:</td>
<td>Massive in lower part</td>
</tr>
<tr>
<td>Sorting:</td>
<td>-</td>
</tr>
<tr>
<td>Vesicles:</td>
<td>none</td>
</tr>
<tr>
<td>Alteration:</td>
<td>fresh (&lt;2% altered)</td>
</tr>
<tr>
<td>Veins:</td>
<td>none</td>
</tr>
<tr>
<td>Fractures:</td>
<td>unfractured</td>
</tr>
</tbody>
</table>

### BOX UNIT 2: clast-supported calcareous sediment

<table>
<thead>
<tr>
<th>Contacts:</th>
<th>Top (R): (R 25 -0.6 -102.4') (depositional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom (R): (R--') (continuing with next box)</td>
<td></td>
</tr>
<tr>
<td>Unit type:</td>
<td>calciclastic sediment</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
<td></td>
</tr>
<tr>
<td>Groundmass/Matrix:</td>
<td>fine-grained (&lt;1 mm) - matrix is coral fragments, shell fragments and shells</td>
</tr>
<tr>
<td>Color:</td>
<td>-</td>
</tr>
<tr>
<td>Structures:</td>
<td>unbedded</td>
</tr>
<tr>
<td>Sorting:</td>
<td>poorly-sorted</td>
</tr>
<tr>
<td>Vesicles:</td>
<td>-</td>
</tr>
<tr>
<td>Alteration:</td>
<td>-</td>
</tr>
<tr>
<td>Veins:</td>
<td>-</td>
</tr>
<tr>
<td>Fractures:</td>
<td>-</td>
</tr>
</tbody>
</table>

### Additional comments:
- **Hardness = firm**
- Hardness = soft. Gradual decrease in proportion of dark shell fragments from R25-0.8 to bottom of box.

---

**Driller's depth:top [feet]:** 100.5  
**Driller's depth:bottom [feet]:** 104.0  
**Core type:** PQ  
**Units in box:** 2

---

**Loggers:** MBB  
**Date logged:** 10/31/93  
**Checked by:** MG  
**Check date:** 11/3/93
Coral fragments ->10% -> 1 cm - sub-angular
Volcanic clasts - 1-2% ->5 mm - sub-rounded -
Some basalt fragments have drill marks; probably cave mixed in from above.

Groundmass/Matrix: fine/medium sand (0.125-0.5 mm) - Subangular shell and coral fragments. 5-10% black (volcanic?) sand. Some well preserved 1-2 mm shells.

Color: 5Y 8/1 yellowish gray - Structures: unbedded - Sorting: poorly-sorted -
Veins: none
Fractures: none
Additional comments:
Cave material at tops of runs 26 and 27 containing a mixture of basalt and coral fragments. Some basalt fragments have cement infilling vesicles. Basalt similar to basalt from above sediment interface. Fragment "B" on photo has piece of carbonate attached - probably came from basalt/sediment contact. Glassy rinds found on some basalt pieces in both cave zones.
BOX UNIT 1: calcareous sediment

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R--') (continuous with next box)

Unit type: calcilastic sediment
Phenocysts/Clasts:
>50% -
coral fragments - 50% - >10 mm - sub-angular -

Groundmass/Matrix: fine/medium sand (0.125-0.5 mm) - angular shell fragments with microfossils
Color: 5Y 6/1 light olive gray - Structures: bedded (thick) - Sorting: poorly-sorted -
Veins: none
Alteration: fresh (<2% altered) -
Veins: none
Fractures: none

Additional comments:
A = caved material at top of R27 mostly coral pieces with some basalt; B = described above; C = cave at top of R28, 50% basalt, 50% coral; D = decrease in abundance of large coral clasts to <10% from R28-0.0 to R28-0.5; E = return of large coral fragments from 0.5-0.7; F = few large coral fragments
BOX UNIT 1: matrix-supported calcareous sediment
Contacts: Top (ft): (R 28-2.0-112.5') (depositional)
Bottom (ft): (R 28-2.0-112.5') (depositional)
Unit type: calcilastic sediment
Phenocrysts/Clasts:
- 10-20% - coral fragments - 2-10% - 1-10 mm - sub-angular
- shell fragments - 10-20% - 1-5 mm - sub-angular
- volcanic clasts - 1-2% - 1 mm - sub-angular
Groundmass/Matrix: medium-grained (1-5 mm) - Coral and shell fragments
Color: - Structures: unbedded - Sorting: poorly-sorted -
Vesicles: - - -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: none
Additional comments:
Color transition at point labeled "A" in photo = decrease in proportion of blackish shell fragments. Call this a unit transition.
Proportion of volcanic and mineral fragments probably <5%.

BOX UNIT 2: matrix supported calcareous sediment
Contacts: Top (ft): (R 28-2.0-112.5') (depositional)
Bottom (ft): (R 28-2.0-112.5') (depositional)
Unit type: neritic sediment
Phenocrysts/Clasts:
- coral fragments - >10% - >5 mm - sub-angular
- shell fragments - 2-10% - >5 mm - angular
Groundmass/Matrix: medium-grained (1-5 mm)
Color: - Structures: unbedded - Sorting: poorly-sorted -
Vesicles: - - -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: none
Additional comments:
Zone labeled "B" represents cave material. Increase in proportion of coral and shell fragments down section (see "C").
BOX UNIT 1: calcareous sediment

Contacts: Top (ft): (R 29-1.2 · 115.2') (depositional)
Bottom (ft): (R -')(continuous with next box)

Unit type: calciclastic
Phenocrysts/Clasts:
<10% - shell fragments - <1% - 1-5 mm - angular - - - - -

Groundmass/Matrix: fine/medium sand (0.125-0.5 mm) - Some silt/clay. Some sponge spicules. Common (10%) dark, rounded grains (volcanic?).

Color: 5Y 6/1 light olive gray - Structures: bedded (thin) - a few bedding surfaces visible - Sorting: well-sorted -

Vesicles: - - - -
Veins: none
Fractures: none

Additional comments:
A = faint bedding structure; B = finer silt/mud layer from R31-0.2 to 0.3; C = zone with more abundant coral/shell fragments (>1 mm).
BOX UNIT 1: calcareous sediment

Contacts:
- Top (R--)(continuous with previous box)
- Bottom (R--)(continuous with next box)

Unit type: calciclastic

Phenocrysts/Clasts:
- <10% -
  - volcanic clasts - <1% - 1-5 mm - sub-rounded -
  - rare spatter fragments
  - shell fragments - 1-2% - 1-5 mm - angular -
  - some rare small pieces of coral as well

Groundmass/Matrix: fine/medium sand (0.125-0.5 mm) - shell fragments with some sponge spicules

Color: 5Y 6/1 light olive gray - Structures: bedded (thin) - Sorting: well-sorted to poorly sorted -

Vesicles: -

Alteration: fresh (<2% altered) -
Veins: none
Fractures: none

Additional comments:
- A = layer with abundant shell fragments (1 mm) and dark (shell or basalt glass?) platy fragments. B = slightly coarser grained with shell fragments and rare fragments. Numerous layers of finer/coarser material present.

UNIT #: 8

Logoers: JCL
Date logged: 10/31/93
Checked by: MG
Check date: 11/3/93

Driller's depth: top [feet]: 127.2
Driller's depth: bottom [feet]: 131.2
Core type: PQ
Units in box: 1

BOX #:
Cores in box
31

Loggers: JCL
Date logged: 10/31/93
Checked by: MG
Check date: 11/3/93

Driller's depth: top [feet]: 127.2
Driller's depth: bottom [feet]: 131.2
Core type: PQ
Units in box: 1

Box #:
Cores in box
31
BOX UNIT 1: calcareous sediment
Contacts: Top (ft): (R --')(continuous with above)
Bottom (ft): (R 31-5.4-127.4')(depositional)
bottom contact labeled "A" in photo
Unit type: neritic sediment
Phenocrysts/Clasts:
10-50% —
coral fragments — 10% — 5 mm — sub-angular —
shell fragments — 10% — 2-10 mm — sub-angular —

Groundmass/Matrix:
Color: —
Structures: —
Sorting: poorly-sorted —

Vesicles: —
Alteration: fresh (<2% altered) —
Veins: none
Fractures: none
Additional comments:
Some irregularly shaped ~5-10 mm sized coral fragments.

BOX UNIT 2: calcareous sediment
Contacts: Top (ft): (R 31-5.4-127.4')(depositional)
Bottom (ft): (R --')(continuous with next box)
Unit type: calciclastic sediment
Phenocrysts/Clasts:
—

Groundmass/Matrix: clay to silt-size material —
Color: —
Structures: unbedded —
Sorting: well-sorted —

Vesicles: —
Alteration: fresh (<2% altered) —
Veins: none
Fractures: none
Additional comments:
Basalt pebbles are cave material — occur on the outer surface of the core. The smaller core diameter is due to scouring by the basalt pebbles.
BOX UNIT 1: calcareous sediment

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R --')(continuous with next box)

Unit type: calciclastic sediment

Phenocrysts/Clasts:
- <1% -
- shell fragments - <1% - 1-5 mm - angular -

Groundmass/Matrix: silt/clay (<0.125 mm) -
Color: 5GY 6/1 greenish gray - Structures: unbedded - Sorting: well-sorted -

Vesicles:
Alteration:
Fractures:
Additional comments:

A = shell fragments (1-4 mm). Basalt pebbles armoring portions of core are probably from up-section, introduced during drilling - see photo and description for box 24.
**BOX UNIT 1:** calcareous sediment

Contacts: Top (ft): (R -)(continuous with previous box)
Bottom (ft): (R34-1.0-153.0')(depositional)

Unit type: calciclastic sediment

Phenocrysts/Clasts: <-1%

Groundmass/Matrix: silt/clay

Color: N8 very light gray - Structures: massive - Sorting: well-sorted

Vesicles: -

Alteration: none

Veins: none

Fractures: none

Additional comments: fine, dark, speckled growth on surface (organics?)

**BOX UNIT 2:** clast-supported calcareous sediment

Contacts: Top (ft): (R 34-1.0-153.0')(depositional)
Bottom (ft): (R-)(continuous with next box)

Unit type: calciclastic sediment

Phenocrysts/Clasts:
- coral fragments - >10% - 1-30 mm - coral-shaped - some of the pieces are >5 mm (to 75 mm)

Groundmass/Matrix: calcareous mud

Color: - Structures: unbedded - Sorting: poorly-sorted

Vesicles: -

Alteration: -

Veins: -

Fractures: -

Additional comments:
**BOX UNIT 1**: clast-supported calcareous sediment

*Contacts:*
- Top (II): (R -->)(continuous with previous box)
- Bottom (II): (R <--)(continuous with next box)

*Unit type:*
- calciclastic sediment

*Phenocrysts/Clasts:*
- >50% – coral fragments – >50% – 1-3 cm – sub-angular –
  - up to 7 cm or more
- shell fragments – 2-10% – 1-5 mm – platy –
  - Original colors preserved in many shells. Some whole shells preserved.

*Groundmass/Matrix:*
- silt/clay (<0.125 mm) – clast-supported

*Color:*
- 5Y 8/1 yellowish gray – Structures: unbedded – Sorting: poorly-sorted –

*Vesicles:*
- – – – –

*Alteration:*
- –

*Fractures:*
- –

*Additional comments:*
- A = zone from R35-0.5 and 0.8 containing small (<1 to 3 mm), angular, black to green grains of basalt glass?
BOX UNIT 1: clast-supported calcareous sediment

Contacts: Top (R): (R--) (continuous with previous box)
Bottom (L): (R--) (continuous with next box)

Unit type: calciclastic sediment

Phenocrysts/Clasts:
- >50% - coral fragments - >50% - 1-5 cm - sub-angular -
- shell fragments - 2-10% - 1-5 mm - angular -

Groundmass/Matrix: silt/clay (<0.125 mm)
Color: Structures: unbedded - Sorting: poorly-sorted -
Vesicles: - - -
Alteration: -
Veins: -
Fractures: -
Additional comments:
BOX UNIT 1: clast-supported calcareous sediment

Contacts: Top (ft): (R--})(continuous with previous box)
Bottom (ft): (R--})(continuous with next box)
Unit type: calcilastic sediment
Phenocrysts/Clasts:
>50% -
coral fragments - >50% - 5 cm -
up to 11 cm
-
-
Groundmass/Matrix: fine sand/silt/clay (<0.125 mm)
Color: - Structures: unbedded - Sorting: poorly-sorted -
Vesicles: -
Alteration: -
Veins:
Fractures:
Additional comments:
**BOX UNIT 1: clast-supported calcareous sediment**

**Contacts:**
- Top (R): (continuous with previous box)
- Bottom (R): (continuous with next box)

**Clasts:**
- >50% - coral fragments - >50% - 5 cm - angular - up to 10 cm
- shell fragments - 2-10% - >5 mm - angular - unbroken shells

**Groundmass/Matrix:**
- silt/clay (<0.125 mm)

**Color:**
- Structures: unbedded
- Sorting: poorly-sorted

**Alteration:**

**Veins:**

**Fractures:**

**Additional comments:**
- A = 2 cm fragment of pelecypod; B = 2.5 cm gastropod complete shell

---

**UNIT #:10**

**Cores in box:**
- 37
- 38

**Loggers:**
- MBB, JCL

**Date logged:**
- 11/2/93

**Checked by:**
- MG

**Check date:**
- 11/4/93

**Driller's depth:top [feet]:**
- 175.8

**Driller's depth:bottom [feet]:**
- 180.7

**Core type:**
- PQ

---

**Effective:**

**Units in box:**
- 1
BOX UNIT 1: clast-supported calcareous sediment

Contacts:
Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R 40-0.5-185.5')(depositional)

Unit type: calciclastic sediment

Phenocrysts/Clasts:
>50% -
coral fragments - >50% - 1-2 mm - angular -
up to 7 cm

Groundmass/Matrix: fine sand/silt/clay (<0.125 mm)

Color: Structures: Sorting:
Vesicles: -
Alteration:
Veins:
Fractures:

Additional comments:
R39-0.0 to 1.0 contains coral pieces with orange discoloration.
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:** Top (R): (R 40-0.5-185.5\')(depositional)  
Bottom (R): (R--')(continuous with next box)  
calcareous sediment overlies basalt

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**  
highly phyric (10-20%) – 200 pts. counted (11/100 and 15/100)  
olivine – 10-20% – 1-5 mm – equant-blocky –  
Olivine distribution appears homogeneous, although variation in vesicle population makes this determination difficult. Locally, altered grains occur in the interval R40-0.5 to R40-3.5. Olivines contain spinel inclusions. Some very large olivines (>5 mm). Some crystal clots.

**Groundmass/Matrix:** microcrystalline –  
**Color:** N3 dark gray – **Structures:** – **Sorting:** –  
**Vesicles:** 10-20% – 1-5 mm – rounded to subrounded – equant to elongate –  
Fe-oxide coating in some of the vesicles. Near the top of the box vesicle proportion approaches 50%; at the bottom of the box the proportion drops to ~10% and average size increases to ~10mm. Some calcareous vesicle fillings at the top of the box (R40-0.5 to R40-0.8).

**Alteration:** –  
**Veins:** None  
**Fractures:** Weakly fractured; 10/4'. Fe-oxide partially coating some of the fractures.  
**Additional comments:**

---

**UNIT #:11**

**Box #:** 32  
**Cores in box:** 40  
**Date logged:** 10/31/93  
**Checked by:** MG  
**Check date:** 11/4/93  
**Loggers:** MBB  
**Driller’s depth:top [feet]:** 187.9  
**Driller’s depth:bottom [feet]:** 192.0  
**Core type:** PQ  
**Units in box:** 1
Box #: 33  Cores in box 41

Loggers: MBB
Date logged: 11/1/93
Checked by: MG
Check date: 11/4/93

Driller's depth: top [feet]: 192.0
Driller's depth: bottom [feet]: 195.2
Core type: PQ

Units in box: 1

**BOX UNIT 1:** highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R --')(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 10-15% - 3-4 mm - equant to blocky
- spinel inclusions; no apparent zoning in phenocryst abundance; some olivine grains >5 mm

Groundmass/Matrix: microcrystalline
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: 5-10% at top; 10-20% at bottom - >5 mm at top; <5 mm at bottom - sub-rounded - elongated
Vesicle size and proportion decrease down section; elongate vesicles subhorizontal.
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured

**Additional comments:**
Small "gabbroic" inclusion (<10 mm in size) + an olivine+clinoxyroxene inclusion. Location of both inclusions marked on photo.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R - -})(continuous with previous box)
Bottom (ft): (R - -})(continuous with next box)
Subaerial flow. Internal flow contact thought to exist based on "glassy" oxidized ropy surface textures and the rapid increase in vesicles of decreasing size.

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 8-10% - 2-3 mm - equant to blocky
- Spinel inclusions; some olivines > 5 mm; some present in crystal clots.

Groundmass/Matrix: microcrystalline
Color: - Structures: - Sorting: -
Vesicles: >50% near contact - 2-3 mm -
Elongate vesicles are subhorizontal; near the contact many of the small vesicles are filled with very fine-grained pinkish material (stained zeolites?)
Alteration: fresh (<2% altered)
Veins: none
Fractures: Highly fractured with some rubbly material in the region of the contact.
Additional comments:
- Internal contact zone labeled "A" on photo (R41-2.5 to R41-3.5); no lithologic change.
**BOX UNIT 1:** moderately olivine phyric basalt

**Contacts:**
- Top (ft): (R--; continuous with previous box)
- Bottom (ft): (R--)(continuous with next box)

Internal flow contact at bottom of box inferred from presence of highly vesicular, discolored rubble with ropy flow textures, questionable contact; no lithologic change.

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phyric (2-10%) -
- olivine - 8-10% - 2-3 mm - equant -
- range 1-7 mm, spinel inclusions

**Groundmass/Matrix:** microcrystalline

**Color:** N3 dark gray

**Structures:**

**Sorting:**

**Vesicles:**
- 20-30% - 1-5 mm - rounded - inclined -
- Vesicles concentrated along 45° bands. Large vesicles (5 mm) are vertically elongated and are found above R43-1.7. Smaller bubbles are found below R43-1.7.

**Alteration:** fresh (<2% altered)

- Some yellowish to brownish discoloration and infilling of vesicles with a white-orange material in rubble from zone B (inferred contact).

**Veins:** none

**Fractures:** Moderately fractured above zone B - subhorizontal and some sub-vertical fractures. Some brown discoloration and infilling of vesicles with whitish material along fractures.

**Additional comments:**
- A = cave material from top of R43 with coral and highly vesiculated basalt. Scoriaceous rubble from zone B (R43-2.2 to 2.7) is more highly discolored and has more infilling than above, and some surfaces have flow textures - inferred to be internal flow contact. NaCl ppt around olivines and fractures.
<table>
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<tr>
<th>Box #: 36</th>
<th>Cores in box</th>
<th>Logs: JCL</th>
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<tbody>
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<td>Date logged: 11/1/93</td>
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<tr>
<td>44</td>
<td></td>
<td>Checked by: MG</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>Check date: 11/4/93</td>
</tr>
</tbody>
</table>

**BOX UNIT 1: moderately olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R --')(continuous with previous box)
  - Bottom (ft): (R --')(continuous with next box)
  - Questionable contact at top; no lithological change across it.

- **Unit type:** rubble

- **Phenocrysts/Clasts:**
  - moderately phyric (2-10%) -
  - olivine - 8-10% - 1-5 mm - blocky (<2:1:1) -
  - spinel inclusions, multi-grain clusters

- **Groundmass/Matrix:** microcrystalline

- **Color:** N2 grayish black - Structures: - Sorting: -

- **Vesicles:** 5-10% - 1-5 mm - rounded - elongated (1:2) -
  - Variable vesicle content-some rubble is highly vesiculated (>25%). Larger vesicles have diktytaxitic texture.

- **Alteration:** slightly (2-10% altered)
  - Brown discoloration and filling of some vesicles with white (zeolites?) material. Material becomes more massive and fresher with depth.

- **Veins:**
  - Fractures: rubble to highly fractured

- **Additional comments:**
  - "A"=highly vesicular rubble with surface flow features grades to more massive, less vesicular core with depth. NaCl ppt.; cave material at top of run 45.
BOX UNIT 1: moderately olivine phric basalt

Contacts: Top (ft): (R --')(continuous with previous box) Bottom (ft): (R --')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phric (2-10%) - olivine - 8-10% - 1-5 mm - equant to blocky - 1-7 mm, some clusters

Groundmass/Matrix: microcrystalline -

Color: N3 dark gray - Structures: - Sorting: -

Vesicles: 5-10% - 5 mm - rounded-irregular - vertically elongated - Variable elongation orientation. Diktytaxitic texture (?). 2 populations; large (~10 mm) irregular and small, 1 mm, round vesicles.

Alteration: fresh (<2% altered) -

Veins: none

Fractures: Weakly to moderately fractured. Gray to brown to red discoloration of fracture surfaces.

Additional comments:
- Cave material at top of R46. Core becomes less fractured and less discolored down-hole. A = Pyroxene-olivine inclusion, 12 mm, on fracture surface, hidden from view on photo, at R46-0.5.
<table>
<thead>
<tr>
<th>Box #:</th>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Date logged:</th>
<th>Checked by:</th>
<th>Check date:</th>
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<td>38</td>
<td>46 47</td>
<td>JCL</td>
<td>11/1/93</td>
<td>MG</td>
<td>11/4/93</td>
</tr>
</tbody>
</table>

**BOX UNIT 1: moderately olivine phyric basalt**

- **Contacts:** Top (ft): (R --')(continuous with previous box)
  Bottom (ft): (R--')(continuous with next box)
- **Unit type:** massive
cave and rubble from R47-0.0 to 1.5
- **Phenocrysts/Clasts:**
  - moderately phyric (2-10%) – 200 pts. counted (8’100, 10/100)
  - olivine – 8-10% - 1-5 mm - blocky (<2:1:1) – 1-7 mm, spinel inclusions, some clusters
- **Groundmass/Matrix:** microcrystalline –
- **Color:** N3 dark gray – **Structures:** – **Sorting:** –
  - Vesicles: 5-10% - 5 mm - irregular - sub-vertically elongate –
    *pipe-type* irregularly shaped vesicles with diktatyptic texture.
- **Alteration:** fresh (<2% altered) –
- **Veins:** none
- **Fractures:** moderate, excluding cave/rubble
- **Additional comments:**
  - Olivine-pyroxene inclusions up to 10 mm. Yellow to dark brown discoloration of some fractures at bottom of R46 and rubble from top of R47. R47-0.0 to R47-1.5: rubby with some cave material; some of the rubble was thick Fe-oxide coatings, some indication of surface textures, but not well developed; however, the vesicle population in the massive portion from R47-1.3 to R47-2.0 is not indicative of a flow top.
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R -)(continuous with previous box)
Bottom (ft): (R -)(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%) -
- olivine - 8-10% - 2-5 mm - equant to blocky -
- spinel inclusions; olivine crystal clots
- - - -
Groundmass/Matrix: microcrystalline
Vesicles: 5-10% - 1-5 mm - sub-rounded - equant to elongate
Alteration: fresh (<2% altered)
Veins: none
Fractures: moderately to highly fractured
Additional comments:
2 inclusions (<4 mm) of olivine+pyroxene(?); locations marked on side of box (at R47-2.6) and on photo.

UNIT #: 11

Cores in box
47
48

Box #:
39

Cores in box
47
48

Logger:
MBB

Date logged: 11/2/93

Check date: 11/4/93

Check date:

Driller's depth: top [feet]: 213.0

Driller's depth: bottom [feet]: 214.4

Core type: PQ

Units in box: 1
**BOX UNIT 1**: moderately olivine phyric basalt

- **Contacts**: Top (ft): (R --)(continuous with previous box)  
  Bottom (ft): (R --)(continuous with next box)
- **Unit type**: massive
- **Phenocrysts/Clasts**:  
  - moderately phyric (2-10%)  
  - olivine - 2-10% - 1-5 mm - equant to blocky  
  - Size variation: <1 to 12 mm; spinel inclusions and crystal clots
- **Groundmass/Matrix**: microcrystalline
- **Color**: N3 dark gray
- **Vesicles**: 10-20% - 1-5 mm - sub-rounded - horizontally elongated  
  - At "B", there is a zone of large (10-20 mm) vesicles grading to pipe vesicles.
- **Alteration**: fresh (<2% altered)  
- **Veins**: none
- **Fractures**: Weakly fractured. At "C" there is a fracture coating consisting of zeolites(? and Fe-oxides.

**Additional comments**:  
This box is the start of the HQ series. The uppermost part of R49 contains cemented, caved material. Feature "A" is a lens of micro-vesicles which contain a concentration of coarse spinel (2-4 mm) grains. Feature "B" is a highly vesicular zone. NaCl ppt.
BOX UNIT 1: moderately olivine phryic basalt

Contacts: Top (ft): (R--) (continuous with previous box)
Bottom (ft): (R--) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
moderately phryic (2-10%)
olivine - 8-10% - 1-5 mm - blocky (<3:1:1)
rare spinel inclusions, multi-grain clusters

Groundmass/Matrix: microcrystalline

Color: N3 dark gray - Structures: -
Vesicles: 10-20% - 1-5 mm - rounded - equant -
three populations: 1) small (<1 mm), equant; 2) medium (1-5 mm) slightly vertically elongate; 3) large (>5 mm) irregularly shaped to horizontally elongate. Some large (>10 mm) vesicles have diktytaxitic texture.

Alteration: fresh (<2% altered)

Veins: none

Fractures: slightly to moderately fractured, mostly subhorizontal (30-60°)

Additional comments:
A = large (2 cm) gabbroic clot with plagioclase and olivine. White or red-brown rinds on some fractures (e.g., B on photo). NaCl ppt.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R-...)(continuous with previous box)
Bottom (ft): (R-...)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%) -
  - olivine - 8-10% - 1-5 mm - blocky (<3:1:1) -
    - many equant crystals; range: 1-8 mm; some spinal inclusions

Groundmass/Matrix: microcrystalline

Color: N2 grayish black

Vesicles: 5-10% - <1 mm - rounded - equant -
  - Two populations: 1) abundant sub-mm spherical vesicles and rarer larger (2-10 mm) vesicles often surrounded by concentrations of sub-mm vesicles.

Alteration: fresh (<2% altered)

Veins: none

Fractures: slight to moderate - horizontal, vertical, and inclined sets, some with yellow to white rinds

Additional comments:
- <1% large (up to 4 mm) black (spinel?) inclusions; clinopyroxene-olivine inclusions
<table>
<thead>
<tr>
<th>Box #:</th>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Date logged:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>55 56</td>
<td>BM</td>
<td>11/2/93</td>
<td>MG</td>
<td>11/4/93</td>
</tr>
</tbody>
</table>

### BOX UNIT 1: moderately olivine phyric basalt
- **Contacts:**
  - Top (It): (R ...)(continuous with previous box)
  - Bottom (It): (R ...)(continuous with next box)
- **Unit type:** massive
- **Groundmass/Matrix:** microcrystalline
- **Color:** N4 medium dark gray
- **Textures:**
  - Vesicles: 5-10 mm - rounded
  - There are two populations of vesicles based on size: (1) a population <1 mm diameter and (2) a population >5 mm diameter.
- **Alteration:** fresh (<2% altered)
- **Fractures:** Weakly fractured. Occasional fractures lined with clay.
- **Additional comments:**

### UNIT #:11
- **Phenocrysts/Clasts:**
  - olivine - 2-10% - 1-5 mm - equant to blocky
- **Sorting:**
- **Vesicles:** none
- **Veins:** none
- **Contacts:**
  - Top (It): (R ...)(continuous with previous box)
  - Bottom (It): (R ...)(continuous with next box)
- **Unit type:** massive
- **Phenocrysts/Clasts:**
  - moderately phyric (2-10%) - olivine - 2-10% - 1-5 mm - equant to blocky
- **Sorting:**
- **Vesicles:** none
- **Veins:** none
- **Fractures:** Weakly fractured. Occasional fractures lined with clay.
- **Additional comments:**
Box #: 44

<table>
<thead>
<tr>
<th>Cores in box</th>
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<tbody>
<tr>
<td>56</td>
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<td>57</td>
<td></td>
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<tr>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

Loggers: MBB
Date logged: 11/2/93
Checked by: MG
Check date: 11/4/93

Driller's depth: top [feet]: 250.8
Driller's depth: bottom [feet]: 259.7
Core type: HQ

Units in box: 1

BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R--)(continuous with previous box)
Bottom (ft): (R--)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phryic (2-10%)
- olivine - 8-10% - 2-4 mm - equant to blocky
- spinel inclusions; homogeneous olivine distribution; olivine clots

Groundmass/Matrix: microcrystalline

Color: NS medium gray

Vesicles: 5-10% - <1 mm & 5-10 mm - rounded to subrounded - equant to elongate

Two populations; small vesicles sometimes occur in 10-20 mm long near-vertical trains.

Alteration: fresh (<2% altered)

Veins: none
Fractures: weakly fractured (20/8.9 ft)

Additional comments:
- "A" = olivine+spinel+pyroxene(?) clot (-4 mm);
- "B" = gabbroic inclusion (-16 mm);
- "C" = gabbroic inclusion (-11 mm);
- "D" = olivine+spinel clot (-15 mm);
- "E" = gabbroic inclusion. The gabbroic inclusions have a quench-like texture (elongate plagioclase laths) and are quite vesicular.

UNIT #: 11

"A" = olivine+spinel+pyroxene(?) clot (-4 mm);
"B" = gabbroic inclusion (-16 mm);
"C" = gabbroic inclusion (-11 mm);
"D" = olivine+spinel clot (-15 mm);
"E" = gabbroic inclusion. The gabbroic inclusions have a quench-like texture (elongate plagioclase laths) and are quite vesicular.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R --)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine - 8-10% - 2-4 mm - equant to blocky
  - spinel inclusions; olivine clots; homogeneous olivine phenocryst distribution

Groundmass/Matrix: microcrystalline
Color: - Structures: - Sorting: -
Vesicles: <5% - <1 mm; 5-10 mm - rounded; subrounded --
Two populations; elongate vesicles have no preferred orientation
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured (189.4 ft)

Additional comments:
Refer to photo: "A" = olivine+pyroxene(?) clot (~5 mm) at RS8-3.2, appears to be infilled by groundmass; "B" = vesicular "microgabbroic" inclusion at RS8-3.45; "C" = vesicular "microgabbroic" inclusion at RS8-4.5; "D" = vesicular "microgabbroic" inclusion; "E" = vesicular "microgabbroic" inclusion; "F" = olivine+spinel in a granular feldspathic(?) matrix.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ff): (R--')(continuous with previous box)
Bottom (ff): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine: 5-10% - 4-6 mm - blocky (<3:1:1)
    - 1-10 mm, some spinel inclusions, multi-grain clots
  - 1-10 mm olivine-plagioclase and olivine-clinopyroxene inclusions, some with vesicles.

Groundmass/Matrix: microcrystalline

Color: N2 grayish black - Structures: - Sorting: -

Vesicles: 5-10% - 5 mm - sub-rounded - irregular to inclined-elongate
1-2 cm horizontal lenses of micro-vesicles also present

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured - 0 to 60°

Additional comments:

2 to 5 mm olivine-plagioclase and olivine-clinopyroxene inclusions, some with vesicles.
**Box #:** 47  
**Cores in box:** 62 63

**Loggers:** BM  
**Date logged:** 11/3/93  
**Checked by:** MG  
**Check date:** 11/4/93

**Driller's depth:** top [feet]: 277.0  
**Driller's depth:** bottom [feet]: 285.6  
**Core type:** HQ

<table>
<thead>
<tr>
<th>Units in box:</th>
<th>1</th>
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</thead>
</table>

**BOX UNIT 1:** moderately olivine phryic basalt  
**Contacts:** Top (ft): (R --')(continuous with previous box)  
Bottom (ft): (R --')(continuous with next box)  
**Unit type:** massive  
**Phenocrysts/Clasts:**  
moderately phryic (2-10%)  
olivins – 2-10% – 1-5 mm – equant to blocky  
Spinel inclusions in olivine; several crystal clots present; variation in grain size from <1 to 8 mm.

**Groundmass/Matrix:** microcrystalline  
**Color:** N3 dark gray  
**Structures:**  
**Sorting:**  
**Vesicles:** <5% – 1-5 mm – sub-rounded – horizontally elongated  
**Alteration:** fresh (<2% altered)  
**Veins:** none  
**Fractures:** weakly fractured: 18/8.6 ft  
**Additional comments:**  
Feature "A" is an olivine-clinopyroxene crystal clot (11 mm long).
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R- - continues with previous box)
Bottom (ft): (R- - continues with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine ~10%

200 point counts made at 3 zones: Top zone "B" contains 15% olivine; Central zone "A" contains 18-21% olivine; Bottom zone "C" contains 12-13% olivine.

Groundmass/Matrix: microcrystalline
Color: N3 dark gray
 Structures: Sorting:­
 Vesicles: <5%
 Viscles were point counted. Zone "A": <1% vesicles; Zone "B": 1-5%, 7 mm, rounded, horizontally elongate; Zone "C": 1-5%; subrounded to subangular, horizontally elongated with aspect ratio of ca. 5:1.
 Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 8/8 ft
Additional comments: Zone "A" is olivine-rich (18-21%), and is a possible cumulative zone. Zone "A" is transitional to zones "B" and "C" which have between 12-15%. Zone "A" is also distinct in its lack of vesicles. Zone "C" vesicles are strongly sheared perpendicular to core axis. Zone "B" is only moderately sheared. There is an olivine-clinopyroxene crystal clot at "D".

Driller's depth: top [feet]: 285.6
Driller's depth: bottom [feet]: 294.7
Core type: HQ
Units in box: 1
**BOX UNIT 1: highly olivine phyric basalt**

Contacts:
- Top (ft): (R 65.4.6 - 297.4) (flow contact)
- Bottom (ft): (R 65.4.8 - 297.4) (flow contact)

Underlain by volcaniclastic siltstone. There is no chilled margin between the basalt and the siltstone. The contact is irregular and dips 45°.

Unit type: massive

Phenocrysts/Clasts:
- olivine (>10% - 1-5 mm - equant to blocky -
  - Point counting of 100 points gave a mode of 12%. This unit has a homogeneous distribution of olivine. Maximum size of olivine is 8 mm. Spinel inclusions in olivine.

Groundmass/Matrix: microcrystalline

Color: N 3 dark gray

Vesicles: <5% - 1-5 mm - sub-rounded to sub-angular - horizontally elongated

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 1/1.7 ft

Additional comments:
- Unit 1 is continuous with zone "C" in Box 48, but vesicle size is smaller towards the base of this unit. Feature "A" is an olivine-clinopyroxene crystal fragment. Bottom of this unit is unusual in not having a glassy base. The bottom contact is irregular.

**BOX UNIT 2: lithic to vitric volcaniclastic silt**

Contacts:
- Top (ft): (R 65.4.6 - 297.4) (flow bottom/sediment contact)
- Bottom (ft): (R 65.5.1 - 297.9) (sedimentary/flow contact)

Unit type: massive

Phenocrysts/Clasts:
- glass shards
- also crystal fragments (magnetite)
- volcanic clasts
- also calcareous microfossils?

Groundmass/Matrix:
- Color: brownish gray 5 YR 4/1
- Structures: unbedded
- Sorting: well-sorted
- Vesicles: none
- Alteration: none
- Veins: none
- Fractures: none

Additional comments:
- upper half of layer is gray and appears to be an ash, but the bottom half is a brown sand-silt with coral fragments and microfossils common (WRC 12/1/93)
BOX UNIT 3: moderately olivine phyric basalt

Contacts: Top (ft): (R 65-5.1-297.9')(flow top pahoehoe)
Bottom (ft): (R--')(continuous with next)

Unit type: pahoehoe
highly vesicular top

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 2-10% - 1-5 mm - equant

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant to horizontally elongated-
Alteration: fresh (<2% altered)
slightly oxidized (hematite?) at uppermost 0.3' of flow
Veins: none
Fractures: weakly fractured: 10/10 ft

Additional comments:
This box contains 2 flows in box unit 3: the uppermost flow (F1) is 5.5' thick. In this flow, the uppermost 0.7' is highly vesicular(15-25%) with small vesicles (<5 mm) and contains <5% olivine. The next 2.3' also contains <5% olivine, but there are fewer (> 15%) vesicles (10-15), and they are larger (5-10 mm). The lowermost 2.3' contains an olivine-rich (20-30%) cumulate zone, which contains <5% vesicles. From R67-0.7 to the bottom of the box a second flow (F2) is present.
Feature "B" is a horizontal lens (vesicle infilling?), 9 mm thick, which contains an infilling of clay and altered and oxidized fragments of <0.1 mm diameter. There are fine horizontal laminas at the bottom of this feature.
Special note: A bivalve shell fragment is contained within a vesicle in the uppermost portion of this unit, at the top of the core.
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)  
Bottom (ft): (R--')(continuous with next box)  
Unit type: massive  
Phenocrysts/Clasts:  
highly phyric (>10%)  
olivine – >10% – 1-5 mm – equant to blocky  
Olivine <15% in the interval R67-1.9 to R67-2.6; point counting on slabbed surface at R68-1.7 gave ~33% olivine, representative of most of the core in the box. Olivines are uniform in size.

Groundmass/Matrix: microcrystalline above R67-2.6; fine-grained (<1 mm) – groundmass consists of microcrystalline material + 
plagioclase laths + clinopyroxene(?)

Color: N3 dark gray  
Structures:  
Sorting:  
Vesicles: 15-30% – <1 mm and 2-4 mm (see comments) – Below R67-2.6 most vesicles are <1 mm, subangular and 15-20%. Rare large subrounded and elongate vesicles are >20 mm.

Alteration: fresh (<2% altered) –  
Veins: none  
Fractures: Weakly fractured (68.5 ft). Fractures in the zone R67-1.9 to R67-2.8 (labeled "B" on photo) have a faintly yellow coating with rare filaments (biological?).

Additional comments:  
**LOGS**

**Cores in box:**

- Box 51: Cores in box
  - 69
  - 70
  - 71

**Logger:** JCL, MG

**Date logged:** 11/3/93

**Checked by:** MG

**Check date:** 11/4/94

**Driller's depth:**
- Top [feet]: 314.1
- Bottom [feet]: 323.7

**Core type:** HQ

**Units in box:** 2

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**BOX UNIT 1: highly olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R 69-3.7-316.2') (flow contact)
  - Bottom (ft): (R-)(continuous with previous box)

- **Unit type:** massive

- **Phenocrysts/Clasts:**
  - highly phyric (>10%)
  - olivine: >10% - 1-5 mm - blocky (<3:1)

- **Groundmass/Matrix:** microcrystalline

- **Color:** N3 dark gray

- **Structures:**
  - Vesicles: 20-30% - <1 mm - sub-rounded

- **Alteration:**
  - Fresh (<2% altered)

- **Veins:** none

- **Fractures:**
  - Weakly to moderately fractured

- **Additional comments:**
  - A = open textured gabbro (4.5 cm)
  - B = olivine + clinopyroxene inclusion (1 cm)

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**BOX UNIT 2: highly olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R 69-3.7-316.2') (flow contact)
  - Bottom (ft): (R-)(continuous with next box)

- **Unit type:** pahoehoe

- **Phenocrysts/Clasts:**
  - highly phyric (>10%)
  - olivine: >10% - 1-5 mm - blocky (3:1)

- **Groundmass/Matrix:** microcrystalline

- **Color:** red at top; med. dk. gray

- **Structures:**
  - Vesicles: 20-30% - <1 mm - sub-rounded

- **Alteration:**
  - Fresh (<2% altered)

- **Veins:** none

- **Fractures:**
  - Weakly to moderately fractured

- **Additional comments:**
  - A = open textured gabbro (4.5 cm)
  - B = olivine + clinopyroxene inclusion (1 cm)
BOX UNIT 1: moderately to highly olivine phryic basalt

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R--') (continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
moderately to highly phryic (2->10%) -
olivine = 9-11% - 1-5 mm - equant to blocky -
At R71-3.0 olivine = 11% at R72-3.0 olivine = 9% (Both measurements based on point counting a slabbed surface). Spinel inclusions present in olivines. Wide distribution in olivine sizes (some >5 mm).

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm; some up to 10 mm - rounded to subrounded - equant to elongate -
Vesicle size and proportion varies throughout section: "A" = zone of <1 mm vesicles; "B" = zone of large (>10 mm) subrounded to subangular vesicles (<10%).

Alteration: fresh (<2% altered) -
Veins: none
Fractures: moderately fractured (26/8.5 ft); pale yellow coating on fractures throughout section (well displayed at "C", see photo)

Additional comments:
Groundmass/Matrix: microcrystalline
Color: 10R6/2 pale red to N4 med. dark gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-5 mm - spherical to subrounded - equant to horizontally elongated -
variable: from 1-30 mm.
Alteration: slightly (2-10% altered)? -
Olivines have a black, iridescent coating (Mn-oxides) along fractures. Unfractured olivine cores are unaltered. Microcrystalline matrix has reddish color.
Veins: none
Fractures: Weakly fractured: 22/9 ft. Fractures at "B" are lined by a yellowish clay with a filamentous texture.
Additional comments:
Feature "A" is an olivine-clinopyroxene-plagioclase xenolith. Crystals of clinopyroxene and olivine are contained within a feldspathic matrix.
BOX UNIT 1: moderately olivine phyric basalt

Contacts:  Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-10% - 1-5 mm - equant to blocky
  Variation in size: <1 to 8 mm. Two point counts of 100 points gave modes of 2 and 10%.

Groundmass/Matrix: microcrystalline

Color: 10R6/2 pale red to medium dark gray

Vesicles: 10-20% - 1-8 mm - spherical to sub-angular - equant to horizontally elongated
  Variation in size from 1-22 mm. "C": Vesicle infillings noted in 2 (rare) instances, with the infilling consisting of oxidized, cemented sugary grains of unknown composition.

Alteration: slightly (2-10% altered) - iddingsite
Olivines have a black, iridescent coating (Mn-oxides) along fractures. Some are iddingsitized. Unfractured olivine cores are unaltered.

Veins: none
Fractures: weakly fractured: 13/9 ft

Additional comments:
Feature "A" is an altered olivine-clinopyroxene crystal clot. Feature "B" is a clinopyroxene-olivine crystal clot in a feldspathic matrix. Features labeled "D" are two zones of highly vesicular lava. Vesicles are small (1-2 mm) and round.
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R -) (continuous with previous box)
- Bottom (ft): (R 77-5.0-357.3) (flow contact)

**Highly vesicular zone and ropy textures define flow bottom**

**Unit type:** massive

**Phenocrysts/Clasts:**
- olivine >10% - 1-5 mm - equant to blocky  
  - point counts: 18% at R76-4.6, 15% at R77-4.7  
  - Some grains are partially iddingsitized. Some grains are up to 10 mm in longest dimension.

**Groundmass/Matrix:** microcrystalline

**Color:**  
**Vesicles:** 5-20% - 1-10 mm - subrounded to subangular - equant  
- There appear to be two generations of vesicles - in zone "A" (see photo) highly sheared vesicles are adjacent to subrounded ones. Vesicle surfaces have red (Fe-oxide) coatings.

**Alteration:** see comments
- Groundmass has reddish tint (oxidation?); more noticeable in the zones that contain abundant <1 mm vesicles.

**Veins:** none

**Fractures:** weakly fractured: 9/6.3 ft

**Additional comments:**
- "B" = zone where elongate vesicles define a circular flow pattern; rare gabbroic inclusions, open-textured.

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### BOX UNIT 2: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 78-0.0-357.5) (flow contact)
- Bottom (ft): (R -) (continuous with next box)

**flow top defined by highly oxidized and vesicular material (scoriaceous)**

**Unit type:** transitional

**Phenocrysts/Clasts:**
- olivine >10% - 2-4 mm - equant to blocky  
  - point counts: 20% at R78-2.0; in cross-section olivines are partially (rimmed) to completely oxidized. Material is dull black - MnO (?).

**Groundmass/Matrix:** microcrystalline

**Color:**  
**Vesicles:** >30% - <1 mm - sub-rounded - equant to elongate

**Alteration:** highly (40-80% altered) - oxidized

**Veins:** none

**Fractures:** zone is rubbly

**Additional comments:**
- rare gabbroic inclusions
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): [R --] (continuous with previous box)
Bottom (ft): [R --] (continuous with next box)
This box contains 2 flows (F1 and F2), with F1 in this box from R78-2.1 to a flow contact at R78-4.8. F2 is from R78-4.8 to end of box. The flow contact dips at 30° and is irregular.

Unit type: transitional
F1 is scoriaceous. F2 is highly vesicular in the upper portion of the flow to massive.

Phenocrysts/Clasts:
highly phyric (>10%)
- olivine (>10% - 1-5 mm - equant to blocky - iddingsite (minor)
- Three point counts of 100 points each at 1, 2, and 3 on photo, gave modes of 15, 18, and 20%, respectively. Fractures on olivine are coated with a black, iridescent material (Mn-oxide?).

Groundmass/Matrix: microcrystalline

Color: N4 med. gray. Scoria fragments are 5YR 3/4 pale red. - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - sub-rounded to sub-angular - horizontally elongated to equant -
Size variation: 1 to 40 mm.
Alteration: fresh (<2% altered) in massive zone; highly-oxidized (40-80% altered) in scoriaceous -
Veins: none
Fractures: weakly fractured: 3/9.4 ft

Additional comments:
There are 2 flows in this box. Flow 1 is highly oxidized and scoriaceous and continuous with Box 55, ending at Run 78+4.8' (Zone C on photo). Flow 2 consists of an uppermost 0.6' of oxidized material and is continuous to the end of the box. Feature "A" is a clinopyroxene-olivine-plagioclase xenolith. Feature "B" is a fragment (4 cm long) of a highly vesicular olivine basalt incorporated into this flow.
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R ----)(continuous with previous box)
Bottom (ft): (R ----)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine: >10% 1-5 mm equant to blocky
- Two point counts of 100 points each gave an average mode of 15% olivine phenocrysts.

Groundmass/Matrix: microcrystalline
Color: med. dark gray
Structures: Sorting:
Vesicles: <5% 1-5 mm spherical
- Irregular, some to 2 cm between R80+2.0 to 3.0.
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured, thin (<1 mm) zone of alteration along fracture
Additional comments:
- NaCl ppt on dry core

UNIT # 15

Cores in box
80
81
82

Loggers: MG
Date logged: 11/4/93
Checked by: MG
Check date: 11/4/93

Driller's depth: top [feet]: 368.4
Driller's depth: bottom [feet]: 377.6
Core type: HQ

Units in box: 1

BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R ----)(continuous with previous box)
Bottom (ft): (R ----)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine: >10% 1-5 mm equant to blocky
- Two point counts of 100 points each gave an average mode of 15% olivine phenocrysts.

Groundmass/Matrix: microcrystalline
Color: med. dark gray
Structures: Sorting:
Vesicles: <5% 1-5 mm spherical
- Irregular, some to 2 cm between R80+2.0 to 3.0.
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured, thin (<1 mm) zone of alteration along fracture
Additional comments:
- NaCl ppt on dry core
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top: (T); R - -(continuous with previous box)
Bottom: (B); R - -(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - >10% - 1-5 mm - equant to blocky
- approx. 30% olivine, based on modes of 29 and 32/100

Groundmass/Matrix: microcrystalline

Color: med. dark gray - Structures: - Sorting:

Vesicles: <5% - 1-5 mm - spherical to irregular
- two populations: one large (2-3 mm), one small (<1 mm)

Alteration: slightly (2-10% altered) - clay along fractures
- Oxidation in small vesicles.

Veins: none

Fractures: weakly fractured

Additional comments:
- NaCl ppt on dry core. A = large open vug with inward radiating plagioclase crystals.
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (R); Continuous with previous box
Bottom (L): Continuous with next box

Unit type: massive
Phenocrysts/Clasts:
- Highly phyric (>10%)
- Olivine: >10% - 1-5 mm - equant to blocky - Mn-oxide? fracture coating
  Two point counts of 100 points gave modes of 14% and 17%.

Groundmass/Matrix: Microcrystalline
Color: N3 dark gray - Structures: - Sorting: -

Vesicles: see below - - -
  Two sections annotated on photo: Zone "B" contains <1% vesicles; Zone "C" contains 5-10% vesicles, subrounded, horizontally elongate.
Alteration: Slightly (2-10% altered) - Mn- and Fe-oxides weathered and oxidized
Veins: None
Fractures: Weakly fractured: 7/9 ft

Additional comments:
  Feature "A" is an olivine-plagioclase xenolith. NaCl ppt on dried core surface.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (T): (R --'X)(continuous with previous box)
Bottom (B): (R--')(continuous with next box)

Internal flow contact at Run 86+0.4' (398'). Thin scoria (5 cm) and red oxidized zone (ca. 80 cm thick).

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine (>10%) - 1-5 mm - equant to blocky - Mn?-oxide fracture coating

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting: -
Vesicles: Base of upper flow (F1) is vesicle-poor <5%. Top of lower flow (F2) is 10-12% vesicles, subrounded, 2-4 mm diameter.
Alteration: oxidation over top 2.7' of F2 - Fe-oxides
Veins: none

Additional comments:
- This unit contains 2 flows with contact at 398'. NaCl ppt on dried core surfaces.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine - 2-10% -- >2-3 mm -- 
    - two populations; more abundant small, equant and less abundant large, blocky; counted 6 and 10/100

Groundmass/Matrix: fine-grained (<1 mm)

Color: med. gray - Structures: - Sorting: -

Vesicles: >30% - 1-5 mm - sub-rounded - horizontally elongated -
abundance variable; some zones 2-5 cm wide are weakly vesicular (~5%) marked on photo as A.

Alteration: slightly (2-10% altered)

Fractures: weakly fractured: 15/8 ft; clay-like material concentrated along fractures and in vesicles in highly vesicular zones

Veins: none

Additional comments:
NaCl ppt; rare, small (3-6 mm) olivine-plagioclase-clinopyroxene and olivine-clinopyroxene inclusions (not open-textured).

Loggers: MG
Date logged: 11/4/93
Checked by: BM
Check date: 11/5/93

Driller's depth: top [feet]: 404.5
Driller's depth: bottom [feet]: 414.7
Core type: HQ
Units in box: 1

Cores in box
87
88
89

Box #:
61

61
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R--)(continuous with previous box)
Bottom (ft): (R--)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) —
olivine — 10-12% — 1-5 mm — equant to blocky —
counted 10 and 12/100; two populations; small and large

Groundmass/Matrix: fine-grained (<1 mm) —
Color: med. gray — Structures: — Sorting: —
Vesicles: 20-30% — 1-5 mm — sub-rounded — equant —
variable; >30% to 10-20%; some vesicles are interconnected and have a diameter of 20 mm
Alteration: fresh (<2% altered) —
Fractures: weakly to moderately fractured; 4/2 ft to 14/2 ft
Additional comments:
NaCl ppt on core surface
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (R): continuous with previous box
          Bottom (R): continuous with next box

Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 6-10% - 1-5 mm - equant to blocky
  - two point counts: 6 and 8/100
Groundmass/Matrix: microcrystalline
Color: med. gray
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant -
  variable; zones of highly (>30%) and moderately to weakly (5-10 %); more vesicular near bottom of box
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly in upper part; moderately at base of box
Additional comments:
  - A = bands of darker, horizontally elongate, large vesicles
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R 93-4.8-436.8')(continuous with previous box)
Bottom (ft): (R 93-4.8-436.8')(flow contact)

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly olivine (>10%)
- olivine ~30% - 1-5 mm - equant to acicular - counted 30/100; elongate or acicular shapes present

Groundmass/Matrix: microcrystalline

Color: med. gray - Structures: Sorting: Vesicles: 20-30% - 1-5 mm - spherical - equant - highest at flow top; decreasing downward

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly; 4/3 ft starting 1 ft below flow top

Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 93-4.8-436.8')(flow)
Bottom (ft): (R 93-4.8-436.8')(continuous with next box)

Unit type: pahoehoe

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine 2-10% - 1-5 mm - equant to blocky - counted 7 and 9/100

Groundmass/Matrix: microcrystalline

Color: med. gray - Structures: Sorting: Vesicles: 20-30% - 1-5 mm - spherical - equant - highest at flow top; decreasing downward

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly down to 3 ft from base of box then moderately; clay-like material along some fractures

Additional comments:
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R--')(continuous with next box)

**Unit type:** pahoehoe to massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine: >10% - 1-5 mm - see below
  - One point count of 100 points gave a mode of 18%; from 442-449' the shape of the olivine varies from acicular to equant, while from 449-451.5' (cumulate zone?) acicular crystals are no longer evident and the shape varies from equant to blocky; size variance of single grains <1 to 6 mm; olivine crystal clots occur in cumulate zone.

**Groundmass/Matrix:** microcrystalline

**Color:** 5Y 4/1 olive gray

**Vesicles:** 10-20% - 1-5 mm - sub-angular - equant

**Alteration:** fresh (<2% altered)

**Fractures:** weakly: 4/9 ft

**Additional comments:**
- There is a transition from acicular to equant olivine basalt to equant to blocky olivine basalt at ~449'. The latter portion of this box may be a cumulate zone.
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R--')(continuous with previous box)
- Bottom (ft): (R--')(continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine ~30% - 1-5 mm - equant to blocky
- acicular grains begin at R97-4.0'

**Groundmass/Matrix:** microcrystalline

**Color:** 5Y 4/1 olive gray

**Structures:**
- Vesicles: 10-20% - 1-5 mm - sub-rounded - equant - variable; < 5% to 10-15%
- Alteration: fresh (<2% altered)
- Veins:
- Fractures: weakly: 4/6 ft

**Additional comments:**
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R 100-3.9-471.0')(flow contact)

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%) —
olivine — ~ 30% — 1-5 mm — equant to blocky —
acicular elongate grains common

Groundmass/Matrix: microcrystalline —

Color: med. gray — Structures: — Sorting: —
Vesicles: 10-20% — 1-5 mm — sub-rounded — horizontally elongated—
acicular hematite at box top
dark zones 2-4 cm wide of large vesicles with vapor-phase mineral growth

Alteration: fresh (<2% altered) —
Veins: none
Fractures: weakly — red stain on 1 fracture

Additional comments:
platy to acicular, white mineral in vugs
BOX UNIT 1: moderately to highly olivine phryic basalt

Contacts:
- Top (T): (R 100-3.9-471.0') (flow contact)
- Bottom (B): (R--') (continuous with next box)

Top of flow at top of box is highly scoriaceous and oxidized

Unit type: pahoehoe?

Phenocrysts/Clasts:
- Highly phryic (>10%)
- Olivine - >10% - 2-4 mm - equant to acicular

Two point counts of 100 points gave 13 and 9%. Size range: 1-5 mm.

Groundmass/Matrix: microcrystalline

Color: 5Y 4/1 olive gray

Vesicles: 5-20% - 1-5 mm - sub-rounded to sub-angular - equant

Acicular hematite

Size and % decrease down section to R102-1.5 and then gradually increase.

Alteration: slightly (2-10% altered)

Mn-oxides along fractures. Upper 2.5' of core is oxidized (with clay coating).

Veins:

Fractures: weakly; 4/10'

Additional comments:
- Feature "A" is an olivine-plagioclase clot.
<table>
<thead>
<tr>
<th>Box #:</th>
<th>Cores in box</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>102</td>
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<td>MG</td>
</tr>
<tr>
<td>Check date:</td>
<td>11/10/93</td>
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<th>Driller's depth:top [feet]:</th>
<th>480.5</th>
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<tbody>
<tr>
<td>Driller's depth:bottom [feet]:</td>
<td>489.6</td>
</tr>
<tr>
<td>Core type:</td>
<td>HQ</td>
</tr>
</tbody>
</table>

BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (tl): (R--)(continuous with previous box) Bottom (bl): (R--)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - >10% - 1-5 mm - acicular to equant - Mn-oxide along fractures
- One point count of 100 points gave a mode of 16%.

Groundmass/Matrix: microcrystalline

Color: 5Y 4/1 olive gray - Structures: - Sorting: -

Vesicles: see below -
- Two zones noted on photo.
  - Zone "B:" from R102-3.4' to R103-0.4': 10-20%, subangular, randomly elongate; zone "C" from R103-0.4' to end of box: <5% vesicles.

Alteration: slightly (2-10% altered)

Veins:

Fractures: weakly fractured: 5/9 It

Additional comments:
- Feature "A" is an olivine-clinoxyroxene crystal clot.
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R--) (continuous with previous box)
Bottom (ft): (R--) (continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - >10% - 1-5 mm - equant to tabular - counted 23 olivine grains per 100 grid points

Groundmass/Matrix: fine-grained (<1 mm)
Color: 5Y 4/1 olive gray

Vesicles: <5% - 1-5 mm - spherical - equant - percentage of vesicles increases towards bottom of box
Alteration: fresh (<2% altered)
Veins:
Fractures: very weakly: 3/10 ft

Additional comments:
- olivine-clinopyroxene inclusions throughout

Box #: 70
Cores in box: 104 105 106

Driller's depth: top [feet]: 489.6
Driller's depth: bottom [feet]: 499.6
Core type: HQ

Units in box: 1
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R 107-0.7-502.7') (flow contact)
Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine -- >10% -- 2-5 mm -- equant to blocky
- Point count: 16% at R106-3.6. Ollivines contain spinel inclusions and are present in crystal clots.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray
Structures: -- Sorting: --
Vesicles: 5-10% -- 2-4 mm -- rounded to subrounded -- equant
- Rare vesicles > 5 mm. Vesicle size decreases and the vesicles become more angular toward flow bottom. Large pipe vesicle near base (R106-4.5). Counts of 5, 7/100.
Alteration: fresh (<2% altered)
Fractures: weakly fractured: 5/3.1 ft
Additional comments: Within this unit are thin (<0.5 mm) horizontal white laminations, see region circled "A" on photo. This unit infills the vesicles in the basalt unit below it.

UNIT #: 17

UNIT #: 18

BOX UNIT 2: fine-grained highly weathered volcanic ash
Contacts: Top (ft): (R 107-0.7-502.7') (flow contact)
Bottom (ft): (R 107-0.7-502.7') (depositional)
Unit type: ash(?)
Phenocrysts/Clasts:
- material appears to be highly weathered

Groundmass/Matrix: silt/clay (<0.125 mm)
Color: -- Structures: unbedded -- Sorting: well-sorted
Vesicles: --
Alteration: very highly (80-95% altered) -- clay
Veins: --
Fractures: --
Additional comments:

BOX 71 CONTINUED ON NEXT PAGE
Box #: 71

Cores in box
106
107
108

Logs:
MBB

Date logged:
11/17/93

Checked by:
MG

Check date:
11/10/93

Driller's depth: top [feet]: 499.6

Driller's depth: bottom [feet]: 508.9

Core type: HQ

Units in box: 3

BOX UNIT 3: aphyric basalt
Contacts: Top (ft): (R 107-0.7-502.7')(flow contact)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%)
olivine <1% <1 mm equant

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N4 medium dark gray Structures:
Vesicles: see comments

Just below contact, vesicles constitute 30-50% of the rock, are ≤1 mm in size and are subrounded to subangular with white-pink coatings on vesicle surfaces; some of the vesicles are filled with material from the ash(? layer above. Below R107-4.0, vesicles constitute 10-15% of the rock, are ~5 mm in size and are subrounded and are subhorizontally elongate.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 10/6.2 ft

Additional comments:
NaCl ppt; groundmass has abundant small angular vesicles often bounded by plagioclase laths
BOX UNIT 1: aphyric basalt
Contacts: Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R 108-8.5-515.7')(flow contact)
ropy pahoehoe surface on base of flow (R108-8.5) with red oxidized highly vesicular zone beneath, but no pronounced lithology change
Unit type: massive
pahoehoe type bottom surface
Phenocrysts/Clasts:
aphyric (<1%)
olivine — <1% — <1 mm — blocky (<3:1:1) —

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) — fine grained tabular crystals in a microcrystalline matrix
Color: N3 dark gray — Structures: — Sorting: —
Vesicles: 20-30% — <1 mm — rounded — equant—
Large (up to 10 mm) rounded vesicles present from R108-1.3 to 4.4. From 4.4-7.4, small vesicles described above. From 7.4 to base, highly vesicular (up to 40%) with sub-mm spherical vesicles.
Alteration: fresh (<2% altered) —
Veins: none
Fractures: weakly fractured 0-40°, red-yellow coating of some fractures
Additional comments: A=ropy bottom of unit 1; NaCl ppt

BOX UNIT 2: aphyric basalt
Contacts: Top (ft): (R 108-8.5-515.7')(flow contact)
Bottom (ft): (R --)(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%)

Groundmass/Matrix: microcrystalline —
Color: N4 medium gray to 5YR 4/1 brownish gray— Structures: — Sorting: —
Vesicles: >30% — 1-5 mm — rounded — horizontally elongated—
37% point count at R109-0.6. Vesicles become larger with depth.
Alteration: fresh (<2% altered) —
red oxidation at flow top, decreasing with depth
Veins: none
Fractures: weakly fractured below vesicular oxidized zone at top of flow
Additional comments:
**BOX UNIT 1**: aphyric basalt

Contacts: Top (ft): (R--)(continuous with previous box)  
Bottom (ft): (R--)(continuous with next box)  
Unit type: massive  
This is an interior section of an approx. 20' thick aa flow.

Phenocrysts/Clasts:  
aphyric (<1%)  

Groundmass/Matrix: fine-grained (<1 mm) - <1 mm long tabular elongate feldspar crystals dominate visible groundmass  

Color: N4 mod. dark gray - Structures: Sorting:  
Vesicles: variable  
rhombic/platy, white to dark red crystals  
10-20% vesicles from R109+1.3' to R109+5.3' which are spherical, subrounded, 5-10 mm diameter, equant; from R109-5.3 to base there are <5% vesicles, 1-5 mm diameter. Some horizontal, vesicle-rich zones are present.  
Alteration: fresh (<2% altered)  
Fractures: none  
Veins: none  
Additional comments:  
NaCl ppt  

---

**UNIT #20**

**Contacts**: Top (ft): (R--)(continuous with previous box)  
Bottom (ft): (R--)(continuous with next box)  
Unit type: massive  
This is an interior section of an approx. 20' thick aa flow.

Phenocrysts/Clasts:  
aphyric (<1%)  

Groundmass/Matrix: fine-grained (<1 mm) - <1 mm long tabular elongate feldspar crystals dominate visible groundmass  

Color: N4 mod. dark gray - Structures: Sorting:  
Vesicles: variable  
rhombic/platy, white to dark red crystals  
10-20% vesicles from R109+1.3' to R109+5.3' which are spherical, subrounded, 5-10 mm diameter, equant; from R109-5.3 to base there are <5% vesicles, 1-5 mm diameter. Some horizontal, vesicle-rich zones are present.  
Alteration: fresh (<2% altered)  
Fractures: none  
Veins: none  
Additional comments:  
NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts: Top (It): (R --')(continuous with previous box)
Bottom (It): (R 110-9.7-536.9') (flow contact)

transitional from massive unit to pahoehoe flow bottom

Unit type: Pahoehoe

Phenocrysts/Clasts:
aphyric (<1%) -

Groundmass/Matrix: fine-grained (<1 mm)

Color: N3 dark gray - Structures: - Sorting: -

Vesicles: 20-30% - 1 mm - spherical - equant -

One point count of 100 points gave a mode for vesicles of 30%.

Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 8/9 ft

Additional comments:
NaCl ppt
BOX UNIT 1: aphyrhic basalt

Contacts: Top (ft): (R 110-9.7-536.9'')(flow contact)
          Bottom (ft): (R--)(continuous with next box)

Pahoehoe surface textures and -1 cm thick reddish oxidized zone define contact. Unit appears to be very similar to unit directly above it (R110-9.0 to bottom of box).

Unit type: massive
Phenocrysts/Clasts:
aphyrhic (<1%) -
olivine - <1% - <1 mm - equant -
- - - -

Groundmass/Matrix: microcrystalline -
Color: - Structures: - Sorting: -

Vesicles: 20-30% - 1-2 mm - sub-rounded - equant to elongate -

Vesicles are homogeneously distributed throughout section in Box 75; they are also uniform in size. In more fractured/rubbly zones, the vesicles have an ivory colored coating.

Alteration: fresh (<2% altered) -
Veins: none
Fractures: Fracturing varies from weakly to highly (i.e., the rubbly zones).
Additional comments:
See photo: “A” = zone of ropy surface textures and -1 cm oxidation front. “B” = ropy surface textures (internal flow contact). “C” = rubbly zone with pieces that display a more “glassy”, i.e., cryptocrystalline surfaces. Groundmass has abundant small angular vesicles often bounded by plagioclase laths.
BOX 76 CONTINUED ON NEXT PAGE
**Box #:**

<table>
<thead>
<tr>
<th>Cores in box</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
</tr>
<tr>
<td>111</td>
</tr>
<tr>
<td>112</td>
</tr>
<tr>
<td>113</td>
</tr>
</tbody>
</table>

**CONTACTS:**
Top (ft): (R 113-0.3-564.3') (depositional)
Bottom (ft): (R--) (continuous with next box)
Top of unit at R113-0.3 to 0.5

**Phenocrysts/Clasts:**
aphyric (<1%) -

**Groundmass/Matrix:** microcrystalline -

**Color:** N5 medium gray -

**Structures:** -

**Sorting:** -

**Vesicles:** 20-30% - 1-5 mm - sub-rounded - irregular to equant to elongate - soft white material partially infilling some vesicles, especially near upper contact.

**Alteration:** fresh (<2% altered) -

**Veins:** none

**Fractures:** weak to moderate, soft white-yellow coating

**Additional comments:**
Probable internal flow contact at R113-1.0 (glassy contact); (brown horizontal band with >50% sub-mm vesicles). Alteration becomes progressively greater towards upper contact.

**UNITS:**

**UNIT # 23**

**Loggers:** JCL
**Date logged:** 11/7/93
**Checked by:** MG
**Check date:** 11/10/93

**Driller's depth:**
**Top [feet]:** 545.7
**Bottom [feet]:** 565.6

**Core type:** HQ

**Units in box:** 3

**Driller's depth:**
**Top [feet]:** 545.7
**Bottom [feet]:** 565.6

**Core type:** HQ

**Units in box:** 3
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R:--)(continuous with previous box)
Bottom (ft): (R:--)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - <1 mm - equant

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: NS medium gray - Structures: - Sorting: -

Vesicles: see comments -

Percentage of vesicles varies from 10-20% to <5%; vesicle size lies in the range 1-5 mm. Vesicles are rounded to subrounded, equant to elongate (random orientation). At R113-7.0, vesicles are filled with a white/yellow clay(?) material.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 17.8 ft

Additional comments:
See photo: "A" = regions of filamentous coatings (biological?) on fractures. "B" = zone of ropy surface textures, probably an internal flow contact (glassy surface). "C" = internal quench zone. Groundmass has abundant small angular vesicles often bounded by plagioclase laths.
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R -÷)(continuous with previous box)
Bottom (ft): (R ÷)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%) –

Groundmass/Matrix: fine-grained (<1 mm) to microcrystalline – feldspars are tabular elongate


Vesicles: see below – 1-5 mm – spherical to sub-angular – equant to horizontal elongate –
vesicle abundance varies from <5 to >30% (see photo)

Alteration: fresh (<2% altered) –

Veins:
Fractures: weakly fractured: 12/9 ft

Additional comments:
NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R -->) (continuous with previous box)
Bottom (ft): (R -->) (continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%) –

Groundmass/Matrix: fine-grained (<1 mm) to microcrystalline – feldspars are tabular elongate
Color: N3 to N4, med. to dark gray – Structures: – Sorting: –
Vesicles: <5% to 20-30% – <1 mm – sub-rounded to sub-angular –
Max. size: 30 mm. Possible pipe vesicles (see photo), infilled with very fine grained basalt with a distinct population of vesicles.
Alteration: fresh (<2% altered) –
Veins: –
Fractures: 9/10 ft. Some fractures lined with white to buff colored clay-like material.
Additional comments:
NaCl ppt
**BOX UNIT 1:** aphyric basalt  
**Contacts:** Top (II): (R --') continuous with previous box  
Bottom (II): (R116-0.3-594.3') (flow contact)  
A thin (~1 mm) quench zone exists at the contact with ash (?) layer.  
**Unit type:** massive  
**Phenocrysts/Clasts:**  
aphyric (~1%)  
-  
-  
-  
**Groundmass/Matrix:** microcrystalline  
**Color:** N5 medium gray  
**Structures:** -  
**Sorting:** -  
**Vesicles:** 5-10%  
1-3 mm  
rounded to subrounded  
Rare large (>20 mm) subrounded and elongate vesicles. Angular <1 mm vesicles present in groundmass.  
**Alteration:** fresh (<2% altered)  
**Veins:** none  
**Fractures:** weakly fractured  
**Additional comments:**

**BOX UNIT 2:** weathered volcanic ash/silt  
**Contacts:** Top (II): (R 116-0.3-594.3') (flow contact)  
Bottom (II): (R116-4.1-598.1') (depositional)  
**Unit type:** ash  
**Phenocrysts/Clasts:**  
<10% volcanic fragments  
volcanic clasts  
2-10%  
1-10 mm  
sub-angular  
clay  
distribution is quite variable  
-  
-  
-  
**Groundmass/Matrix:** silt/clay (<0.125 mm)  
**Color:** -  
**Structures:** -  
**Sorting:** varies from well sorted to poorly sorted  
**Vesicles:** -  
-  
-  
**Alteration:** very highly (80-95% altered)  
**Veins:** none  
**Fractures:** none  
**Additional comments:** See photo: "A" = zone of angular lithic (5-1 mm): some altered and partially altered olivine. "B" = zone of flattened highly altered pumice(?). Different colored angular clasts of fine-grained material are interspersed within this unit. Chocolate-brown, organic smelling clay. JPL Comments, 11-23-93: This box contains core which samples approx. 5.1 ft of "Pahala Ash" in R116-0.9-1.8. Classic base surge lithic debris is cored. This is composed of fines and depleted angular to sub-angular lithic clasts to 8 mm size. This surge material was almost certainly derived from a huge explosive phreatomagmatic eruption at Kilauea ~40 km away. Chemistry of lithic clasts should prove distinctive. This unit possibly correlates with an anomalous deposit of base surge deposits ~20 km to the SSE at Waio'ahu (sp?) Quarry. The age of this deposit was known to be only ~10 ka in age. The 2.4' directly underlying the surge deposit is composed of organic rich "Pahala Ash" that has been highly disturbed. It looks as if it may have been deposited in a stagnant bog. A 14C AMS date will very likely be possible from this horizon - which will give a maximum age for the surge deposits and will fix a time horizon at this critical zone at ~595' depth. GPLW comment: top foot of unit looks like hydrovolcanic "lalagonite" tuff; next foot ("A"+"B" above) described as "lithic-rich pyroclastic (littoral cone?)", "the bed with the angular lithics is reminiscent of such beds in the Pu'u Kila littoral cone on the SW coast of Mauna Loa."
BOX UNIT 3: aphyric basalt

Contacts: Top (ft): (R 116-4.1-598.1') (depositional)
Bottom (ft): (R 116-5.1-599.1') (flow contact)

Thin (<5 mm) quench zones are present at top and bottom contact. Material at the bottom contact looks cryptocrystalline.

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - <1 mm - equant -

Groundmass/Matrix: microcrystalline -
Color: - Structures: - Sorting: -
Vesicles: - - 20-30% - 1-3 mm - rounded - equant to elongate -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: see description to unit 1
Additional comments: This flow seems out of place within soil/ash unit.

GPLW comment: “hyaloclastite”

BOX UNIT 4: highly weathered volcanic ash/soil

Contacts: Top (ft): (R 116-5.1-599.1') (flow contact)
Bottom (ft): (R 116-6.0-600.0') (depositional)

Unit type: massive

Phenocrysts/Clasts:

Groundmass/Matrix: microcrystalline -
Color: - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - rounded - equant to elongate -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: see description to unit 1
Additional comments: see unit 2 for a description

GPLW comment: “hyaloclastite”

BOX 80 CONTINUED ON NEXT PAGE
BOX UNIT 5: aphyric basalt

Contacts: Top (ft): (R 116-6.0-600.0')(flow contact)
Bottom (ft): (R--')(continuous with next box)
Faint glassy top

Unit type: pahoehoe
strongly vesicular top

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - <1 mm - equant

Groundmass/Matrix: microcrystalline
Color: N4 dark gray
Vesicles: 10-20% - 2-3 mm - rounded to subrounded - equant to elongate
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 5/2 ft
Additional comments:
Unit looks very similar to unit 3.
**BOX UNIT 1: aphyric basalt**

Contacts: Top (ft): (R -7-; continuous with previous box)
Bottom (ft): (R117-4.0-608.2') (flow contact)

Unit type: pahoehoe?

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 2-3 mm - equant

Point count of 100 grains at base of flow gave a mode of 1%.

Groundmass/Matrix: medium-grained (1-5 mm) - plagioclase

Color: N4 dark gray - Structures: - Sorting:

Vesicles: 10-20% - 1-3 mm - spherical - equant

Point counting of 100 points near base of flow gave a mode of 17%.

Alteration: -

Veins: none

Fractures: weakly fractured: 10/7 ft

Additional comments:

**BOX UNIT 2: moderately olivine phyric basalt**

Contacts: Top (ft): (R 117-4.0-608.2') (flow contact)
Bottom (ft): (R-7-; continuous with next box)

Unit type: aa?

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 2-10% - 3-5 mm - see below

Grains range from acicular to equant to blocky. Point counting of 100 points gave a mode of 7%; intergrown with plagioclase

Groundmass/Matrix: microcrystalline

Color: N3 to N4, med. to dk. gray - Structures: - Sorting:

Vesicles: 10-20% - <1 mm to 10 mm - sub-rounded - horizontally elongated

Point counting of 100 points gave a mode of 18%.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured

Additional comments:

Feature "A" is a block of highly vesicular material (possible clinker fragment?). This unit is the beginning of a distinctive basalt which contains acicular olivine. A similar unit has been logged uphole from ca. 440' and 470-480'.
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R --)(continuous with previous box)
           Bottom (ft): (R--)(continuous with next box)
Unit type: aa?
           contains acicular olivines
Phenocrysts/Clasts:
    highly phyric (>10%)
    olivine — >10% — 1-5 mm — see below — Mn-oxides along fractures
    One point count of 100 points gave a mode of 11%; abundant acicular grains.

Groundmass/Matrix: microcrystalline
Color: 5Y 6/1 light olive gray to olive gray — Structures: — Sorting: —
Vesicles: <5% — 1-2 mm — sub-angular — randomly elongated —
    10 cm thick oxidized zone has 10-20% vesicles at R120-3.5
Alteration: slightly (2-10% altered) — Fe- and Mn-oxides
Veins: none
Fractures: Weakly to moderately fractured: 20/5 ft. Fractures lined with white to buff-colored clay-like material
Additional comments:
    NaCl ppt; rubby, weathered top R119-0.0

Loggers: BM
Date logged: 11/7/93
Checked by: MG
Check date: 11/11/93

Driller's depth: top [feet]: 611.0
Driller's depth: bottom [feet]: 622.1
Core type: HQ
Units in box: 1
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine - 2-10% - 1-5 mm - blocky (<3:1:1) - iddingsite(?)
  - 9% point count at R120-9.2, 7% at R121-5.0. Abundant acicular (1-5 mm) olivines not included in count. Red alteration of olivines along grain boundaries and fractures.

Groundmass/Matrix: microcrystalline

Color: 5YR 4/1 brownish gray

Vesicles: 2-25% - 1-5 mm - irregular
Range from 20-25% at top of box down to <2% at bottom of box. Irregular subhorizontal striations suggestive of collapsed vesicles. Larger vesicles are generally sub-horizontally elongate.

Alteration: fresh (<2% altered)
- red oxidation, decreasing with depth

Fractures: weakly fractured with soft white-yellow rind on some

Additional comments:
- Color grades from brownish gray (5YR 4/1) at top to light brownish gray/medium light gray at bottom (5YR 6/1 to N6).
**BOX UNIT 1:** moderately phytic olivine basalt

**Contacts:**
- Top (ft): (R 22-5.3-638.8') (flow contact)
- Bottom (ft): (R 122-5.3-638.8') (flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phytic (2-10%)
  - olivine - 2-10% - 1-5 mm - equant
  - Point count: 9% at R122-0.5. Towards the bottom of the flow some olivines have an acicular habit (<1 mm in length). Olivines contain spinel inclusions.

**Groundmass/Matrix:** microcrystalline

**Color:** med. red 5 R 4/6

**Vesicles:** <5% - 1-5 mm - subangular - subvertically elongate

**Alteration:** very highly (80-95% altered) - oxidized

**Veins:** none

**Fractures:** moderately to highly fractured; is close to being a rubbly zone

**Additional comments:**
- See photo: "A" = rubbly zone.

**BOX UNIT 2:** moderately olivine phytic basalt

**Contacts:**
- Top (ft): (R 22-5.3-638.8') (flow contact)
- Bottom (ft): (R --') (continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phytic (2-10%)
  - olivine - 2-10% - 2-4 mm - equant to tabular - iddingsite, MnO(?)
  - point count: 9% (see photo for location); olivines appear completely oxidized

**Groundmass/Matrix:** microcrystalline

**Color:** med. red 5 R 4/6

**Vesicles:** <5% - 1-5 mm - sub-angular - subvertically elongate

**Alteration:** very highly (80-95% altered) - oxidized

**Veins:** none

**Fractures:** moderately to highly fractured; is close to being a rubbly zone

**Additional comments:**
- See photo: "A" = rubbly zone.
BOX UNIT 1: moderately olivine phric basalt

Contacts: Top (ft): (R -->)(continuous with previous box)
Bottom (ft): (R-->)(continuous with next box)

Unit type: a rubbly, reddish, highly weathered top with hunks of olivine

Phenocrysts/Clasts: moderately phric (2-10%)
- olivine - 2-10% - 1-5 mm - blocky (<3:1:1) -
  8% point count at R125-1.0. Abundant acicular microphenocrysts, not included in abundance estimate. Acicular olivines decrease in abundance with depth, becoming rare below R125-0.5. Some olivines altered along rims and fractures to black.

Groundmass/Matrix: microcrystalline

Vesicles: 10-20% - 1-5 mm - irregular - horizontally elongated -
Variable vesicle content ranging from 1% near top to >15%, increasing with depth. Some large vesicles partially infilled with diktytaxitic melt.

Alteration: -

Veins: none

Fractures: Weakly fractured with yellowish-white soft coatings above R125-1.0, diktytaxitic texture along fractures below this. A-veleses and fractures with infilling of platy/acicular crystals.

Additional comments:
Box #: 86

Cores in box:

125
126

Loggers: MBB
Date logged: 11/7/93
Checked by: MG
Check date: 11/11/93

Driller's depth: top [feet]: 652.0
Driller's depth: bottom [feet]: 661.9
Core type: HQ

Units in box: 1

BOX UNIT 1: moderately olivine phyric basalt

Contacts:
Top (ft): (R --) (continuous with previous box)
Bottom (ft): (R --) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%) -
- olivine - 2-10% - 2-4 mm - equant to tabular -

Point count: 7% at R126-6.7. Acicular olivines occur throughout the section in box 86 (not included in point count). Degree of olivine oxidation increases from R126-2.0 to the bottom of the box at -R126-3.0. Towards the bottom some olivines are nearly completely oxidized.

Groundmass/Matrix:
- microcrystalline -
- Color: N6 medium light gray -
- Structures: -
- Sorting: -
- Vesicles: 5-10% - 4-10 nm - subrounded to subangular - elongate -
- rare >20 mm sized vesicles/vugs

Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 7/9.8 ft
Additional comments:
- local vug-filling of plagioclase-olivine vesicular material

UNIT #: 29
<table>
<thead>
<tr>
<th>Box #: 87</th>
<th>Cores in box</th>
<th>Core type: HQ</th>
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<tbody>
<tr>
<td>126</td>
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<td>127</td>
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<table>
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<tr>
<th>Loggers: BM</th>
<th>Driller's depth:top [feet]: 661.9</th>
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<tbody>
<tr>
<td>Date logged: 11/7/93</td>
<td>Driller's depth:bottom [feet]: 671.8</td>
</tr>
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<td>Checked by: MG</td>
<td>Check date: 11/11/93</td>
</tr>
</tbody>
</table>

**Units in box:** 1

**Driller's depth:**
- Top: 661.9 feet
- Bottom: 671.8 feet

**Core type:** HQ

**BOX UNIT 1:** moderately olivine phric basalt

**Contacts:**
- Top (ft): (R--')(continuous with previous box)
- Bottom (ft): (R--')(continuous with next box)

**Unit type:** massive

**Phenocryts/Clasts:**
- moderately phric (2-10%)
- olivine - 2-10% - 1-5 mm -
  - acicular to equant to blocky olivine grains throughout; Mn-oxides and iddingsite alteration products

**Groundmass/Matrix:** microcrystalline -

**Color:** 10R 4/2 grayish red -

**Structures:** -

**Sorting:** -

**Vesicles:** 5-10% - >5 mm - sub-rounded to sub-angular - horizontally elongated -

**Alteration:** slightly to moderately (2-40% altered) -

**Veins:**

**Fractures:** weakly fractured: 12/10 ft

**Additional comments:**
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R 127·5.4-669.8') (flow contact) Bottom (ft): (R 127.6-669.8') (flow contact with weathered zone)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-10% - 1-5 mm - blocky (<3:1:1) -
- 7% by point count. Some grains have white alteration.

Groundmass/Matrix: microcrystalline -

Color: medium dark gray - Structures: - Sorting: -

Vesicles: 4-10% - 1-5 mm - sub-rounded - horizontally elongated - red-brown color

Alteration: fresh (<2% altered) - red-some oxidation

Veins: none

Fractures: none

Additional comments:
- Acicular olivines abundant near base of flow.

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 127-5.4-669.8') (flow contact) Bottom (ft): (R 128-2.6-677.0') (flow contact with weathered zone)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 30-40% - 1-5 mm - blocky (<3:1:1) -
- Olivines highly altered from R128·2.6 to 4.0, become fresher with depth - iddingsitized? Black to red alteration. Point count at R127·5.5 = 37%. Size range 1-10 mm.

Groundmass/Matrix: microcrystalline -

Color: see comments - Structures: - Sorting: -

Vesicles: 1-5 mm - irregular to rounded -

Grades from highly vesicular, horizontally elongate at top and bottom contacts to less vesicular with larger, irregular, equant to vertically elongate in center of unit.

Alteration: moderately (10-40% altered) -

Grades from highly altered at top of unit to less altered interior.

Veins: none

Fractures: weakly fractured with a reddish-white soft coating

Additional comments:
- Color grades from dark reddish brown (10R 3/4) at top contact to lighter grayish red (5R 4/2) with depth.

BOX #:

Cores in box
127
128

Loggers: JCL
Date logged: 11/7/93
Checked by: MG
Check date: 11/11/93

Driller's depth: top [feet]: 671.8
Driller's depth: bottom [feet]: 681.8
Core type: HQ

Units in box: 3
BOX UNIT 3: highly olivine phyric basalt

Contacts:
Top (ft): (R 128-2.6-677.0') (flow contact)
Bottom (ft): (R--) (continuous with next box)
This box contains 2 oxidized zones, possibly reflecting upper surfaces of flows; highly oxidized red rubble zone marks top

Unit type: aa
dinker? zone present

Phenocrysts/Clasts:
highly phyric (>10%)
olivine ~>10% ~ 1-5 mm ~ equant to blocky ~ Mn-coating in fractures
Spinel inclusions in olivine; olivine crystal clots; olivine appears black near weathered flow boundaries.

Groundmass/Matrix:
microcrystalline

Color: N5 med. gray
Structures: -- Sorting: --

Vesicles: -- rounded -- equant--
Varies from <5 to 20-30%, mostly subrounded, equant to horizontally elongate; some pipe vesicles.

Alteration: fresh (<2% altered) -- clay
highly oxidized (1-1.5 ft from flow boundaries

Veins: none
Fractures: weakly fractured

Additional comments:
**Box #:** 89

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Driller's depth:top [feet]:</th>
<th>Date logged:</th>
<th>Driller's depth:bottom [feet]:</th>
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<tr>
<td>128</td>
<td>BM</td>
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<td>11/7/93</td>
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</thead>
<tbody>
<tr>
<td>MG</td>
<td>11/11/93</td>
<td>2</td>
</tr>
</tbody>
</table>

**BOX UNIT 1:** highly olivine phyric basalt

- **Contacts:**
  - Top (ft): (R --')(continuous with previous box)
  - Bottom (ft): (R128 -8.0 -682.4')(Reddish soil marks top of lower flow)

- **Unit type:** aa
  - clinker (?) zone present from R129-1.0'

- **Phenocrysts/Clasts:**
  - highly phyric (>10%)
  - olivine -- >10% -- 1-5 mm -- equant to blocky -- Mnoxide coats fractures
  - Spinels inclusions in olivine; olivine crystal clots; olivine appears black near weathered flow boundaries.

- **Groundmass/Matrix:** microcrystalline

- **Color:** N5 med. gray

- **Structures:**
  - Sorting:

- **Vesicles:**
  - 5-15% -- 2-10 mm -- round to sub-round -- equant

- **Alteration:** slightly (2-10% altered) -- clay

- **Veins:**

- **Fractures:** weakly fractured: 11/9 ft

**Additional comments:**
- There are 2 flows in this box, probably aa. Flow 1 is only 3.6' thick. Flow 2 is 6.5' and continues into next box. NaCl ppt on dry core.

**BOX UNIT 2:** highly olivine phyric basalt

- **Contacts:**
  - Top (ft): (R 128.8-8.0-682.4')(flow contact)
  - Bottom (ft): (R --')(continuous with next)

- **Unit type:** pahoehoe?
  - highly vesicular top; small rounded vesicles

- **Phenocrysts/Clasts:**
  - highly phyric (>10%)
  - olivine -- >10% -- 2-4 mm --
  - multi-grain clots

- **Groundmass/Matrix:** microcrystalline

- **Color:** N5 med. gray

- **Structures:**
  - Sorting:

- **Vesicles:**
  - 5-15% -- 2-10 mm -- round to sub-round -- equant

- **Alteration:** slightly (2-10% altered) -- clay

- **Veins:**

- **Fractures:** weakly fractured (6/3 ft)

**Additional comments:**

**UNIT #: 31**

**UNIT #: 32**
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R-)(continuous with previous box)
Bottom (ft): (R-)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) –
olivine – >10% - 2-5 mm – equant to blocky – minor iddingsite
Point count: 14% at R129-8. Olivines contain spinel inclusions and occur in crystal clots.

Groundmass/Matrix: microcrystalline –
Vesicles: 5-15% – 2-10 mm – rounded to subrounded – equant to elongate (no orientation) –
Alteration: fresh (<2% altered) –
Reddish-brown coating in some of the vesicles and on some of the fracture surfaces.
Veins: none
Fractures: weakly fractured: 25/9.4 ft
Additional comments:
NaCl ppt. “A” = large vug (see photo).
# BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): R -- (continuous with previous box)
- Bottom (ft): R 130-6.1-702.1' (flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly olivine (>10%)
  - olivine >10% - 2-3 mm - equant to tabular - iddingsite
  - Point count: 22% at R130-4.2. Slight oxidation; spinel inclusions present in some olivines.

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray

**Vesicles:** see comments

**Alteration:** fresh (<2% altered)

**Fractures:** weakly fractured

**Additional comments:**
- "A" = highly weathered/oxidized zone at the bottom of the flow. "B" = gradational zone of increasing oxidation/weathering.

---

# BOX UNIT 2: highly olivine phyric basalt

**Contacts:**
- Top (ft): R 130-0.1-702.1' (flow contact)
- Bottom (ft): R 130-0.4-706.4' (flow contact)

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- highly olivine (>10%)
  - olivine >10% - 2-3 mm - equant to tabular - iddingsite
  - Point count: 11% at R130-3.5. Olivines are oxidized near the top and bottom contacts.

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray

**Vesicles:** see comments

**Near the top contact the rock is more than 30% subrounded and elongate vesicles that are <1 mm in size. At center of flow (R130-6.8), >1 cm sized vesicles constitute between 5 and 10% of the rock; they are subrounded and subhorizontally elongate.**

**Alteration:** fresh (<2% altered)

**Fractures:** weakly fractured

**Additional comments:**
- "C" = zone of weathered material/ash (?) infilling a large vug - vesicle size and population does not indicate a flow contact.
Box #: 91
Cores in box:
130
131

Loggers: MBB
Date logged: 11/7/93
Checked by: MG
Check date: 11/12/93

Driller's depth: top [feet]: 700.3
Driller's depth: bottom [feet]: 710.4
Core type: HQ
Units in box: 3

BOX UNIT 3: highly olivine phyric basalt

Contacts:
- Top (ft): (R 130-10.4-706.4') (flow contact)
- Bottom (ft): (R-*) (continuous with next box)

Top contact is somewhat uncertain; oxidized rubble zone with pieces covered with reddish clay(?) material.

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%) -
  - olivine - >10% - 2-3 mm -
    - Point count: 16% at R131-2.1. Near the contact, olivines are iddingsitized and often have MnO(?) coating.

Groundmass/Matrix: microcrystalline -
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm -
Vesicles vary from rounded to highly elongate (flattened).
Alteration: slightly (2-10% altered) - oxidized -
Groundmass has reddish tint.

Veins: none
Fractures: From contact, fracturing varies from high (rubbly zone) to weak.

Additional comments:
- J.P. Lockwood and Frank Trusdell comment, 11/19/93: definite Mauna Loa flow
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (It): (R --')(continuous with previous box)
Bottom (It): (R--')(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - >10% - 1-5 mm - equant to blocky
  - Size varies to 8 mm; counted 13/100.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray
Structures: 
Vesicles: 10-20% - >5 mm - spherical to subrounded - equant-
- clay where fractures intersect vesicles, feldspar
- Large vesicles (up to 6 cm x 3 cm) with secondary basalt liquid infilling. Feldspar in secondary liquid are 1-2 mm long.
- Segregation vesicles.
Alteration: fresh to slightly (<2-10% altered)
- Olivines are black (Mn-oxide coatings?) and matrix material is oxidized.
Veins: none
Fractures: weakly fractured: 3/10 ft; clay infilling of fractures
Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R- -')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine >10% - 1-5 mm - equant to blocky
  - Two point counts of 100 points gave modes of 11 and 14%.

Groundmass/Matrix: microcrystalline

Color: N3 dark gray - Structures: - Sorting: -

Vesicles: <5% - 1-5 mm - spherical - equant -
- Pipe vesicles (horizontally elongate) with feldspar crystals infilling secondary vesicles.

Alteration: fresh (<2% altered) -

Veins: none


Additional comments:
- NaCl ppt
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R -'){(continuous with previous box)
Bottom (ft): (R -'){(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - >10% - 1-5 mm - equant to blocky
    - Spinel inclusions; olivine clots throughout. Counted 24/100.

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting:
Vesicles: <5% - >5 mm - spherical - equant-
Pipe vesicle "A", (3.2' long) extends down axis of core. Feldspar crystals infill vugs.
Alteration: -
Veins:
Fractures: weakly fractured: 6/9 ft
Additional comments:
NaCl ppt

UNIT #:34

Cores in box
133
134

Box #: 94

Loggers: BM
Date logged: 11/8/93
Checked by: MG
Check date: 11/11/93

Driller's depth:top [feet]: 729.3
Driller's depth:bottom [feet]: 738.5
Core type: HQ
Units in box: 1
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R -)(continuous with previous box)
Bottom (ft): (R 134-9.0-745.2')(flow contact)

There are 2 flows with the same lithology in this box. Base of flow 1 (F1) occurs at R134+9.0'. Between F1 and F2, a brown 6" layer of clay-rich weathered basalt is present.

Unit type: massive

Phenocrysts/Clasts:
- highly phric (>10%)
- olivine - >10% - 1-5 mm - equant to blocky
  - Minor Mn-staining of olivine near the base of F1 and top of F2. One point count of 100 points near the base of F1 gave a mode of 14%. Spinel inclusions. Some olivines are multigranular and attain a size of 8 mm.

Groundmass/Matrix: microcrystalline

Color: N3 dark gray

Vesicles: 10-20% - 1-5 mm - sub-rounded to rounded - equant to horizontally elongated

One point count of 100 points near base of F1 gave a mode of 20%.

Alteration: fresh (~2% altered)

Veins: none

Fractures: 4/10 ft. Minor clay development along some fractures.

Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 134-9.0-745.2')(flow contact)
Bottom (ft): (R-')(continuous with next)

Unit type: pahoehoe/vesicular top

Phenocrysts/Clasts:
- highly phric (>10%)
- olivine - >10% - 2-4 mm - equant to blocky

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray

Vesicles: 20-30% - 1-2 mm - spherical - equant

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 1/1 ft

Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R--)(continuous with previous box)  
Bottom (ft): (R 135-7.0-754.0'') (continuous with next box)

This rock at the top of this box is part of a flow continued from Box 95. There is no obvious base contact of this flow before it becomes highly oxidized and weathered.

Unit type: massive

Phenocrysts/Clasts:
  highly phyric (>10%)
  olivine >10% - 1-5 mm - equant to blocky -  
  One point count of 100 points gave a mode of 16%. Olivine crystal clots present.

Groundmass/Matrix: microcrystalline -

Color: N3 dark gray - Structures: Sorting: -

Vesicles: >30% - 1-5 mm - spherical - equant -  
Point count of 100 points gave a mode of 35%.

Alteration: fresh (<2% altered) -

Veins: none

Fractures: weakly fractured: 5/6 ft

Additional comments:
Run 136 had very poor core recovery (2' over 10' core run). Glass at beginning of run 136. Discussion on whether rubbly glassy fragments are submarine in origin. These fragments are within obvious subaerial contacts. Tentative conclusion is subaerial origin for this unit.

GPlFW comment: "palagonitic glass at 749.5 ft [R135-2.5] possibly mark the subaqueous parts of a lava delta" (This zone is marked as "oxidized/weathered zones" on the photograph.)

BOX UNIT 2: hyaloclastite/altered fragmental basalt

Contacts: Top (ft): (R 135-7.0-754.0'') (weathering horizon)  
Bottom (ft): (R--)(continuous with next box)

This logger interprets this unit to be simply a zone of weathering by groundwater. Immediately below this unit is a 27' zone of poor recovery (possibly a fault zone).

Unit type: weathered zone

Weathered "clasts" of basalt, typically poor in vesicle content surrounded by a matrix of clay and Fe-oxides.

Phenocrysts/Clasts:
  highly phyric (>10%)
  olivine >10% - 1-5 mm - equant to blocky - iddingsite, Mn-oxides
  One point count of 100 points gave a mode of 13%.

Groundmass/Matrix: clay and Fe-oxides -

Color: SYR 4/4 moderate brown - Structures: Sorting: -

Vesicles: -

Alteration: -

Veins: -

Fractures: -

Additional comments:
This unit has caused some debate. D. Clague has called it a hyaloclastite, based on his observations of glassy, brecciated volcanic fragments. He has interpreted it to be the basal section of Unit 1 that has flowed into an aqueous body. The extensively developed oxidized, weathered zone in this scenario has occurred in a subaerial environment, requiring either a drop in sea level or uplift of previously subaqueous basalt. This logger has not observed material which can be unequivocally called glass. The dark rims of oxidized/oxidized olivine that have been observed in weathered sections throughout the hole can appear glass-like, and this may be what Clague observed. The weathered olivines in this unit have a mode of 13%, compared to 16% in the overlying unweathered basalt. The "volcanic fragments" appear to be tuff breccia within a more highly oxidized/weathered matrix. In sections which grade in weathering intensity from fresh to weathered it has been observed that sections with few, large vesicles are generally less oxidized/weathered than areas with many, small vesicles.

Tab Matteo and Dave Clague comments, HBO: "looks like fragmental beach, sand and gravel (glassy stuff) deposited by an active lava entry to us! Fragments are all glassy-vesicular with occasional olivine crystals. Also big globular vesicles in some of fragments; glassy seawater in semi-molten fragments off active entry?" 

GPLFW comment: "hyaloclastite at 754-767' and palagonitic glass at 749.5' possibly mark the subaqueous parts of a lava delta"
<table>
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<tr>
<th>Box #:</th>
<th>Cores in box</th>
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<tr>
<td>97</td>
<td>136 139</td>
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<td></td>
<td>137 140</td>
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<td>138 142</td>
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**Loggers:** BM, MG  
**Date logged:** 11/9/93  
**Checked by:** MG  
**Check date:** 11/11/93  
**Driller's depth: top [feet]:** 784.7  
**Driller's depth: bottom [feet]:** 790.0  
**Core type:** HQ  
**Units in box:** 2

**BOX UNIT 1:** hyaloclastite/ altered fragmental basalt  
**Contacts:**  
Top (ft): (R --) (continuous with previous box)  
Bottom (ft): (R 140 -0.0-784.0') (flow contact)
  
**Unit type:** rubble
  
**Phenocrysts/Clasts:**  
highly phyric (<10%)  
olivine > 10% - 1-3 mm - equant to blocky
  
**Groundmass/Matrix:** microcrystalline
  
**Color:** mixed
  
**Structures:** - Sorting: -
  
**Vesicles:** >30% - 1 mm - spherical - equant
  
**Alteration:** moderately (<50% altered)
  
**Veins:** none
  
**Fractures:** rubble
  
**Additional comments:**  
Run 139 contains ropy textures in a highly oxidized, weathered rubble zone. Could the extensive weathering/rubblcy nature from 767-789' be due to drilling of a fault zone. Evidence for this is the highly fractured nature of the core from 789-820.'

**BOX UNIT 2:** moderately olivine phyric basalt  
**Contacts:**  
Top (ft): (R 140-0.0-784.0') (flow top/weathered zone)  
Bottom (ft): (R -) (continuous with next box)
  
**Unit type:** pahoehoe
  
**Phenocrysts/Clasts:**  
moderately phyric (2-10%)  
olivine - 2-10% - 1-5 mm - equant to blocky  
  
**Groundmass/Matrix:** microcrystalline
  
**Color:** N3 dark gray
  
**Structures:** - Sorting: -
  
**Vesicles:** 10-20% - 1 mm - spherical - equant
  
**Alteration:** slightly to moderately (2-40% altered) oxidized along fractures
  
**Veins:** none
  
**Fractures:** Moderately fractured (18/3 ft). Clay and Fe-oxides occur along fractures.
  
**Additional comments:** Glassy flow top at base of R140.
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- moderately to highly phyric (2->10%) -
- olivine - 7-11% - 1-5 mm - equant to blocky -
Point count: 7% at R142-1.5; 11% at R142-8.5. Some olivines contain spinel inclusions.

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 2-4 mm - rounded - equant -
Vesicles are uniformly distributed.
Alteration: fresh (<2% altered) -
Veins: none
Fractures: moderately fractured: 36/8.5 ft
Additional comments:
NaCl ppt
**BOX UNIT 1: moderately olivine phyric basalt**

**Contacts:**
- Top (ft): (R--)(continuous with previous box)
- Bottom (ft): (R--)(continuous with next box)

Brown oxidized rubbly material with possibly some glass from R144-0.0 to R145-1.0, but no lithology change or change in vesicularity.

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phyric (2-10%) –
  - olivine – 6-10% – 2-4 mm – equant to tabular –
  - Point counts at R143-1.6 and R143-3.6 gave 10% and 6%, respectively.

**Groundmass/Matrix:** microcrystalline

**Color:** N5 medium gray

**Vesicles:** 10-20% – 1-2 mm – rounded – equant–
- Slightly vertically to sub-vertically elongate, increasing in size with depth.

**Alteration:**
- Veins: none

**Fractures:** moderately fractured: 32/6.5 ft; subhorizontal and some vertical sets, soft yellowish-white coating

**Additional comments:**
- Glassy rubble (2-4 mm thick) R144-0.0 to R145-0.5. No lithologic change across this zone.
Box #: 100

Cores in box:
- 145
- 146

Loggers: BM
Date logged: 11/9/93
Checked by: MG
Check date: 11/11/93

Driller's depth: top [feet]: 810.0
Driller's depth: bottom [feet]: 819.5
Core type: HQ

Units in box: 1

BOX UNIT 1: moderately olivine phyric basalt
Contacts:
- Top (ft): (R- -) (continuous with previous box)
- Bottom (ft): (R- -) (continuous with next box)

Unit type: massive
Interior of pahoehoe? flow

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-10% - 4-6 mm - equant to blocky
- Olivine clots; point count of 100 points gave a mode of 8%; max. size=10 mm.

Groundmass/Matrix:
- microcrystalline

Color:
- N5 med. gray

Vesicles:
- 10-20% - 1-2 mm - spherical - equant
- counted 12/100 pts

Alteration:
- fresh (<2% altered)

Veins:
- none

Fractures:
- Moderately fractured: 49/9.5 ft. Clay minerals occur as fracture coatings.

Additional comments:
- Top of Run 146—glassy cave material (looks like glassy material at top of Run 145).
### Box 101

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<th>Loggers</th>
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<th>Checked date</th>
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<td>11/9/93</td>
<td>MG</td>
<td>11/11/93</td>
<td>HQ</td>
<td>2</td>
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</table>

#### BOX UNIT 1: moderately olivine phryic basalt
- **Contacts:**
  - Top (ft): (R -2.6-820.1') (continuous with previous box)
  - Bottom (ft): (R 146-2.6-820.1') (flow contact)
- **Bottom contact contains horizontally elongated, sheared vesicles at base of basalt unit; contact itself consists of angular fragments of basalt in a matrix of sandy material.**
- **Unit type:** pahoehoe base
- **Phenocrysts/Clasts:**
  - moderately phryic (2-10%)
  - olivine - 2-10% - 1-5 mm - equant
- **Groundmass/Matrix:** glassy? to microcrystalline
- **Color:** N5 medium gray
- **Sorting:** -
- **Vesicles:** <5% - 1-2 mm - spherical to sub-rounded - equant to horizontally elongated
- **Alteration:** fresh (<2% altered)
- **Fractures:** Weakly to moderately fractured. Clay minerals coating fractures.
- **Additional comments:** Some glassy margins on rock fragments at base.

#### UNIT #37
- **Contacts:**
  - Top (ft): (R 146 -2.6 -820.1') (depositional)
  - Bottom (ft): (R -2.6-820.1') (continuous with next)
- **Unit type:** volcaniclastic sediment
- **Horizontal laminations of light colored sand occur at the top of this unit, and eventually grades down into the lower portion of this unit (undear, EMS).**
- **Phenocrysts/Clasts:**
  - No microfossils observed, however sponge spicules are common. Some calcite.
  - olivine
  - volcanic clasts
  - weathered/altered clasts
  - magnetite
- **Groundmass/Matrix:** sand sized particles
- **Color:** 5YR 3/4 mod. brown
- **Sorting:** bedded (thin) to unbedded
- **Vesicles:** N/A
- **Alteration:** fresh (<2% altered)
- **Veins:** none
- **Fractures:** none

#### BOX UNIT 2: volcaniclastic sand (green)
- **Contacts:**
  - Top (ft): (R 146-2.6-820.1') (continuous with next)
  - Bottom (ft): (R -2.6-820.1') (continuous with next)
- **Unit type:** volcaniclastic sediment
- **Horizontal laminations of light colored sand occur at the top of this unit, and eventually grades down into the lower portion of this unit (undear, EMS).**
- **Phenocrysts/Clasts:**
  - No microfossils observed, however sponge spicules are common. Some calcite.
  - olivine
  - volcanic clasts
  - weathered/altered clasts
  - magnetite
- **Groundmass/Matrix:** sand sized particles
- **Color:** 5YR 3/4 mod. brown
- **Sorting:** well-sorted
- **Vesicles:** N/A
- **Alteration:** fresh (<2% altered)
- **Veins:** none
- **Fractures:** none

#### Additional comments:
- In dried sections of core, a random network of elongated tubular structures were observed, possible worm burrows or bioturbation traces. There are some carbonate grains in this unit, but no microfossils. "Olivine beach."
- GPLW comment: "A sand deposit at 823-846 ft looks like a sand dune deposit and contains what appear to be calcified plant rootlets. [could these be NaCl ppt?]"
BOX UNIT 1: volcaniclastic sand
Contacts: Top (ft): (R ~)(continuous with previous box)
Bottom (ft): (R 149-0.0-847.0')(missing)
1 ft. gap between sand and lava below
Unit type: pahoehoe
Phenocrysts/Clasts: sparsely phryic (1-2%) -
olivine - 1-2% - 1-5 mm - equant -

- Groundmass/Matrix: fine-grained (<1 mm) -
- Color: 5YR 3/4 mod. brown - Structures: unbedded - Sorting: well-sorted -
- Vesicles: - - - -
- Alteration: -
- Veins: none
- Fractures: none
- Additional comments: gray sand beach

BOX UNIT 2: sparsely olivine phyric basalt
Contacts: Top (ft): (R 149-0.0-847.0')(missing)
Bottom (ft): (R 149-3.0-850.0')(depositional)
1 ft. gap between sand and lava below
Unit type: pahoehoe
Phenocrysts/Clasts: sparsely phryic (1-2%) -
olivine - 1-2% - 1-5 mm - equant -

- Groundmass/Matrix: fine-grained (<1 mm) -
- Color: med. gray - Structures: - Sorting: -
- Vesicles: 20-30% - 1-5 mm - spherical - elongate -
- Alteration: fresh (<2% altered) - clay-like material
- Veins:
- Fractures: moderately; 9/1.5 ft
- Additional comments:
  - Internal contacts of sandy material and abundant vesicles.
  - F. Trusdell comments, 11/16/93: as indicated on the photo, the zone from R149-2.7 to 3.0 is identified as part of a complex pyroclastic unit with an upper zone rich in lithic clasts, a middle matrix-supported zone, and a lower, glass rich, clast supported zone, likely related to the soil/ash identified at the top of underlying Unit 40.
BOX UNIT 3: highly olivine phryic basalt

Contacts: Top (ft): (R 149-3.0-850.0') (depositional)
Bottom (ft): (R 150-2.5-855.5') (flow contact)
soil on top

Unit type: massive

Phenocrysts/Clasts:
highly phryic (>10%)
olivine – >10% – 1-5 mm – equant –

Groundmass/Matrix: microcrystalline –
Vesicles: 10-20% – ~1 mm – spherical – equant –
bimodal: ~1 mm and 3-5 mm
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured
Additional comments:
Soil/Ash is 10 YR 4/6 (gray orange).
BOX UNIT 1: weathered ash
Contacts:
Top (ft): (R 150-2.5-855.5') (flow contact)
Bottom (ft): (R 150-3.3-856.3') (depositional)
Unit type: ash
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - <1% - <1 mm - rounded
Concentrated along small vertical cracks - probably incorporated from above ash unit.
voleanic clasts - <1% - <1 mm - rounded
Red to black rounded grains, concentrated along cracks - probably incorporated from above unit. Abundance increases towards upper and lower contacts.

Groundmass/Matrix: silt/clay (<0.125 mm)

Color: 10YR 5/6 pale yellowish orange

Structures: unbedded
Sorting: well-sorted

Vesicles:

Alteration: completely (95-100% altered)
clay

Fractures:

Additional comments:
Sharp rather than gradational contact with underlying flow unit suggests ash deposit rather than soil horizon.

BOX UNIT 2: aphyric basalt
Contacts:
Top (ft): (R 150-3.3-856.3') (depositional)
Bottom (ft): (R 150-4.1-857.1') (flow contact)
Clay-like rubble/soil at base (poor recovery)

Unit type: massive
pahoehoe?

Phenocrysts/Clasts:
ephyric (<1%)
olivine - <1% - <1 mm - equant

Groundmass/Matrix: micocrystalline

Color: N5 medium grey

Structures:
Sorting:

Vesicles: variable - 1-5 mm

Alteration: fresh (<2% altered)

Veins:

Fractures: weakly fractured

Additional comments:

BOX 103 CONTINUED ON NEXT PAGE
BOX UNIT 3: moderately olivine phyric basalt

Contacts:
Top (ft): R 150-4.1 - 857.1 (flow contact)
Bottom (ft): R - (continuous with next box)
soil marks top of unit

Unit type: massive

Phenocrysts/Clasts:
moderately phyric (2-10%) -
olivine - 6-8% - 1-5 mm - blocky (<3:1:1) -
Point count 7/100; red oxidation on smaller grains and along rims of larger grains.

Groundmass/Matrix: microcrystalline -
Color: NS med. gray - Structures: - Sorting: -
Vesicles: variable - 1-5 mm - spherical - equant -
Content ranges from <5% to 20%. Smaller vesicles are equant to sub-vertically elongate. Larger vesicles are irregular to sub-horizontally elongate. Partial gray to orange-yellow infilling above R150-5.0. Vesicle content decreases to <5% below R151-0.0, with some areas containing more vesicles. Striations present from R150-5.0 to 6.0.

Alteration: fresh (<2% altered) -
Veins: 
Fractures: weakly fractured: 9/8 ft

Additional comments:
0.1 ft mud containing rounded basalt clasts from R150-4.1 to 4.2, infilling of vesicles immediately below this point.

J. Lockwood/F. Trusdell comment, 11/19/93: probably a Mauna Loa flow
<table>
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<tr>
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<th>104</th>
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<tbody>
<tr>
<td>Cores in box</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>152</td>
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**Loggers:** MBB  
**Date logged:** 11/9/93  
**Checked by:** MG  
**Check date:** 11/11/93  
**Driller's depth:top (feet):** 868.2  
**Driller's depth:bottom (feet):** 878.5  
**Core type:** HQ  

**Units in box:** 1

---

**BOX UNIT 1:** moderately olivine phyric basalt  
**Contacts:** Top (ft): R - (continuous with previous box)  
Bottom (ft): R - (continuous with next box)  
**Unit type:** massive  
**Phenocrysts/Clasts:**  
- moderately phyric (2-10%)  
- olivine - 2-10% - 2-4 mm - equant to blocky  
- Point counts: 5% at R151-7.4; 6% at R152-0.8. Olivines contain spinel inclusions. Minor oxidation - some olivines have iridescent coating (MnO?).  
**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)  
**Color:** N6 medium light gray  
**Vesicles:** 5-10% - >5 mm - sub-rounded - equant to elongate  
- Also present are subhorizontal strings of highly elongate vesicles - see "A" on photo; bimodal (<1 mm and >5 mm).  
**Alteration:** fresh (<2% altered)  
**Veins:** none  
**Fractures:** weakly fractured: 7/9.8 ft  
**Additional comments:**

---

**UNIT #43**
**BOX UNIT 1:** moderately olivine phyric basalt

- **Contacts:** Top (fl): (R _) continuous with previous box
  Bottom (fl): (R _) continuous with next box
- **Unit type:** massive
- **Phenocrysts/Clasts:**
  - moderately phyric (2-10%)
  - olivine - 2-10% - 2-4 mm - equant to tabular
  - 9% at R153-2.4. Spinel inclusions within olivine phenocrysts; olivines occur in crystal clots.
- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)
- **Color:** N4 medium dark gray
- **Vesicles:** 5-10% - 1-5 mm - rounded to subrounded - equant -
  - Note subhorizontal vesicle trains at "B" (see photo). Yellowish-orange coating on surfaces of vesicles.
- **Alteration:** fresh (<2% altered)
- **Veins:** none
- **Fractures:** weakly fractured: 11/9.4 ft

**Additional comments:**

---

**Loggers:** MBB
**Date logged:** 11/9/93
**Checked by:** MG
**Check date:** 11/11/93

**Driller's depth:**
- **top [feet]:** 878.5
- **bottom [feet]:** 887.8

**Core type:** HQ

**Units in box:** 1

---

**Box #:** 105
**Cores in box:**
- 152
- 153
- 154

---

**UNIT #:** 43

**Box #:**
- 105

**Loggers:**
- MBB
**Date logged:** 11/9/93
**Checked by:** MG
**Check date:** 11/11/93

**Driller's depth:**
- **top [feet]:** 878.5
- **bottom [feet]:** 887.8

**Core type:** HQ

**Units in box:** 1
**Box #:** 106  
**Cores in box:** 154, 155  

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<td>MG</td>
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<tr>
<td>Check date:</td>
<td>11/11/93</td>
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</tbody>
</table>

**Driller's depth:**  
- Top [feet]: 887.8  
- Bottom [feet]: 897.7  

**Core type:** HQ  

---

**BOX UNIT 1:** moderately olivine phryic basalt  
**Contacts:**  
- Top (ft): (R--) (continuous with previous box)  
- Bottom (ft): (R--) (continuous with next box)  

- **Unit type:** massive  
- **Phenocrysts/Clasts:**  
  - moderately phryic (2-10%)  
  - olivine - 7.9% - 1-2 mm - blocky (<3:1:1)  
  - Point count at R154-2.0. Fresh above R154-5.5, becoming redder below this depth.  

- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)  
- **Color:** N5 medium gray  
- **Structures:** - Sorting:  
- **Vesicles:** <5% - 1-5 mm - rounded - see below:  
  - Equant to vertically elongate above R154-5.5; equant to horizontally elongate below R154-5.5.  
- **Alteration:** fresh (<2% altered)  
- **Veins:** none  
- **Fractures:** Weakly fractured: 12/10 ft; red clay(?)/oxidation rinds on surfaces.  
- **Additional comments:**  
  - rare gabbroic open-textured inclusions
**BOX UNIT 1:** moderately olivine phyric basalt

**Contacts:**
- Top (ft): R (continuous with previous box)
- Bottom (ft): R (continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 5-7% - 2-4 mm - blocky (<3:1:1)

**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)

**Color:** N5 medium gray

**Structures:**

**Vesicles:** 2-5% - 1-5 mm - rounded - equant to horizontally elongated

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** Weakly fractured: 5/10 ft. Some fresh fractures, some with yellowish-white coating.

**Additional comments:**

---

**UNIFY #43**

**Contacts:**
- Top (ft): R (continuous with previous box)
- Bottom (ft): R (continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 5-7% - 2-4 mm - blocky (<3:1:1)

**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)

**Color:** N5 medium gray

**Structures:**

**Vesicles:** 2-5% - 1-5 mm - rounded - equant to horizontally elongated

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** Weakly fractured: 5/10 ft. Some fresh fractures, some with yellowish-white coating.

**Additional comments:**
BOX UNIT 1: moderately olivine phryic basalt

Contacts: Top (ft): (R-0 to 0.0) (continuous with previous box)
Bottom (ft): (R 157-0.0 - 917.0') (flow contact)

Ubber at base overlying a reddish soil

Unit type: massive
Phenocrysts/Clasts:
- moderately phryic (2-10%)
- olivine - 8-9% - 2-4 mm - blocky (<3:1:1)
- Point count at R156-2.0.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N5 medium gray
Vesicles: <5-20% - 1-4 mm - rounded to sub-rounded - equant to horizontally elongated -
3% point count at R156-1.0, 11% at R156-3.0. Vesicles get larger and more abundant till R156-3.2, then smaller, concentrated in sub-horizontal bands and partially infilled with reddish brown material below this depth.
Alteration: fresh (<2% altered)
Veins: none
Fractures: Weakly fractured above R156-4.0.
Additional comments:
- Missing about 9.5 ft from runs 156 and 157, combined. Base of flow from R156-4.6 to R157-0.0 is a brecciated, highly altered zone containing vesicular basalt clasts.

BOX UNIT 2: clay-rich soil

Contacts: Top (ft): (R 157-0.0 - 917.0') (flow contact)
Bottom (ft): (R 157-1.0 - 918.0') (weathering profile)

Unit type: soil
Phenocrysts/Clasts:
- volcanic clasts - <1% - >5 mm - rounded
- a very few vesicular basalt clasts, similar in vesicle content to top of underlying flow
- olivine - <1% - <1 mm - rounded
- green to red olivine grains, variably altered, increasingly abundant towards lower contact

Groundmass/Matrix: silt/clay
Color: 5YR 4/4 moderate brown
Vesicles: - - -
Alteration: completely (95-100% altered)
Veins:
Fractures:

Additional comments:

BOX 108 CONTINUED ON NEXT PAGE
**Box #:** 108  
**Cores in box:**  
156  
157

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<td>Driller's depth:bottom [feet]: 921.7</td>
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<td>Check date</td>
<td>11/12/93</td>
<td>Units in box: 3</td>
</tr>
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</table>

**BOX UNIT 3:** sparsely to moderately olivine phyric basalt

**Contacts:**  
Top (ft): (R 157-1.0-918.0')(soil horizon)  
Bottom (ft): (R--')(continuous with next)

**Unit type:**  
Pahoehoe  
Based on highly vesicular zone at top of flow just below soil

**Phenocryst/Clasts:**  
Sparsely to moderately phyric (1-10%) – phenocryst abundance is highly variable  
Olivine – 1-5% – 1-3 mm – blocky (<3:1:1)  
Highly vesicular zone near top contact has 5% 1-4 mm olivines. The more massive zone below R157-2.5 contains about 1% sub-mm olivines, with olivine content increasing with depth again into next box. Olivine settling apparently has been important in this flow.

**Groundmass/Matrix:**  
Microcrystalline to fine-grained (<1 mm)  
Color: N4 medium dark gray  
Structure:  
Sorting:  
Vesicles: 20-30% – 1-5 mm  
25% 1-2 mm spherical vesicles at R157-1.0. Vesicles become larger and sub-horizontally elongate below R157-2.5

**Alteration:**  
Fresh (~2% altered)  
extcept at top of flow where vesicles are filled with clay-like material

**Veins:** none

**Fractures:** Weakly fractured: 6/4 ft

**Additional comments:**  
J. Lockwood/F. Trusdell comment, 11/19/93: definite Mauna Kea flow
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R - -)(continuous with previous box)
Bottom (ft): (R 158-6.6-929.4')(flow contact)

Unit type: massive/transitional

Phenocrysts/Clasts:
- moderately to highly phyric (2-10%)
- olivine - 2-10% - 1-3 mm - equant
  - Olivine volume% is quite variable: ≤3% at R157-5.4; 14% at R158-2.2; 5% at R158-6.0. Near bottom contact olivines have an iridescent (MnO?) coating.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N5 medium gray - Structures: - Sorting:

Vesicles: 5-30% - 1-10 mm - rounded to subrounded - equant to elongate
- Vesicle size and volume% varies dramatically within section - see photo. Size decreases and volume% increases toward bottom contact. "A" (see photo) = region of large vugs with Fe-oxide coatings. At R158-3.5 flattened horizontal vesicles form vesicle trains. Near contact, vesicles are filled with clay(?).

Alteration: fresh (<2% altered)

Veins: none

Fractures: Weakly fractured: 10/6 ft. Fractures have pale-yellow coatings (clay? - see region marked "B" on photo).

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 158-6.6-929.4')(flow contact)
Bottom (ft): (R - -)(continuous with next box)

For discussion of flow contact, see comments for unit 1

Unit type: massive/transitional

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - 1-3 mm - equant to blocky
  - Irrespective coating (MnO?) and some iddingsite alteration

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N5 medium gray - Structures: - Sorting:

Vesicles: 10-50% - 1-10 mm - rounded to subrounded - equant
- Vesicle size increases and volume% decreases down section, away from contact.

Alteration: fresh (<2% altered)

Veins:

Fractures: Weakly fractured; fractures have white/yellow clay(?) coating.

Additional comments:
BOX UNIT 1: sparsely to moderately olivine phyric basalt

Contacts:
- Top (ft): (R.--) (continuous with previous box)
- Bottom (ft): (R 159.3-5.1-938.1') (flow contact)

Probable flow boundary based on increase in vesicularity and rubble zone with "ropy" surface flow features, but no distinct lithology change.

Unit type: massive

Phenocrysts/Clasts:
- sparsely to moderately phyric (1-10%)
- olivine - 1-5% - 1-5 mm - blocky (<2:1:1)
  - Point count at R159-0.5-1%. Point count at R159-2.0-3%. Olivine settling. Olivines get larger and more abundant with depth.

Groundmass/Matrix:
- fine-grained (<1 mm) to microcrystalline

Color: N4 medium dark gray

Vesicles: 20-30% - 5-10 mm - rounded - equant to sub-vertically elongated
- 28% large (5-10 mm) vesicles at R158-9.5. Vesicles get smaller and more abundant with depth. (5-10%) Small plagioclase laths visible in vesicles.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 4/4 ft

Additional comments: Yellow-brown coating on rubble from lower contact.

BOX UNIT 2: sparsely olivine phyric basalt

Contacts:
- Top (ft): (R 159-3.5-938.1') (flow contact)
- Bottom (ft): (R--) (continuous with next box)

Unit type: pahoehoe

Phenocrysts/Clasts:
- sparsely phyric (1-2%)
- olivine - 1-2% - 1-5 mm - blocky (<3:1:1)
  - Iddingsitized along rims

Groundmass/Matrix:
- fine-grained (<1 mm) to microcrystalline

Color: N4 medium dark gray

Vesicles: 20-30% - 1-5 mm - rounded - equant to sub-vertically elongated
- 26% point count at R159-4.5

Alteration: fresh (<2% altered)

Veins: none

Fractures: Moderately to weakly fractured. White to yellow-brown coating.

Additional comments:
BOX UNIT 1: aphyric to moderately olivine phric basalt

Contacts: Top (ft): (R-')(continuous with previous box)
Bottom (ft): (R-')(continuous with next box)
Two possible internal flow contacts at R160-1.0 and at R160-3.0; defined by an increase in vesicle volume% and a decrease in size.

Unit type: massive
Phenocrysts/Clasts:
aphyric to moderately phric (<1-10%) -
olivine - <1-7% - 2-3 mm - equant to blocky -
Olivine volume% is variable: <1% between R159-6.5 and 9.8 and at R160-1.0; 5% at R160-5.5; 7% at R160-6.7. Olivines display a blackish-blue iridescent coating (MnO?) and minor iddingsite alteration.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-40% - variable - rounded to subrounded - equant to elongate -
Vesicle size and volume% is quite variable, see photo. In more highly fractured regions ("B" in photo), vesicles are filled with white/yellow clay (?).
Alteration: fresh to slightly (<2-10% altered) -
reddish tint to groundmass (weak oxidation)
Veins: none
Fractures: Weakly to moderately fractured; brownish Fe-oxide coating on some fractures (see "A" on photo).
Additional comments:
- Caves material has ropy surface textures, however material above and below does not have any of the characteristics of a flow boundary.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R - -) (continuous with previous box)
- Bottom (ft): (R 160-8.9-951.4') (flow contact)
Bottom flow contact defined by 0.2 ft weathered ash(?) layer; material is now all clay.

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 16% - 2 mm - equant
- 16% aI R160-8.2; rare spinel inclusions in the olivines; olivines are present as crystal clots. Alteration consists of minor feldspar and blackish/blue indescent coatings on some grains.

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 10-20% - 1-2 mm - rounded - equant
- Near contact the volume% increases to >30% and the vesicles are often filled with white/yellow clay (?)

Alteration: fresh (<2% altered)

Veins: none

Fractures: Weakly fractured: 2/1 ft; yellowish clay on fracture surfaces.

Additional comments:

BOX UNIT 2: weathered ash(?)

Contacts:
- Top (ft): (R 160-8.9-951.4') (flow contact)
- Bottom (ft): (R 160-9.1-951.6') (depositional)

Unit type: ash(?)

Phenocrysts/Clasts:
- <10% clasts

Groundmass/Matrix: silt/clay sized material

Color: 5YR 5/6 light brown - Structures: unbedded - Sorting: -

Vesicles: none

Alteration: completely (95-100% altered) - clay

Veins: none

Fractures: none

Additional comments:
- Rounded volcanic clasts; high content clay material (ash?)

BOX 112 CONTINUED ON NEXT PAGE
**BOX UNIT 3: moderately olivine-plagioclase phryic basalt**

**Contacts:**
- Top (ft): (R 160-9.1-951.6') (flow contact)
- Bottom (ft): (R-') (continuous with next box)

Flow contact defined by highly weathered ash (?) unit (see description of unit 2).

**Unit type:** aa to massive
- weathered rubble zone (see photo) = aa flow top (see additional comments).

**Phenocrysts/Clasts:**
- moderately phryic (2-10%)
- plagioclase -2% - 3 mm - tabular to lath-shaped - sericite (?)
  2% at R160-9.3. Most of the plagioclase phenocrysts have a milky-white color.
- olivine - <1% - 1-2 mm - blocky (<3:1:1)
  - minor iddingsite on rims

**Groundmass/Matrix:** microcrystalline

**Color:** N4 medium dark gray

**Structures:** - Sorting:

**Vesicles:** <5% - <5 mm - sub-angular - elongate - no preferred orientation - clay

**Alteration:** moderately (10-40% altered)
- groundmass has a brownish tint (oxidation?) and incipient clay formation

**Fractures:** Moderately to highly fractured; highly fractured regions are essentially rubble zones (see photo).

**Additional comments:**
- Subrounded to subangular clasts (1-5 mm) in diameter set in a more weathered/oxidized matrix of the same material.
- Plagioclase phenocrysts with similar morphologies are present in both the clasts and the matrix. The subrounded clasts may reflect the action of a stream flowing over the top of the aa flow.
BOX UNIT 1: moderately olivine-plagioclase phytic basalt

Contacts:
- Top (ft): (R --)(continuous with previous box)
- Bottom (ft): (R--)(continuous with next box)

Unit type:
- aa to massive

Groundmass/Matrix:
- microcrystalline

Color:
- N4 medium dark gray; massive unoxidized zone

Vesicles:
- <5% - 1-5 mm - subrounded to subangular - equant vesicles are only present in the clasts

Alteration:
- highly (40-80% altered) to fresh (<2% altered) at bottom of box
- alteration consists of oxidized material and clay

Veins:
- none

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - plagioclase - 2-8 mm longest dimension - tabular to lath-shaped
  - Some larger grains display a sieve-texture. Many grains are altered to a milky-white colored material
  - olivine - <1% - 1-2 mm - equant
  - Olivines are almost completely altered to iddingsite.

Additional comments:
- see photo: "A" = zone of clasts where the matrix has been washed away. "B" = inclusion of plagioclase-rich basalt (?)
BOX UNIT 1: moderately olivine-plagioclase phyric basalt

Contacts:
Top (ft): (R--) (continuous with previous box)  
Bottom (ft): (R--) (continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
- moderately phyric (2-10%)
- plagioclase - 5%  
- 5% at R163-6.0; plagioclase phenocrysts are inhomogeneously distributed
- olivine - <1% - 1-2 mm - equant - iddingsite
  - Olivine is almost completely altered.
- 
Groundmass/Matrix: microcrystalline
Color: -  
- Structures: - Sorting: -
Vesicles: <5% - <1 mm - sub-angular - elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: Weakly fractured: 7/9.2 ft; reddish-brown (iron-oxide?) and whitish-yellow clay (?) coatings on some fracture surfaces.

Additional comments:
- see photo: "A" = 14 mm long sieve-textured plagioclase; other less definitive examples are present in this section. "B" = zone of minor oxidation
BOX UNIT 1: moderately magnetite-olivine-plagioclase phyric basalt

Contacts: Top (fl): (R 165-5.8-993.6'; flow contact)
Bottom (fl): (R 165-5.8-993.6'; flow contact)

Unit type: massive grading to aa

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - <1% - 1-5 mm - blocky to equant
- magnetite - <1% - <1 mm - equant

Groundmass/Matrix: microcrystalline

Color: N5 medium gray - Structures: - Sorting:

Vesicles: <5% - 1-2 mm - sub-rounded - horizontally elongated
- Horizontal striations of micro-vesicles. Occasional autoliths of more vesicular basalt (10% vesicles), especially near lower contact.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured (12/8 fl) above rubbly base

Additional comments:
- Rubbly base is oxidized red. Zone of discoloration (groundwater staining?) at R165-2.1 to 2.3.

BOX UNIT 2: aphyric basalt

Contacts: Top (fl): (R 165-5.8-993.6'; flow contact)
Bottom (fl): (R 165-5.8-993.6'; continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- aphyric (<1%)
- plagioclase - <1% - 1-2 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: 5YR 4/1 brownish gray - Structures: - Sorting:

Vesicles: variable - 1-10 mm - rounded - variably elongate
- 10% at R165-7.2, increasing to 32% at R165-8.0. Vesicles become smaller and partially infilled with yellowish white soft (clay or zeolite?) material near upper contact.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured (4/2 fl), except for some altered rubbly zones

Additional comments:
- red to black coating of rubble from R165-8.9
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R 166-3.1-1001.0')(flow contact)
Bottom (ft): (R 166-7.7-1005.6')(flow contact)
Flow contact defined by decrease in vesicle size and ropy surface textures, however the lower unit looks lithologically similar, implying that the contact may be an internal one.

Unit type: massive

Phenocrysts/Clasts: aphyric (<1%)
- olivine - <1% - <1 mm - equant -
  - Olivines are nearly completely altered to iddingsite.
- plagioclase - <1% - <1 mm - lath-shaped -

Groundmass/Matrix: microcrystalline -

Color: - Structures: - Sorting: -

Vesicles: 10-20% - <1 to 10 mm - rounded to subrounded - equant to elongate -
Vesicle size and volume% are quite variable, see photo; vesicles are filled with clay(?) in regions of higher fracture density.

Alteration: slight (10-40% altered) - oxidation

Veins: none
Fractures: weakly fractured: 11/4.9 ft

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 166-3.1-1001.0')(flow contact)
Bottom (ft): (R 166-7.7-1005.6')(flow contact)
Possible lower flow contact defined by oxidized rubby zone with abundant small vesicles.

Unit type: massive

See unit 1 for a description of this unit - this material is nearly identical to that in unit 1.

Phenocrysts/Clasts: aphyric (<1%)
- olivine - <1% - <1 mm - equant -

Groundmass/Matrix: microcrystalline -

Color: N5 medium gray - Structures: - Sorting: -

Vesicles: 10-20% - bimodal - round - equant -

Alteration: slight (10-40% altered) - oxidation
Veins: none
Fractures: weakly: 10/5 ft

Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R 166-7.7-1005.6')(flow contact)
Bottom (ft): (R--') (continuous with next box)
Oxidized, vesicular upper zone with some "transitional" breccia, but no distinct lithology change - probable flow boundary.

Unit type: massive
transitional upper contact

Phenocrysts/Clasts:
aphyric (<1%) -
plagioclase - <1% - 4-6 mm - tabular (>3:1:1) - sieve-textured
olivine - <1% - 1-3 mm - equant -

Groundmass/Matrix: microcrystalline -

Color: N5 medium gray - Structures: - Sorting: -
Vesicles: >30% - variable - rounded to irregular -
>30% spherical vesicles near upper contact. 2-8 mm inclined vesicles from R166-8.5 to R167-1.5 (30-40%). Becomes less vesicular with smaller vesicles (<1 mm) below R167-1.5. Vesicles in lower portion concentrated along inclined to sub-horizontal trains and some vertical "pipes". Some larger vesicles also present in lower portion of flow.

Alteration: fresh (<2% altered) -
red oxidized flow top becoming fresher with depth

Veins:
Fractures:
Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (t): (R --)(continuous with previous box)
Bottom (t): (R 167-8.0-1016.2)(flow contact)

Unit type: aa

Phenocrysts/Clasts:
aphyric (<1%)

Groundmass/Matrix: microcrystalline

Color: see below- Structures: - Sorting:

Vesicles: <30% - 1-2 mm - rounded - equant

Alteration: moderately (10-40% altered)

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (t): (R 167-8.0-1016.2)(flow contact)
Bottom (t): (R --)(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1-2 mm - blocky (<3:1:1) -
mostly highly altered - red to black in color

Groundmass/Matrix: microcrystalline clasts in clay matrix

Color: see below- Structures: - Sorting:

Vesicles: 10-30% - 1-2 mm - subrounded to irregular - variably elongated-

Veins:

Fractures: weakly to moderately fractured - subhorizontal sets.

Additional comments:

Color grades from moderate reddish brown (10R 4/6) at upper contact to dark gray (N4) at base. Recognizable autoliths become more abundant with depth.

J. Lockwood comment, 11/19/93 (re material at top of unit 53, identified by some observers as “stream gravel”): “typical surface caliche”, perhaps indicating this flow top was at the surface for an extended time; looks like things on Kohala and at Puuko-Kawahi road cut on Mauna Kea.
<table>
<thead>
<tr>
<th>Box #:</th>
<th>Cores in box</th>
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<th>Date logged:</th>
<th>Checked by:</th>
<th>Check date:</th>
<th>Driller's depth: top [feet]:</th>
<th>Driller's depth: bottom [feet]:</th>
<th>Core type:</th>
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</thead>
<tbody>
<tr>
<td>119</td>
<td>168</td>
<td>MBB</td>
<td>11/11/93</td>
<td>MG</td>
<td></td>
<td>1023.4</td>
<td>1033.0</td>
<td>HQ</td>
</tr>
</tbody>
</table>

**Box UNIT 1: moderately olivine phyric basalt**

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R 168-9.6-1028.1') (flow contact)
Flow contact occurs within weathered zone labeled "CONTACT ZONE" on the photo (R168-9.3 to end of run).

Unit type: massive
Phenocrysts/Clasts:
- moderately phonic (2-10%) -
  olivine - - 1-2 mm - equant to tabular -
  2-4% at R168-8.0; minor iddingsite alteration of the olivine rims.
- plagioclase - <<1% - <1 mm - lath-shaped -
  very rare plagioclase

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) -
Color: - Structures: - Sorting: -
Vesicles: 10-20% - subrounded to subangular - equant to horizontally elongate -
Vesicle size and volume% are quite variable, see photo; at R168-6.4 vesicles are filled with fine-grained white material.
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 5/2.9 ft; fracture surfaces are oxidized and clay (?) coatings

Additional comments:

**BOX UNIT 2: sparsely olivine phyric basalt**

Contacts: Top (ft): (R 168-9.6-1028.1')(flow contact)
Bottom (ft): (R --')(continuous with next box)
Flow contact defined by zone of weathering and oxidation that grades into massive material lower in section.

Unit type: massive
Phenocrysts/Clasts:
- sparsely phonic (1-2%) -
  olivine - 1-2% - 2-4 mm - equant -
  <1% and 2% at R169-3.0; no spinel inclinations observed; minor iddingsite alteration along rims
- 1-2% at R169-3.0; no spinel inclinations observed; minor iddingsite alteration along rims

Groundmass/Matrix: microcrystalline -
Color: N6 medium light gray - Structures: - Sorting: -
Vesicles: 10-30% - 1-10 mm - subrounded to subangular - elongate -
small (<1 mm) vesicles are generally equant
Alteration: fresh (<2% altered) -
Veins: none
Fractures: Weakly fractured: 9/5.9 ft; white clay (?) coatings on fracture surfaces.

Additional comments:
- see photo: "A" = possible cave material. "B" = zone of oxidation and incipient clay formation.
- J. Lockwood comment, 11/19/93: "Mauna Kea rocks" based on fine-grained matrix
**BOX UNIT 1:** sparsely olivine phyric basalt

**Contacts:**
- Top (ft): (R --)(continuous with previous box)
- Bottom (ft): (R 170 -4.1 -1039.4')(flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- sparsely phyric (1-2%)
- olivine - 1.2% - 1-2 mm - equant to blocky
- <1% at R169-6.5, 2% at R170-2.5

**Groundmass/Matrix:** microcrystalline

**Color:** N6 medium light gray

**Structures:**

**Vesicles:** see below - 1-10 mm - irregular - sub-horizontally elongated
- 14% at R169-6.5, 3% at R170-2.5. Vesicle size and abundance decreases with depth. Vesicles form sub-horizontal striations.

**Alteration:** fresh (<2% altered)

**Fractures:** weakly fractured: 5/5 ft; thin white to yellowish-orange rinds

**Additional comments:**

**BOX UNIT 2:** moderately olivine phyric basalt

**Contacts:**
- Top (ft): (R 170 -4.1 -1039.4')(flow contact)
- Bottom (ft): (R --)(continuous with next box)

**Unit type:** aa

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 2-10% - 2-4 mm - blocky (<3:1)
- 8% iddingsitized olivines identifiable in fresher basalt clasts

**Groundmass/Matrix:** microcrystalline clasts in clay-rich matrix of smaller
- lithic fragments

**Color:** moderate brown 5YR 4/4

**Structures:**

**Vesicles:** <5% to 10% - 1-5 mm - irregular

**Alteration:** moderately (10-40% altered)
- >40% to <10%, decreasing with depth

**Veins:**

**Fractures:**

**Additional comments:**

Subrounded to subangular basalt breccia in a highly altered/oxidized clay-rich matrix. Clasts vary greatly in the amount of internal alteration. Fresher clasts are moderately olivine phyric.

J. Lockwood comment, 11/19/93 (re weathered zone at top of Unit 55): heavy weathering probably indicates the passage of "a long time", perhaps several thousand years.

F. Trusdell comment, 11/19/93 (re the same zone): basalt clinker?
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R ---)(continuous with previous box)
Bottom (ft): (R ---)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%) —
olivine — 18% — 3-4 mm — equant to tabular —
18% at R170-2.5; olivine phenocrysts contain spinel inclusions and are present as crystal clots. From R170-8.8 to bottom of R170 and from R171-0.0 to R171-1.5, olivines are almost completely oxidized or altered to iddingsite.

Groundmass/Matrix: microcrystalline —

Color: N5 medium gray — Structures: — Sorting: —
Both large (>10 mm) and small vesicles are generally subhorizontal.

Alteration: fresh (<2% altered) —

Veins: none

Fractures: weakly fractured: 6/7.3 ft; rubbly zone from R171-0.0 to R171-1.0

Additional comments:
see photo: "A" = a vesicular olivine + plagioclase inclusion; similar vesicular mafic phase + plagioclase inclusions are present in this unit; vast majority are <2 mm in longest dimension
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R 172-0.0-1057.0)(flow contact)
Bottom (ft): (R 172-2.0-1056.0)(flow contact)
Flow contact defined by increased oxidation/weathering, rubby character of zone and a change in lithology below R172.0.0.

Unit type: massive
Phenocrysts/Clasts:
- highly olivine (10%)
- olivine: 12% - 2-4 mm - equant to tabular
12% at bottom of flow; below R171-8.5 the olivines are almost completely liddingsitized.

Groundmass/Matrix: microcrystalline
Color: N5 medium gray
Structures: - Sorting:
Vesicles: <5% - 1.5 mm - sub-angular - equant to elongate
Alteration: moderately (10-40% altered)
Near the contact the groundmass has a reddish, oxidized tint.
Veins: none
Fractures: highly fractured; i.e., rubby
Additional comments:
Color determined on less oxidized piece at R171-8.0.

BOX UNIT 2: aphyric basalt

Contacts:
Top (ft): (R 172-0.0-1057.0)(flow contact)
Bottom (ft): (R 172-3.0-1060.0)(flow contact)
Poor recovery has obscured lower flow contact; oxidized vesicular rubby zone suggest as contact, however the basalt at the top of R173 looks similar to the unit in R172.

Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%)
- plagioclase: <1% - 1-2 mm - tabular (>3:1:1)
plagioclase appear altered (milky-white in color - sericite?)
- olivine: <1% - <1 mm - equant
Olivines are completely liddingsitized.

Groundmass/Matrix: fine-grained (<1 mm) to microcrystalline
Color: N5 medium gray - Structures: - Sorting:
Vesicles: 20-30% - 5 mm - sub-rounded to subangular - equant to sub-horizontally elongate
Vesicles vary in size and volume% throughout section - see photo. Vesicle surfaces have reddish iron-oxide coatings.
Alteration: fresh (<2% altered)
oxidation near both flow contacts
Veins: none
Fractures: weakly fractured: 7/3 ft
Additional comments:
"A" = layer of red clay infilling fracture/vug near top of flow, precursor may have been a wind-blown ash. Contact between clay and basalt is relatively sharp. Groundmass contains abundant plagioclase laths.
**Box #:** 122

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>171</th>
<th>172</th>
<th>173</th>
</tr>
</thead>
</table>

**Loggers:** MBB

**Date logged:** 11/12/93

**Checked by:** MG

**Check date:** 

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**Driller's depth:top [feet]:** 1055.1

**Driller's depth:bottom [feet]:** 1064.5

**Core type:** HQ

**Units in box:** 3

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**BOX UNIT 3: aphyric basalt**

**Contacts:**
- Top (ft): (R 172-3.0-1060.0')(flow contact)
- Bottom (ft): (R--')(continuous with next box)

As noted in the lower contact description for unit 2, the flow contact is not definitive.

**Unit type:** massive

**Phenocrysts/Clasts:**
- aphyric (<1%) -
- plagioclase - <1% - 1-2 mm - tabular -
- olivine - <1% - <1 mm -

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray -

**Structures:**
- Sorting: -
- Vesicles: 20-30% - 2-4 mm - round - equant -

**Alteration:** slightly (2-10% altered)

**Veins:** none

**Fractures:** moderately to highly fractured; "B" (see photo) = rubbly zone; surfaces of the rubble have a coating of white to brown material (weathering products - iron oxides & clays?)

**Additional comments:**

---

**UNIT #57**

**Contacts:**
- Top (ft): (R 172-3.0-1060.0')(flow contact)
- Bottom (ft): (R--')(continuous with next box)

**Unit type:** massive

For description of unit, see unit 2.

**Phenocrysts/Clasts:**
- aphyric (<1%) -
- plagioclase - <1% - 1-2 mm - tabular -
- olivine - <1% - <1 mm -

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray -

**Structures:**
- Sorting: -
- Vesicles: 20-30% - 2-4 mm - round - equant -

**Alteration:** slightly (2-10% altered)

**Veins:** none

**Fractures:** moderately to highly fractured; "B" (see photo) = rubbly zone; surfaces of the rubble have a coating of white to brown material (weathering products - iron oxides & clays?)

**Additional comments:**
**BOX UNIT 1: aphyric basalt**

Contacts:
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R --) (continuous with next box)

Although an altered zone (marked "A" on photo) may be a contact, the lack of lithologic change across it suggests it is an internal weathering horizon of a rubbly region of the flow. This is supported by relatively fresh pieces in the altered zone ("B" in photo).

**Unit type:** massive

**Phenocrysts/Clasts:**
- aphyric (<1%)
- plagioclase = -1% = 1 mm - tabular (>3:1)
- olivine = <<<1% = 1 mm - equant

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray

**Structures:**

**Sorting:**

**Alteration:** slightly (2-10% altered)

**Veins:** none

**Fractures:** weakly: 1/2 ft

**Additional comments:**
BOX UNIT 1: aphyric basalt

Contacts:
Top (ft): (R -1.3-1076.7')(depositional)
Bottom (ft): (R 175-1.3 -1076.7')(depositional)
Red zone marks top of lower flow; rubble at base of this flow.

Unit type: aa

Phenocrysts/Clasts:
aphyric (<1%) - 200 points counted
plagioclase - <1% - 1 mm - tabular (>3:1:1)
olivine - <1% - 1 mm - equant

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting:

Vesicles: 5-10% - 2-4 mm -
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 4/2 ft

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts:
Top (ft): (R -1.3-1076.7')(depositional)
Bottom (ft): (R -1.3-1076.7')(continuous with next box)
red baked zone at top

Unit type: aa

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1 mm - blocky (<3:1:1)

Groundmass/Matrix: microcrystalline

Color: 10YR 4/2 dk. yellow, brown - Structures: - Sorting:
Vesicles: variable - 1-5 mm - sub-rounded - horizontally elongated
< 5% to 10-20%
Alteration: moderately (10-40% altered)
Veins: none
Fractures: rubbly

Additional comments:
weathered top of aa flow
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)

       Bottom (ft): (R --')(continuous with next box)

Unit type: aa to massive

rubby top

Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - <1 mm - equant -
substantial percentage of the rare olivine phenocrysts are iddingsitized

Groundmass/Matrix: microcrystalline -

Color: N5 med. gray - Structures: - Sorting: -

Vesicles: <5% - 2-10 mm - sub-angular - vertically elongated -

Alteration: fresh (<2% altered) -

white material coating fracture surfaces and some vesicle surfaces

Veins: none

Fractures: weakly fractured: 20/5.8 ft

Additional comments:

"A" = zone of subrounded to subangular weathered/oxidized basalt clasts (generally ≤20 mm in diameter) set in a clay matrix.

This zone is the top of an aa flow. The partially rounded clasts suggest the action of a stream flowing along the top of the flow. In unweathered massive portion of flow, subhorizontal to subvertical sheared vesicle trains become more subhorizontal with increasing depth within box.
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R --')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - 1 mm - equant -

Groundmass/Matrix: microcrystalline -
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: variable - 1-5 mm - sub-rounded - elongate -
<5% to 10-20%
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 9/10 ft; white coating on surfaces

Additional comments:
- rare dunite inclusions, 0.5 to 1.3 cm in length

Cores in box
177
178

Box #: 126
BOX UNIT 1: aphyric basalt
Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R 179 -3.0-1108.9')(depositional)
lithology change at rubbly base
Unit type: aa
Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - 1-2 mm -

Groundmass/Matrix: microcrystalline -
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: variable - 1-5 mm - sub-rounded -
<5% to 10-20 %
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 7/5; white coating on surfaces
Additional comments:

BOX UNIT 2: moderately olivine phyric basalt
Contacts: Top (ft): (R 179-3.0-1108.9')(continuous with previous box)
Bottom (ft): (R --')(depositional)
lithology change at rubbly base
Unit type: aa
Phenocrysts/Clasts:
moderately phyric (2-10%) -
olivine - 2-4% - 1-2 mm - blocky (<3:1:1) -
200 points counted

Groundmass/Matrix: -
Color: gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm (bimodal) - - -
-1-2 mm; <1 cm
Alteration: slightly (2-10% altered) - oxidized
Veins:
Fractures:
Additional comments:

J. Lockwood comment, 11/19/93 (re Unit 59): definite Mauna Kea, the plagioclase in the matrix is very distinctive
**Box #:** 128  
**Cores in box:** 179, 180

### BOX UNIT 1: moderately olivine phyric basalt

**Contacts:**  
Top (ft): (R - - ) (continuous with previous box)  
Bottom (ft): (R - - ) (continuous with next box)

**Unit type:** aa rubby top

**Phenocrysts/Clasts:**  
moderately phyric (2-10%)  
olivine - 5-6% - 2-4 mm - equant  
- 200 points counted

**Groundmass/Matrix:** microcrystalline -

**Color:** N4 dk. med. gray  
**Structures:**  
**Sorting:**

**Vesicles:** 10-20% - 1-2 mm - sub-rounded - horizontally elongated  
**Alteration:** fresh (<2% altered)  
**Veins:** none  
**Fractures:** weakly fractured: 3/4 ft  
**Additional comments:**

---

**UNIT #:** 59

**Loggers:** MG  
**Date logged:** 11/12/93  
**Checked by:** MG  
**Check date:** 11/17/93

**Driller's depth: top [feet]:** 1110.3
**Driller's depth: bottom [feet]:** 1120.1

**Core type:** HQ

**Units in box:** 1

---
Box #: 129

Cores in box:
180
181

LOGS:

Logger: MG
Date logged: 11/12/93
Checked by: MG
Check date: 11/17/93

Core type: HQ
Driller's depth: top [feet]: 1120.1
Driller's depth: bottom [feet]: 1130.0

Units in box: 1

BOX UNIT 1: moderately olivine phryic basalt

Contacts:
Top (ft): (R-') (continuous with previous box)
Bottom (ft): (R-') (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phryic (2-10%)
- olivine - 5-6% - bimodal - equant to blocky
- 1-2 mm, 5-10 mm; 200 points counted

Groundmass/Matrix:
- microcrystalline

Color:
- N5 med. gray

Structures:
- Vesicles: <5% - bimodal - sub-rounded - horizontally elongated
- < 1 mm, 2-4 mm; flow banded

Alteration:
- fresh (<2% altered)

Veins:
- none

Fractures:
- weakly fractured: 6/10 ft

Additional comments:

UNIT #: 59
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R181.7-4.1134.0')(depositional)
Rubbly base overlying red baked zone.
Unit type: aa
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine – 5-6% – variable – equant to blocky –
bi-modal; 1-2 mm, 3-4 mm; 200 points counted
-- --
Groundmass/Matrix: microcrystalline
Vesicles: 5-10% – 1-3 mm – sub-rounded – horizontally elongated –
some are larger (~1 cm)
Alteration: fresh (~2% altered) –
Veins: none
Fractures: weakly fractured: 3/3.7 ft
Additional comments:
BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 181.7-4.1134.0'Xdepositional)
Bottom (ft): (R--')(continuous with next box)
red, baked top
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine – 25-30% – 1-3 mm – equant to blocky –
25 & 26 points in two 100 point counts at R182-1.0
-- --
Groundmass/Matrix: microcrystalline
Vesicles: 10-20% – 3-5 mm – sub-rounded – subhorizontally elongated –
rare 3-6 cm vesicles
Alteration: fresh (~2% altered)
Veins: none
Fractures: weakly fractured: 6/6 ft (some are vesicle-rich zones)
Additional comments:
**BOX UNIT 1: highly olivine phyric basalt**

**Contacts:**
- Top (ft): (R 182.3-3.3-1140.2') (flow contact)
- Bottom (ft): (R 182.3-3.3-1140.2') (flow contact)

Bottom flow contact defined by the top of the weathered and oxidized ash (?) layer marked "A" in photo. Note, there does not appear to be a lithologic change.

**Unit type:** Massive

**Phenocrysts/Clasts:**
- Highly phyric (>10%)
- Olivine: 30% - 2-5 mm - equant
- 33% at R182-2.9; spinel inclusions in olivine phenocrysts; olivine crystal clots present. Olivine rims altered to iddingsite near flow contact.

**Groundmass/Matrix:**
- Microcrystalline

**Color:**
- N5 medium gray

**Structure:**
- Sorting:

**Vesicles:**
- 10-20% - <1-5 mm - rounded to subangular - equant to elongate
- Higher vesicle volume % near contact; smaller vesicles are rounded, larger ones are horizontally elongate. Right at contact, vesicles are filled with clay.

**Alteration:**
- Fresh to highly altered

**Veins:**
- None

**Fractures:**
- Weakly fractured

**Additional comments:**
- Minor oxidation zone 2-5 cm in depth above contact.

---

**BOX UNIT 2: highly olivine phyric basalt**

**Contacts:**
- Top (ft): (R 182.3-3.3-1140.2') (flow contact)
- Bottom (ft): (R 182.3-3.3-1140.2') (flow contact)

Top flow contact defined by zone of completely oxidized olivines, partially oxidized clasts in a more oxidized matrix.

**Unit type:** Massive

**Phenocrysts/Clasts:**
- Highly phyric (>10%)
- Olivine: ~30% - 2-4 mm - equant to tabular
- 33% at R182-7.0; below highly oxidized zone (labeled "B" on photo), the olivines show some iridescent oxidation coating (MnO7? as well as minor alteration to iddingsite. Olivines occur as crystal clots and contain spinel inclusions.

**Groundmass/Matrix:**
- Microcrystalline

**Color:**
- N4 medium dark gray

**Structure:**
- Sorting:

**Vesicles:**
- 5-20% - <1-10 mm - rounded to subangular - equant to elongate
- Small vesicles are rounded and equant; larger vesicles are more irregularly shaped; largest vesicles are >10 mm in longest dimension and are inhomogeneously distributed (see photo).

**Alteration:**
- Fresh to highly altered

**Veins:**
- None

**Fractures:**
- Weakly fractured; minor oxidation and clay formation on some fracture surfaces.

**Additional comments:**
- see photo: "A" = ash layer (?) weathered to clays and then baked by overlying flow. "B" = weathered flow top. Relatively rare olivine + pyroxene inclusions up to ~5 mm observed in fresh portions of the section. Some of the small inclusions look like microgabbro crystal clots.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R183-3.5-1152.5')(flow contact)

Flow contact marked by a transition from highly olivine phyric material to less olivine phyric basalt clasts in a highly weathered matrix.

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 20-25% - 2-4 mm - equant to tabular - 23% at R183-4.7; olivines occur in crystal clots; no apparent spinel inclusions; minor iddingsite near contact

Groundmass/Matrix: microcrystalline

Color: N5 medium gray

Vesicles: 10-20% - 5-10 mm - subrounded to subangular - subhorizontally elongated

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 2/5.2 ft

Additional comments:

BOX UNIT 2: moderately olivine phyric basalt

Contacts:
- Top (ft): (R 183-5.3-1152.5')(flow depositional)
- Bottom (ft): (R --')(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-5% - 1-4 mm - equant - 23% at R183-4.7; olivines occur in crystal clots; no apparent spinel inclusions; minor iddingsite near contact

Groundmass/Matrix: microcrystalline

Color: N4 medium gray

Vesicles: variable - scoriaceous rubble

Alteration: fresh

Veins: none

Fractures: weakly: 3/4 ft

Additional comments:
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
Top (ft): (R-~)(continuous with previous box)
Bottom (ft): (R-~)(continuous with next box)
red rubbly top

Phenocrysts/Clasts:
moderately phytic (2-10%) -
olivine - 2-3% - 1-4 mm - equant -
300 points counted at R185-7.5

Groundmass/Matrix: microcrystalline -

Color: N4 med. dk. gray - Structures: - Sorting: -

Vesicles: 5-10% - 1-3 mm - sub-rounded - vertically elongated -
vesicular autoliths at R185-5.5 and 7.5

Alteration: fresh (<2% altered) -

Fractures: weakly fractured: 5/8 ft

Additional comments:
BOX UNIT 1: moderately olivine phryic basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R 186-6.2-1173.2')(depositional)
red baked zone at base

Unit type: massive

Phenocrysts/Clasts:
moderately phryic (2-10%) - olivine - 2-4% - 2-4 mm - blocky (<3:1:1) - 300 points counted

Groundmass/Matrix: microcrystalline - 
Color: N5 med. gray - Structures: 
Vesicles: 5-10% - 2-4 mm - sub-rounded - horizontally elongated-
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 10/6 ft; some are filled with white clay (?)

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 186-6.2-1173.2')(depositional)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%) - olivine - <<1% - 1 mm - blocky (<3:1:1) -

Groundmass/Matrix: fine-grained (<1 mm) - 
Color: N5 med. gray - Structures: 
Vesicles: 10-20% - 1-2 mm - sub-rounded - equant-
Alteration: slightly (2-10% altered) - red coating on vesicles
Veins: none
Fractures: weakly fractured: 3/3 ft; 1-2 cm wide fracture filled with white clay (?)

Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R - -)(continuous with previous box)
          Bottom (ft): (R 187-7.6-1184.9)(depositional)

Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1 mm - blocky (<3:1)

Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: - variable - variable - subhorizontally elongated
-<5? to 20-30%: 1.2 to 4.8 mm
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 1/8 ft

Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 187-7.6-1184.9)(depositional)
          Bottom (ft): (R - -)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 25-30% - 2-4 mm - equant to blocky

Groundmass/Matrix: micocrystalline
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-20% - 3-5 mm - sub-rounded - elongated
Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly fractured: 1/1 ft
Additional comments:
### BOX UNIT 1: highly olivine phyric basalt

- **Contacts:**
  - Top (ft): (R -.) (continuous with previous box)
  - Bottom (ft): (R -.) (continuous with next box)

- **Unit type:** aa
  - Rubbly except below R188-7.1

- **Phenocrysts/Clasts:**
  - Highly phytic (>10%)
  - Olivine - 25-30% - 1-5 mm - equant to blocky

- **Groundmass/Matrix:** microcrystalline

- **Color:** N4 med. dk. gray

- **Structures:**
  - Sorting:
  - Vesicles: 10-20% - 3-5 mm - spherical - subhorizontally elongated
  - Alteration: slightly (2-10% altered) - clay
    - Upper part of box has clay (?) alteration
  - Veins: none
  - Fractures: weakly fractured: 10/6 ft

- **Additional comments:**
  - GPLW comment: nearly all of Boxes 136 and 137 (1187-1203') were identified as "probably tuff ... could be a Sandhills-like littoral pyroclastic deposit; I would however like to see this core again"
Box #: 137

Cores in box:
188
189

UNIT #64

BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R --) (continuous with previous box)
Bottom (ft): (R --) (continuous with next box)

Unit type:
arb except below R189-5.8

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 25-30% - 2-4 mm - equant to blocky -

Groundmass/Matrix:
microcrystalline -

Color: N5 med. gray - Structures: - Sorting: -

Vesicles: <5% - 1 mm - sub-rounded - elongated -
vertical to horizontally oriented

Alteration: moderately (10-40% altered) - clay (?)

Veins: none

Fractures: weakly fractured: 12/10 ft

Additional comments:

GPLW comment: nearly all of Boxes 136 and 137 (1187-1203') were identified as a "probably tuff ... could be a Sandhills-like
littoral pyroclastic deposit; I would however like to see this core again"
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R - -) (continuous with previous box)
Bottom (ft): (R - -) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine: 32% - 2-4 mm - equant to tabular
- 32% at R189-9.5; olivine phenocrysts contain spinel inclusions; olivine clots are present. Alteration includes minor iddingsite and oxidation (black discoloration). Olivines are more oxidized in the region R190-0.6 to R190-6.1.

Groundmass/Matrix: microcrystalline

Color: NS medium gray - Structures: - Sorting: -

Vesicles: 5-15% - 2-10 mm - subrounded to subangular - equant to elongate -

Alteration: slightly (2-10% altered)
- groundmass has reddish tint indicative of oxidation

Veins: none

Fractures: weakly fractured: 5/10 ft; reddish-brown discoloration on some fracture surfaces

Additional comments:
- see photo: "A" = micрогabbro inclusion
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R -.')(continuous with previous box)
Bottom (ft): (R190-9.5-1216.9')(flow contact)
Red zone marks top of next flow.
Unit type: aa (?)
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 20-30% - 2-4 mm - equant to blocky
Groundmass/Matrix: microcrystalline
Color: - Structures: - Sorting: -
Vesicles: <5% - 1-2 mm - spherical - equant -
Alteration: moderately (10-40% altered) - clay + oxidation
Veins: none
Fractures: none
Additional comments:
weathered base of flow

UNITS in box: 2

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R190-9.5-1216.9')(flow contact)
Bottom (ft): (R-.')(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 6-40% - 2-3 mm - equant
- 18% at R191-0.3; 40% at R191-4.2; 6% at R191-5.7; 28% at R191-7.0; olivine volume% quite variable within section. Iridescent
(MnO?) coatings on some grains throughout section; within interval R191-0.0 to R191-1.0, olivines are completely
oxidized/iddingsitized.
Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-30% - 1-5 mm - rounded to subrounded - equant to elongate -
Elongate vesicles have no preferred orientation. Vesicles near fractures are filled with clays and zeolites (?).
Alteration: slightly to very highly (2-95% altered) -
Degree of oxidation decreases down section away from contact.
Veins: none
Fractures: Weakly fractured: 15/8 ft; localized zones (e.g., "B" on photo) are highly fractured. Fractures are zones of increased
weathering and clay development.
Additional comments:
"A" = possible internal flow contacts. "C" = relatively olivine-poor zone; may represent a separate flow, or be indication of flow
differentiation.
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 191-continuous with previous box)
- Bottom (ft): (R 192-1.2-1228.3)(flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%) - olivine - 1-2% - 3-4 mm - equant to tabular -
- slightly altered -

**Groundmass/Matrix:** microcrystalline -

**Color:** N5 medium gray -

**Vesicles:** 10-30% - 1-3 mm - subrounded to subangular - equant to elongate -

**Alteration:**
- slightly (2-10% altered)
- groundmass has faint reddish tint of oxidation

**Fractures:**
- weakly fractured

**Additional comments:**

**BOX UNIT 2: sparsely olivine phyric basalt**

**Contacts:**
- Top (ft): (R 192-1.2-1228.3)(flow contact)
- Bottom (ft): (R 192-5.7-1232.8')(flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- sparsely phyric (1-2%) - olivine - 1% - 1-2 mm - equant -
- <1% at R192-3.4; within 2 ft of upper contact, olivine phenocrysts are almost completely altered to iddingsite, 200 points counted at R192-1.5

**Groundmass/Matrix:** microcrystalline -

**Color:** N5 medium gray -

**Vesicles:** 10-30% - 2-5 mm - subrounded to subangular - equant to elongate -

**Photo shows the extent of the variability in vesicle size and volume%; rare vugs are present in section; more fractured regions of the core display greater amounts of clay/zeolite (?) in the vesicles.**

**Alteration:**
- fresh (<2% altered)

**Fractures:**
- moderately fractured

**Additional comments:**
- see photo: "A" = olivine + plagioclase crystal clot.

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**Driller's depth: top [feet]:** 1225.2
**Driller's depth: bottom [feet]:** 1234.9
**Core type:** HQ
BOX UNIT 3: aphyric basalt

Contacts:  Top (ft): (R 192.5-7-1232.8)(flow contact)  
          Bottom (ft): (R 192.5-6-1234.1)(continuous with next box)  
          Top flow contact defined by a decrease in vesicle size toward contact and the presence of a cm thick brown oxidized/weathered zone. This may be an internal contact. Note: base of this unit is a few inches into the next box.

Unit type: massive

Phenocrysts/Clasts:  aphyric (<1%)
          olivine  - <1%  - ≤1 mm  - equant  
          Olivines display minor iddingsite alteration.

Groundmass/Matrix: microcrystalline

Color: N5 medium gray  
Structures: Sorting:  
Vesicles: 10-20%  
          1-10 mm  - subrounded to subangular  - equant to sub-horizontally elongate  
          Vesicle size and volume% is variable within this section - see photo

Alteration: slightly (0-10% altered)  
          clay in vesicles

Veins: none
Fractures: weakly fractured

Additional comments:  
Olivine + plagioclase crystal clots present within section. Note: units 66 and 67 are lithologically similar.
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R 192-8.0-1235.1'flow contact)
Bottom (ft): (R 193-1.1-1238.3'flow contact)
Note: a few inches of Unit 67 is present at the top of this box. Orangish soil/ash marks top contact; vesicular zone marks base.

Unit type: massive
Phenocryst/Clasts:
- moderately to highly phyric (2->10%)
- olivine – 9-12% – 2-3 mm – blocky (<3:1:1)
  - 9% at R192-8.5; 12% at R192-9.5
- Groundmass/Matrix: microcrystalline
- Color: N5 medium gray
- Structures: - Sorting:
- Vesicles: 20-50%, variable – 1-5 mm
- 30-60% 1-2 mm rounded, inclined elongate vesicles at top grade to larger (5-10 mm), fewer vesicles with depth. Small subrounded vesicles predominate near lower contact.

Alteration: fresh (2% altered)
Veins: none
Fractures: weakly fractured: 5/3 ft
Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 193-1.1-1238.3'flow contact)
Bottom (ft): (R --')(continuous with next box)
highly vesicular brown horizon at R193-1.1 with moderate increase in olivine content below

Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine – 10-20% – 1-5 mm – equant to blocky
- 19% at R193-7.0. Many olivines oxidized to black.
- Groundmass/Matrix: microcrystalline
- Color: N5 medium gray
- Structures: - Sorting:
- Vesicles: 20-30%, variable – 1-5 mm
- 20-30% <1 mm sub-vertically elongate vesicles at top grade to 1-5 mm horizontal vesicles with depth (R193-7.0). Some infilling with soft white material from R193-0.7 to 3.0.

Alteration: fresh to slightly (<2-10% altered)
Veins: none
Fractures: weakly fractured: 7/6 ft; subhorizontal
Additional comments:
- Olivines are weathered and oxidized (reddish black to black) from top of unit to R193-3.0.
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
Top (ft): (R --) (continuous with previous box)
Bottom (ft): (R --) (continuous with next box)
Red, baked rubble zones at 193-7.5, 193-8.5, 193-9.5, 194-0.5, 194-4.5

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - 10-20% - 1-5 mm - blocky (<3:1:1)
- Weathered, oxidized (red to black). 14% at R193-8.5, 14% at R194-6.5,

**Groundmass/Matrix:** microcrystalline

**Color:** 5YR 6/1 light brownish gray - Structures: - Sorting: -

**Vesicles:** 10-20% - 1-2 mm - rounded -
- Most of the flow is too friable and altered to determine accurately vesicle content and shape. Generally 10-20%, partially infilled with soft white to yellow material.

**Alteration:** moderately (10-40% altered)
- Oxidation of groundmass; partial infilling of vesicles

**Veins:**
- Fractures: weakly fractured, sub-horizontal: 19/10 ft; some rubble zones

**Additional comments:**
- Many thin flow units but no distinct lithologic change. Repeated oscillations of small (<1 mm) to large (1-5 mm) to small vesicles, separated by friable breccia/rubble zones. Smaller vesicles are sub-horizontal and rounded. Larger vesicles are rounded to irregular, subvertical.
Box #: 143

Cores in box:
194
195

Loggers: JCL
Date logged: 11/16/93
Checked by: MG
Check date: 11/19/94

Driller's depth: top [feet]: 1254.1
Driller's depth: bottom [feet]: 1263.7
Core type: HQ

Units in box: 2

BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R 194-9.4-1256.6)(continuous with previous box)
Bottom (ft): (R 194-9.4-1256.6)(flow contact)
red
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 10-20% - 1-5 mm - blocky (<3:1:1) -
11% at R194-8.6
- - -
Groundmass/Matrix: microcrystalline -
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - sub-rounded - horizontally elongated -
16% at R194-9.2
Alteration: fresh (<2% altered) -
minor oxidation, especially along vesicle surfaces
Veins: none
Fractures: weakly fractured: 2/2 ft
Additional comments:

Fracture at lower contact (R194-9.4) appears to have 60° dip of slickensides.

UNIT #: 69

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 194-9.4-1256.6)(flow contact)
Bottom (ft): (R 194-9.4-1256.6)(continuous with below)
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 10-20% - 1-5 mm - blocky (<3:1:1) -
11% at R194-8.6
- - -
Groundmass/Matrix: microcrystalline -
Color: 5YR 6/1 light brownish gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-2 mm - rounded -
Preferential weathering of groundmass around olivines has obliterated most vesicles - difficult to determine vesicle content.
Alteration: moderately (10-40% altered) -
Some oxidation and clay formation in matrix. Olivines are black along rims.
Veins: none
Fractures: Rubble at top grading to weakly fractured with depth.
Additional comments:
BOX UNIT 1: highly olivine phric basalt

Contacts: Top (R-)(continuous with previous box)
Bottom (R-)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phric (>10%)
- olivine - 10-20% - 1-5 mm - blocky (<3:1:1)
- 19% at R195-7.7, 15% at R195-6.5. Weathered, oxidized (red to black) near top, becoming fresher with depth. Some small spinel inclusions.

Groundmass/Matrix: microcrystalline

Color: N5 medium gray

Structures: none

Vesicles: <5% - 1-5 mm - irregular - vertically elongated

Alteration: fresh (<2% altered)
- minor oxidation of olivines and groundmass, decreasing with depth

Veins: none

Fractures: Weakly fractured: 13/10 ft; sub-horizontal. A few have soft white coating.

Additional comments:
Box #: 145
Cores in box: 196, 197

Driller's depth:top [feet]: 1270.4
Driller's depth:bottom [feet]: 1284.3
Core type: HQ

UNITS in box: 1

BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R - ')(continuous with previous box)
Bottom (ft): (R - ')(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 20-30% - 1-5 mm - blocky (<3:1:1) -
- 24% at R196-7.6. Olivines become more oxidized with depth.
- - - - -
Groundmass/Matrix: microcrystalline -
Color: 5YR 6/1 light olive gray - Structures: - Sorting:
- Vesicles: <5% - 1-5 mm - rounded - equant to horizontally elongated -
- Alteration: fresh (<2% altered) -
- Oxidation of olivines increases with depth.
Veins:
Fractures: weakly fractured: 8/10 ft; sub-horizontal
Additional comments:
- Microgabbroic clots and dunitic inclusions, <1 to 2 cm, found throughout flow.

UNIT #: 70

GABBROIC CLOTS
DUNITE INCLUSION

UNIT 70 BOX 145
<table>
<thead>
<tr>
<th>BOX UNIT 1: highly olivine phyric basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts:</td>
</tr>
<tr>
<td>Top (ft): (R --') (continuous with previous box)</td>
</tr>
<tr>
<td>Bottom (ft): (R 197-10.0-1286.9') (flow contact)</td>
</tr>
<tr>
<td>Flow contact defined by oxidation zone at the top of the lower flow, clasts from the lower flow within the basalt zone of the upper flow and a change in lithology.</td>
</tr>
<tr>
<td>Unit type: massive</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td>highly phyric (&gt;10%)</td>
</tr>
<tr>
<td>olivine - ~35% - 2-5 mm - equant -</td>
</tr>
<tr>
<td>34% at R197-6.5; 37% at R197-9.3; volume% of olivine phenocrysts decreases slightly up section. Olivines contain spinel inclusions and are present as crystal clots. Olivine alteration consists of minor iddingsite as well as iridescent (MnO?) coatings on some grains.</td>
</tr>
<tr>
<td>Groundmass/Matrix: microcrystalline -</td>
</tr>
<tr>
<td>Color: N5 medium gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td>Vesicles: &lt;10% - 1-10 mm - rounded to subangular - equant to horizontally elongate -</td>
</tr>
<tr>
<td>Small (&lt;1 mm) vesicles tend to be more rounded and equant than the larger vesicles. Below R197-8.0 vesicle volume% decreases to ~2%.</td>
</tr>
<tr>
<td>Alteration: slightly to moderately (2-40% altered) -</td>
</tr>
<tr>
<td>Extent of groundmass oxidation increases toward contact.</td>
</tr>
<tr>
<td>Veins: none</td>
</tr>
<tr>
<td>Fractures: weakly fractured: 4/3.7 ft; soft white to yellow material (clay?) coating some fractures.</td>
</tr>
<tr>
<td>Additional comments: Color determined on a relatively fresh piece of core. see photo: &quot;A&quot; = location of non-vesicular pale-green inclusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOX UNIT 2: sparsely olivine phyric basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts:</td>
</tr>
<tr>
<td>Top (ft): (R 197-10.0-1286.9') (flow contact)</td>
</tr>
<tr>
<td>Bottom (ft): (R --') (continuous with next box)</td>
</tr>
<tr>
<td>See unit 1 description for a description of the flow contact.</td>
</tr>
<tr>
<td>Unit type: aa'(?) to massive</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td>sparsely phyric (1-2%)</td>
</tr>
<tr>
<td>olivine - 1-2% - 2-4 mm - equant -</td>
</tr>
<tr>
<td>Within oxidized zone near the contact, olivines are oxidized and partially iddingsitized. plagioclase - &lt;1% - 1 mm - tabular (&gt;3:1:1) -</td>
</tr>
<tr>
<td>- - - Groundmass/Matrix: microcrystalline -</td>
</tr>
<tr>
<td>Color: N5 medium gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td>Vesicles: &lt;2% - &lt;2 mm - sub-angular - elongate -</td>
</tr>
<tr>
<td>Vast majority of vesicles have very high aspect ratios and random orientations; vesicles in the clasts (region labeled &quot;B&quot; on photo) are more equant.</td>
</tr>
<tr>
<td>Alteration: fresh to highly (&lt;2-80% altered) -</td>
</tr>
<tr>
<td>Clasts and matrix are highly oxidized within 1.3 ft of the contact.</td>
</tr>
<tr>
<td>Veins: none</td>
</tr>
<tr>
<td>Fractures: weakly fractured: 17/6.3 ft</td>
</tr>
</tbody>
</table>
| Additional comments: "B" = zone of oxidized, angular basalt clasts in an oxidized/weathered friable matrix which grades into essentially oxidized massive material over a distance of ~3 ft.
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (ft): (R - -) (continuous with previous box)
Bottom (ft): (R 199-4.2-1301.4') (flow contact)
red rubbly contact at base

Unit type: massive

Phenocrysts/Clasts:
sparsely phyric (1-2%) -
olivine - 1-2% - 1-5 mm - blocky (<3:1:1) -
1-2% at R199-6.5
plagioclase - <1% - <1 mm - tabular (>3:1:1) -

Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - Structures: - Sorting:

Vesicles: <5% - <1 mm - irregular to sub-rounded - equant to horizontally elongated -
Very small (<1 mm), equant micro-vesicles with some sub-horizontal striations or vesicle trains. Occasional larger (1-5 mm)
irregular to sub-horizontal vesicles.

Alteration: fresh (<2% altered) -
Veins: none
Fractures: Weakly fractured: 14/6 ft. Becomes highly fractured/rubbly at lower contact.
Additional comments:

BOX UNIT 2: sparsely olivine phyric basalt

Contacts: Top (ft): (R 199-4.2-1301.4') (flow contact)
Bottom (ft): (R - -) (continuous with next box)
red rubbly top

Unit type: rubble grading to massive

Phenocrysts/Clasts:
sparsely phyric (1-2%) -
olivine - 1-2% - 1-3 mm - blocky (<3:1:1) -
abundance measured in larger, fresher clasts

Groundmass/Matrix: subrounded microcrystalline breccia -

Color: 5YR 4/1 brownish gray - Structures: - Sorting:

Vesicles: 5-10% - <1-2 mm -
highly variable
Alteration: highly (40-80% altered) - clay
substantial oxidation of flow top
Veins: none
Fractures: highly fractured to rubble
Additional comments:
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (R-): (R-)(continuous with previous box)
Bottom (R-): (R-)(continuous with next box)

Unit type: aa to massive
Phenocrysts/Clasts:
- sparsely phyric (1-2%) -
  - olivine - 1-2% - 2-5 mm - equant -
  - Rare spinel inclusions in the olivines; grains are partially oxidized/diödsitized within oxidized zone (labeled "A" on photo), unaltered below this zone.
  - plagioclase - <1% - <1 mm - tabular (>3:1:1) -
Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: <2% - <1 to 4 mm - subangular to angular - equant to elongate -
  - Clasts in the oxidized zone can be more vesicular (<20%) than the massive portion of the core; hard, white spheroids (silica precipitates?) on the surfaces of some vesicles.
Alteration: fresh (<2% altered) below R200-0.0 -
  - Core is highly oxidized in the region between R199-5.0 to R199-9.0; groundmass oxidation decreases over this interval.
Veins: none
Fractures: Weakly fractured: 13/8.7 ft; doesn't include highly fractured zone between R199-6.0 to R199-7.0.
Additional comments:
  - see photo: "A" = zone of less oxidized angular clasts in a more oxidized friable matrix (no obvious clay development); grades into massive unoxidized material by the bottom of the run (R199-10.0); rare small (3-5 mm) gabbroic clots
BOX UNIT 1: sparsely to moderately olivine phytic basalt

Contacts:
Top (ft): (R - -) (continuous with previous box)
Bottom (ft): (R - -) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- sparsely to moderately phytic (1-10%)
- olivine - 1-3% - - -
- 1-2% at R202-2.5, 3% at R203-5.3

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N5 medium gray

Structures: Sorting:
- Vesicles: <5% - 2-6 mm - irregular - variably elongate
- Some sub-horizontal trains of micro-vesicles. Larger vesicles form sub-horizontal to sub-vertical trains. Some larger vesicles have sugary interior with soft white hexagonal sub-mm crystals.

Alteration: fresh (<2% altered)

Veins: none

Fractures: Weakly fractured: 11/10 ft. Sub-horizontal (mechanical?) fractures. Some have dark brown to black surfaces, some have dendritic (biological?) appearance.

Additional comments:
- rare, small (~3-5 mm) open-textured gabbroic inclusions
BOX UNIT 1: moderately olivine phryic basalt

Contacts: Top (ft): (R 3.8-1320.8'f) continuous with previous box
Bottom (ft): (R203-6.2, 3.8 at R203-3.0)

Phenocrysts/Clasts:
- moderately phryic (2-10%)
  - olivine - 2-3% - 1-3 mm - blocky (<3:1:1) -
  - 2% at R203-6.2, 3% at R204-3.0

Groundmass/Matrix: fine-grained (<1 mm) to microcrystalline

Color: N5 medium gray - Structures: - Sorting:

Vesicles: <5% - <1 mm - rounded - horizontally elongated -
  Sub-horizontal micro-vesicles striations grade into larger sub-horizontal vesicle trains (1-3 mm) with depth.

Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 10/6 ft; subhorizontal

Additional comments:
- R204-0.8: 2.5 cm white material infilling vug (?), crystalline, softer than knife, not calcite - possibly zeolite?

BOX UNIT 2: moderately olivine phryic basalt

Contacts: Top (ft): (R 203-3.8-1320.8') continuous with next box
Bottom (ft): (R 3.8-1320.8')

Unit type: massive

Phenocrysts/Clasts:
- moderately phryic (2-10%)
  - olivine - 2-4% - 1-3 mm - blocky (<3:1:1) -
  - iddingsitized - weathered red

Groundmass/Matrix: microcrystalline

Color: 5YR 6/1 light brownish gray - Structures: - Sorting:

Vesicles: 10-20% - 1-5 mm - irregular - sub-horizontally elongated -
Alteration: fresh (<2% altered) -
  some oxidation of groundmass
Veins: none
Fractures: weakly fractured: 5/1.5 ft

Additional comments:
BOX UNIT 1: aphyric to moderately olivine phyric basalt

Contacts: Top (ft): (R - ')(continuous with previous box)
        Bottom (ft): (R205-4.2-1341.4)'(flow contact)

Flow contact defined by rubbly, more vesicular zone (relative to material further up section) in upper flow and angular oxidized clasts at the top of the lower flow.

Unit type: massive

Phenocrysts/Clasts:
aphyric to moderately phyric (<1-10%) - olivine - <1-4% - 1-2 mm - equant - <1% at R205-0.4; 4% at R205-2.0. Olivine abundance is variable, some grains are up to 4 mm in longest dimension, no spinel inclusions observed in olivine phenocrysts. See alteration comments for discussion of olivines.

Groundmass/Matrix: microcrystalline

Color: N5 - medium gray - Structures: - Sorting: -

Vesicles: 3-15% - 1-10 mm - sub-angular - subhorizontally elongate - Vesicle volume% and size decrease between R204-5.2 to R205-2.0.

Alteration: slightly to highly (2-80% altered)

From R204-5.2 to R205-0.0 groundmass is oxidized (reddish tint); olivines are almost completely oxidized and/or iddingsitized. Below R205-0.0, olivines are partially altered; groundmass has faint reddish tint.

Veins: none

Fractures: weakly to highly fractured (see photo for locations of rubbly zones): 9/6.3 ft; reddish coatings on some fractures (clays/iron-oxides)

Additional comments:
see photo: "A" = slickenides on fracture surfaces

BOX UNIT 2: sparsely olivine phyric basalt

Contacts: Top (ft): (R205-4.2-1341.4)'(flow contact)
        Bottom (ft): (R - ')(continuous with next box)

oxidized angular clasts in an oxidized/weathered matrix

Unit type: aa

Phenocrysts/Clasts:
sparsely phyric (1-2%) - olivine - 1-2% - 1-2 mm - equant -

Olivines in the clasts are almost completely oxidized so it is difficult to estimate their percentage.

Groundmass/Matrix: microcrystalline

Color: 10R 4/2 grayish red - Structures: - Sorting: -

Vesicles: 3-20% - 1-2 mm - subrounded to subangular - equant -

Vesicle content of clasts is highly variable.

Alteration: very highly (60-95% altered) - oxidized -

Veins: none

Fractures: not applicable (see photo)

Additional comments:
BOX UNIT 1: sparsely plagioclase-olivine phyric basalt

Contacts: Top (ft): (R.205-0-6-1347.5') (flow contact)
Bottom (ft): (R.206-0-6-1347.5') (flow contact)

Unit type: aa

Phenocrysts/Clasts:
- sparsely phyric (1-2%) -
  - olivine - 5-10% - 1-2 mm - equant -
  - 200 pts counted @ R205.8
- plagioclase - <1% - tabular -

Groundmass/Matrix: microcrystalline -
Color: N7 light gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-3 mm - sub-rounded - elongate to equant -
vesicle abundance increases to end of R205 and in broken basalt from here to R206-0.8

Alteration: slightly to moderately (2-40% altered) - highly (oxidized) clasts to R206-0.8

Veins: none

Fractures: Rubble from R205-4.8 to 6.8, weakly fractured from R205-7.0 to R206-0.0; rubble from R206-0.0 to 0.8.

Additional comments:
- Xenoliths (5 mm) at R205-8.5 (plagioclase, clinopyroxene?) and 8.7 (dunite?). Brecciated, more oxidized flow top?
- More oxidized material in white clay matrix down to R205-7.0. Sheared from R205-7.0 to 8.0.

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (ft): (R.206-0-6-1347.5') (flow contact)
Bottom (ft): (R.206-0-6-1347.5') (flow contact)

Unit type: aa

Phenocrysts/Clasts:
- moderately phyric (5-10%) -
  - olivine - 5-10% - 1-2 mm - equant -
  - seen only in clasts -

Groundmass/Matrix: microcrystalline -
Color: N7 light gray (clasts); 5RP6 pale red purple (matrix) -

Vesicles: 5-10% - 1-6 mm - sub-rounded - equant -
highly variable on clast type in rubble

Alteration: moderately to highly (10-50% altered) -

Veins: none

Fractures: highly fractured, core is essentially broken rubble

Additional comments:
BOX UNIT 1: moderately olivine phyric basalt
Contacts:
- Top (ft): (R--')(continuous with previous box)
- Bottom (ft): (R--')(continuous with next box)

Unit type: aa to massive
Massive material begins at -R207-4.5

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 5% - 2-3 mm - equant
- 5% at R208-3.5; above R208-2.0 olivines are almost completely oxidized (some iddingsite); below this level, olivines have minor iridescent coatings and show some iddingsite development

Groundmass/Matrix:
- microcrystalline

Color:
- N6 medium light gray

Vesicles:
- <2-10% - <1-10 mm - subangular - equant to horizontally elongate
- Smaller vesicles occur in the clasts; the elongate vesicles are present in the massive portion of the unit.

Alteration:
- Fresh to highly altered (<2-80% altered)
- No apparent oxidation below R208-2.5

Veins:
- none

Fractures:
- Weakly fractured: 14/7.8 ft; measured from R207-4.0. Soft white/yellow material (clay?) partially coating some fracture surfaces.

Additional comments:
- "A" = part of an aa flow top; consists of partially oxidized subrounded to subangular basalt clasts in a more oxidized matrix. Degree of oxidation decreases down section; groundmass is only slightly oxidized by R207-4.5.
**BOX UNIT 1:** moderately plagioclase-olivine phyric basalt

**Contacts:**
- Top (T): (R--)(continuous with previous box)
- Bottom (B): (R--)(continuous with next box)

**Unit type:** aa
massive aa flow continuous with previous box

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 8-10% - 2 mm - equant -
  - 8% (R208-8.4), 10% (R209-3.1); scattered clusters of olivine up to 5 mm; olivine % increases towards bottom of core
- plagioclase - <1% - 1-2 mm - tabular (>3:1:1)

**Groundmass/Matrix:** microcrystalline

**Color:** N7 light gray

**Structures:**
- Sorting:
- Vesicles: 3-5% - 1-2 mm - sub-rounded - equant
- 5-10 mm vesicles scattered, subrounded, elongate and angled at 30% in Run 209

**Alteration:** fresh (<2% altered)

**Fractures:** weakly fractured: 7/10 ft

**Additional comments:**
- rare, small (3-5 mm) gabbroic inclusions

**UNIT #75**
BOX UNIT 1: moderately plagioclase-olivine phyric basalt
Contacts: Top (ft): (R-209.3.6-210.0.0)(flow contact)
Bottom (ft): (R-210.0.0-1377.0)(flow contact)
Flow contact defined by lithologic change from a moderately to a highly olivine phyric basalt.
Unit type: massive to rubbly from R209.3.6 to R210.0.0, subangular to angular basaltic clasts of varying degrees of oxidation set in a friable oxidized matrix
Phenocrysts/Clasts: moderately phyric (2-10%)
- olivine - 10% - 2-3 mm - equant -
- 10% at R209-3.4; many of the olivine phenocrysts are oxidized and/or altered to iddingsite
- plagioclase - <1% - 1 mm - tabular (>3:1:1) -
- rare xenocryst at R209-3.7 (*A* on photo)

Groundmass/Matrix: microcrystalline -
Color: N6 medium light gray - Structures: - Sorting: -
Vesicles: <2-20% - 1-5 mm - sub-angular - elongate -
Alteration: slightly to moderately (2-40% altered) -
proportion of groundmass (i.e., rubbly material) that is oxidized increases toward contact

Fractures: weakly to rubbly: 1/0.5 ft; see photo for location of rubbly zones

Additional comments:

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R-210.0.0-1377.0)(flow contact)
Bottom (ft): (R-210.0.0-1377.0)(flow contact)
Flow contact defined by change in unit type and lithology.
Unit type: aa
Phenocrysts/Clasts: highly phyric (>10%)
- olivine - 25% - 2-5 mm - equant -
- 25% at R210-0.7; olivine phenocrysts contain spinel inclusions and occur as crystal clots; olivines are partially oxidized and iddingsitized.

Groundmass/Matrix: microcrystalline -
Color: 5R 4/6 to 10R 4/2 - Structures: - Sorting: -
Vesicles: 10-20% - 2-4 mm - rounded to subangular - equant to elongate -
Alteration: slightly to very highly (2-95% altered)
Veins: none
Fractures: Unit is friable and in some regions core recovery was poor (see photo).

Additional comments:
BOX UNIT 1: highly olivine phric basalt

Contacts: Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R--') (continuous with next box)

Unit type: aa
rubby to partly massive flow, porphyritic

Phenocrysts/Clasts:
- highly phric (>10%) - olivine - 20-28% - 2-5 mm - equant - hematite
- 2-5 mm, avg. 3 mm, 20% (point count 1), 28% (point count 2)

Groundmass/Matrix: microcrystalline -

Color: N5 to N6, light to medium gray - Structures: - Sorting: -

Vesicles: 5-10% - variable - sub-rounded - equant -
R210-5.0 to -5.5 contains large subrounded vesicles 2-20 mm, occasionally elongate. Rest of rock has narrow angular to subangular <1 mm clay-lined vesicles.

Alteration: slightly to moderately (2-40% altered) -

Veins: none
Fractures: initial 0.5' and R211-3.0 to -3.8 rubbly; 7/10 ft

Additional comments:
- caved sand at start of run 212
Box #: 157

Cores in box

212
213

Loggers: JCL
Date logged: 11/17/93
Checked by: MG
Check date: 11/30/93

Units in box: 3

BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R --continues with previous box)
Bottom (ft): (R212-5.0-1396.0')(flow contact)

rubby zone with sharp decrease in olivine content in lower unit - difficult to pinpoint exact contact depth (R212-4.0 to 5.0).

Unit type: aa

Phenocrysts/Clasts:

highly phyric (>10%)
olivine - 25-35% - 1-5 mm - blocky (<3:1:1)
30% at R212-1.8; multi-grain clusters

Groundmass/Matrix: microcrystalline

Color: N5 medium gray - Structures: - Sorting:
Vesicles: 5-10% - 1-5 mm - irregular
increasing towards base
Alteration: fresh (<2% altered)
oxidized at base of flow

Veins:
Fractures: weakly fractured grading to rubble near lower contact of oxidized breccia

Additional comments:

UNIT #: 76

Box 157 CONTINUED ON NEXT PAGE
BOX UNIT 3: highly olivine phyric basalt

Contacts: Top (It): (R 213-0.1-1398.8'(flow contact)
Bottom (It): (R--')(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
- highly phryc (>10%)
- olivine - >10% - 2-4 mm - blocky (<3:1:1)

Groundmass/Matrix: microcrystalline

Color: SYR2/2 greyish brown

Structures: Sorting:
Vesicles: 20-30% - 1-3 mm - sub-angular - equant
Alteration: highly (40-80% altered)
Veins:
Fractures: rubble only

Additional comments:
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R--)(continuous with previous box)
Bottom (ft): (R--)(continuous with next box)

Unit type: aa

From R213-0.9 to R213-5.0 the core consists of relatively unweathered/oxidized subangular/angular basaltic clasts set in an oxidized friable matrix; below R213-5.0 the core becomes massive.

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-10% - 2-4 mm - equant -
- 2% at R214-0.6; 9% at R214-2.8; olivine phenocrysts are inhomogeneously distributed. Rare spinel inclusions; rare crystal clots up to 8 mm in longest dimension. Olivines are generally unaltered in massive portion of the unit, extensively oxidized and iddingsititized in the clast-rich portion of the unit.

Groundmass/Matrix: microcrystalline

Color: N6 medium light gray (fresh piece)

Vesicles: 3-10% - 1-5 mm - subangular to equant - easily elongate -
Vesicles in clasts are less elongate than those in the massive portion of the unit.

Alteration: fresh to moderately (2-40% altered)
- alteration consists of oxidation of the friable matrix in the interval R213-0.9 to R213-5.0.

Veins: none

Fractures: Above R213-4.0, material is relatively rubbly; below that depth core is weakly fractured (12/6.3 ft).

Additional comments:
- see photo: "A" = zone of highly sheared subvertical vesicle trains
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R-7) continuous with previous box)
Bottom (ft): (R214-8.8-1414.6')(flow contact)
red, baked rubbly top on flow beneath this unit
Unit type: massive
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 2-4% - 2-4 mm - equant to blocky
- - - -
Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: <5% to 5-10% - bimodal - sub-angular - inclined -
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 7/6 ft
Additional comments:

UNIT #78

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 214-8.8-1414.6')(flow contact)
Bottom (ft): (R215-2.5-1418.4')(flow contact)
red baked contacts
Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 20-25% - 1-2 mm - equant to blocky
- - - -
Groundmass/Matrix: microcrystalline
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-2 mm - sub-rounded - equant -
Alteration: moderately (10-40% altered)
Veins: none
Fractures: rubbly
Additional comments:

BOX 159 CONTINUED ON NEXT PAGE
BOX UNIT 3: highly olivine phyric basalt

Contacts:
Top (fl): (R 215-2.5-1418.4')(flow contact)
Bottom (fl): (R-')(cont. with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - (20% - 2-4 mm - equant to blocky

Groundmass/Matrix: microcrystalline

Color: 5R 4/6 mod. red

Structures: Sorting:

Vesicles: 0%

Alteration: highly (40-80% altered) - clay oxidation

Veins: none

Fractures: none

Additional comments:
- only upper 0.2 ft of this unit present in this box; no vesicles

Box #:
159

Cores in box
214
215

Loggers: MG
Date logged: 11/18/93
Checked by: MG
Check date: 11/30/93

Driller's depth: top [feet]: 1407.1
Driller's depth: bottom [feet]: 1417.4
Core type: HQ

Units in box: 3
BOX UNIT 1: highly olivine phryic basalt

Contacts: Top (T): (R--)(continuous with previous box)
Bottom (B): (R--)(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
- highly phryic (>10%) -
- olivine - 20-30% - 2-4 mm - equant -
- 20% at R21S-7.5, 30% at R21S-2.0; rare spinel (?) inclusions in the olivine phenocrysts. Locally some olivines have blue/black iridescent (MnO?) coatings.

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray (fresh piece) - Structures: - Sorting:

Vesicles: <1 to 10% - 1-5 mm - rounded to subangular - equant to elongate -

Alteration: slightly to highly (2-80% altered) -
- Groundmass is oxidized down to R21S-3.8; yellow material (clay?) in vesicles and on fractured surfaces between R21S-3.8 and R21S-5.5.

Fractures: below R21S-3.8
Veins: none

Additional comments:
- NaCl ppt
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R216-3.1-1429.0') (flow contact)
  - red baked contact

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
  - olivine - 20-26% - 1-3 mm - equant to blocky

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Vesicles:** 10-20% - 1-4 mm - sub-rounded - horizontally elongated

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** 1/0.5 ft

**Additional comments:**
- NaCl ppt

### BOX UNIT 2: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R216-3.1-1429.0') (flow contact)
- Bottom (ft): (R217-2.0-1437.5') (flow contact)
  - internal flow contact at R216-9.3

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- highly phyric (>10%)
  - olivine - 15-20% - 1-3 mm - equant to blocky

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Vesicles:** 20-30% - 1-2 mm - sub-rounded - equant

**Alteration:** slightly (2-10% altered)

**Veins:** clay in some vugs

**Fractures:** weakly fractured: 17/9 ft

**Additional comments:**
- 

---

### Units in box: 2

**Box #:** 161

**Cores in box:**
- 216
- 217

---

**Loggers:**
- MG

**Date logged:**
- 11/18/93

**Checked by:**
- MG

**Check date:**
- 11/30/93

**Driller's depth: top [feet]:** 1427.9

**Driller's depth: bottom [feet]:** 1436.9

**Core type:** HQ
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R 217-2.0-1437.5') (flow contact (?))
Bottom (ft): (R 217-9.5-1445.0') (flow contact)
Upper flow contact defined by thin (<1 cm thick) oxidized zone, followed by a 22 cm thick more friable zone that contains angular basalt clasts and which grades into massive material; lower contact defined by a baked ash (?) layer.

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-30% - 1-4 mm - equant
14% at R217-3.4; 22% at R217-6.6; no obvious spinel inclusions in the olivine phenocrysts; in the interior portion of the unit, olivines display minor oxidation and iddingsite alteration, more altered near contacts

Groundmass/Matrix: microcrystalline
Color: N6 medium gray - Structures: - Sorting:
Vesicles: 5-15% - 1-10 mm - subrounded to subangular - equant to horizontally elongate
See photo for fluctuations in vesicle size and volume% throughout unit.
Alteration: slightly to moderately (2-40% altered)
Extent of oxidation and proportion of ivory/yellow clay (?) decreases down section from the contact; minor amounts of clay are present at the base of the unit.
Veins: none
Fractures: weakly fractured: 14/7 ft, this measurement does not include the rubbly zone marked on the photo.

Additional comments:
NaCl ppt; filamentous clay (?) material on some fracture surfaces; rare cm-sized dunite xenoliths; possible internal flow contact at R217-3.7

Driller's depth: top [feet]: 1436.9
Driller's depth: bottom [feet]: 1446.9
Core type: HQ

UNIT #: 82

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 217-9.5-1445.0') (flow contact)
Bottom (ft): (R 217-11.0-1445.0') (continuous with next box) See unit 1 for a description of the flow contact

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 11% - 2-4 mm - equant
11% at R218-1.6; olivines are fresh except near contact where they are substantially oxidized

Groundmass/Matrix: microcrystalline
Color: N6 medium light gray - Structures: - Sorting:
Vesicles: 5-10% - 2-5 mm - rounded to subrounded - equant
<1 mm sized vesicles occur near contact; light brown material (clays?) coating basalt surfaces inside vesicles and vugs (see photo)
Alteration: slightly to highly (2-80% altered)
highly oxidized 10 cm thick zone at top of flow
Veins: none
Fractures: weakly fractured: 6/2.4 ft
Additional comments:
NaCl ppt
Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray
Structures: - Sorting: -
Vesicles: >30% - 1-3 mm - sub-rounded - equant
Alteration: slightly to moderately (2-40% altered) - clay
Veins: none
Fractures: weakly: 3/1 ft
Additional comments:

BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R218-4.5-1450.1') (flow contact)
Bottom (ft): (R218-6.0-1451.6') (flow contact) baked vesicular just below contact; internal flow contact at R218-3.3
Unit type: pahoehoe
Phenocrysts/Clasts: moderately phyric (2-10%)
- olivine - 6-8% - 1-3 mm - equant -
200 pts counted at R218-2.0
Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - variable - sub-rounded - equant -<1 to 5 mm
Alteration: slightly to moderately (2-40% altered) -
Veins: none
Fractures: 1/1.5 ft
Additional comments:

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R218-4.5-1450.1') (flow contact)
Bottom (ft): (R218-6.0-1451.6') (flow contact) baked top; ropy bottom (may be an internal contact)
Unit type: pahoehoe
Phenocrysts/Clasts: highly phyric (>10%)
- olivine - 15-20% - 1-3 mm - equant to blocky -
Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: >30% - 1-3 mm - sub-rounded - equant -
Alteration: slightly to moderately (2-40% altered) - clay
Veins: none
Fractures: weakly: 3/1 ft
Additional comments:

BOX 163 CONTINUED ON NEXT PAGE
**Box #:** 163  
**Cores in box:** 218, 219

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<td>Core type:</td>
<td>HQ</td>
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</table>

**BOX UNIT 3:** highly olivine phyric basalt  
Contacts: Top (ft): (R 218-6.0-1451.6') (flow contact)  
Bottom (ft): (R 218-9.5-1455.1') (flow contact)  
possible internal contact at R 218-6.9

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 15-20% - 1-3 mm - equant  

**Groundmass/Matrix:** microcrystalline

**Color:** N 4 med. dk. gray  
**Structures:**  
**Sorting:**  
**Vesicles:** >30% - 1-3 mm - sub-rounded - equant  
**Alteration:** slightly to moderately (2-40% altered) - clay  
clay-like material in vesicular areas  
**Veins:** none  
**Fractures:** moderately fractured: 8/2 ft  
**Additional comments:**

**UNIT #: 85**

**BOX UNIT 4:** highly olivine phyric basalt  
Contacts: Top (ft): (R 218-9.5-1455.1') (flow contact)  
Bottom (ft): (R--) (continuous with next box)  
ropy surface

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 10-20% - 1-4 mm - equant to blocky  

**Groundmass/Matrix:** microcrystalline

**Color:** variable  
**Structures:**  
**Sorting:**  
**Vesicles:** 5-10% - 1-5 mm - sub-rounded - equant  
**Alteration:** moderately (10-40% altered)  
**Veins:** none  
**Fractures:** moderately fractured: 4/1 ft; clay along fractures  
**Additional comments:**
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R --) (continuous with previous box)
Bottom (ft): (R 219-8.8-1464.5') (flow contact)
baked, vesicular zone defines base
Unit type: massive
Phenocrysts/Clasts:
moderately phyric (2-10%) –
olivine – 6-9% –
---
200 pts counted at R219-4.0
---
Groundmass/Matrix: microcrystalline –
Vesicles: 20 to >30% – 1 to 2 mm – sub-rounded – equant to horizontally elongated –
Alteration: slightly (2-10% altered) –
mild oxidation
Veins: none
Fractures: weak: 10/6 ft
Additional comments:

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 219-8.8-1464.5') (flow contact)
Bottom (ft): (R --) (continuous with next box)
red vesicular top
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) –
olivine – 20-30% – 2-4 mm – equant –
---
---
Groundmass/Matrix: microcrystalline –
Vesicles: 20-30% – 1-2 mm –
Alteration: moderately (10-40% altered) – clay oxidation
Veins: none
Fractures: rubbly
Additional comments:
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R220-5.1-1470.7)(flow contact)
flow contact defined by a sharp increase in degree of oxidation, by baked ash/soil horizons in lower flow, and by surface
flow textures

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-10% - 2-4 mm - equant
- 10% at R220-1.5; olivines partially to completely oxidized, correlates with extent of groundmass oxidation

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray (fresh piece) - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - rounded to subrounded - equant to sub-horizontally elongate - oscillating regions of large and small vesicles (see photo)
Alteration: slightly to moderately (2-40% altered) -
Alteration consists of groundmass oxidation (patchy reddish-brown tint to groundmass).
Veins: none
Fractures: weakly fractured: 10/4.5 ft; soft white/yellow material (clay?) on some fracture surfaces
Additional comments: see photo: "A" = slickensides on fracture surfaces
rare small (<5 mm) microgabbroic clasts present in unit

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 220-5.1-1470.7)(flow contact)
Bottom (ft): (R --)(continuous with next box)
See unit 1 for a description of flow contact.

Unit type: aa

From R220-5.1 to R220-8.0, the core consists of angular basaltic clasts set in a friable variably-sized matrix. Oxidized
and baked between R220-5.1 and R220-8.0; yellow material (clay?) on the interior surfaces of the larger vugs in the friable zone.

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - 1-2 mm - equant
- 0.8% at R220-9.0; rare spinel inclusions in olivine phenocrysts. Olivines are fresh in the massive zone and substantially
oxidized in the clast-rich zone.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10% - 1-5 mm - rounded to subrounded - equant-
In the massive zone, some vesicles range up to 20 mm in longest dimension.
Alteration: fresh to highly (<2-80% altered) -
See "unit type" for comments.
Veins: none
Fractures: weakly fractured: 5/4 ft; doesn't include rubbly zone between R220-7.0 and R220-8.0
Additional comments:
NaCl ppt
Box UNIT 1: sparsely olivine phyric basalt

Contacts: Top (R - *)(continuous with previous box)
Bottom (R - *)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- sparsely phyric (1-2%)
- olivine - 1%

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures:

Vesicles: 5-10% - 1-10 mm - sub-rounded - horizontally elongated

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly to moderately

Additional comments:

Box #:
166

Cores in box:
220
221

Loggers: MG
Date logged: 11/18/93

Checked by: MG
Check date: 11/30/93

UNIT #: 88

Driller's depth: top [feet]: 1475.0
Driller's depth: bottom [feet]: 1483.7
Core type: HQ

Units in box: 1
**BOX UNIT 1:** sparsely olivine phyric basalt

Contacts:
- Top (ft): (R 221) (continuous with previous box)
- Bottom (ft): (R222-0.0-1486.1') (flow contact)

- red rubble at base

Unit type: massive

Phenocrysts/Clasts:
- sparsely olivine (1-2%)
- olivine - 1% - 2 mm - blocky (<3:1:1)

Groundmass/Matrix: microcrystalline

Color: N5 med. gray

Vesicles: 5-10% - 1-3 mm - sub-rounded - horizontally elongated

Alteration: fresh (<2% altered)

Fractures: strongly at base

Additional comments:

**UNIT #: 88**

**BOX UNIT 2:** moderately olivine phyric basalt

Contacts:
- Top (ft): (R 222-0.0-1486.1') (flow contact)
- Bottom (ft): (R 227-6.5') (continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-4% - 1-5 mm - equant to blocky
- 200 points counted at R227-6.5

Groundmass/Matrix: microcrystalline

Color: N5 med. gray

Vesicles: 10-20% - 2-4 mm - sub-angular - equant

Alteration: fresh to slightly (<2-10% altered) - clay

Veins: none

Fractures: highly to moderately

Additional comments:
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 2-5% - 1-3 mm - equant
200 points counted at R223-6.8

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray - Structures: - Sorting:
Vesicles: 5-10% - 2-5 mm - sub-rounded - horizontally elongated
Alteration: fresh (<2% altered)
 fresher towards base of box
Veins: none
Fractures: weakly to moderately

Additional comments:
mild NaCl ppt (it redissolved into rock?)

Loggers: MG
Date logged: 11/18/93
Checked by: MG
Check date: 11/30/93

Driller's depth: top [feet]: 1492.2
Driller's depth: bottom [feet]: 1503.2
Core type: HQ

Units in box: 1
Box #: 169

Cores in box:

- 223
- 224

Loggers: MG
Date logged: 11/18/93
Checked by: MG
Check date: 11/30/93

Driller's depth: top [feet]: 1503.2
Driller's depth: bottom [feet]: 1512.5
Core type: HQ

Units in box: 2

**BOX UNIT 1: moderately olivine phyric basalt**

Contacts:
- Top (ft): (R - -)(continuous with previous box)
- Bottom (ft): (R224 - 7.1 - 1512.4')(flow contact)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-4% - 1-4 mm - equant -
- 100 points counted

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting: -

Vesicles: 5-10% - bimodal - sub-rounded - horizontally elongated -
- 1-2 mm and 6-8 mm

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly 1/6 ft

Additional comments:
- open-textured gabbro clot at R224-1.2; mild NaCl ppt

**UNIT #: 89**

**BOX UNIT 2: moderately olivine phyric basalt**

Contacts:
- Top (ft): (R 224 - 7.1 - 1512.4')(flow contact)
- Bottom (ft): (R--')(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2% - 1-3 mm - equant -

Groundmass/Matrix: rubble

Color: med. red - Structures: - Sorting: -

Vesicles: none - except in clasts (10-20%; 1 mm subangular, equant)

Alteration: moderately (10-40% altered) - clay

Veins: none

Fractures: rubble

Additional comments:

**UNIT #: 90**
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
- Top (ft): (R- -)(continuous with previous box)
- Bottom (ft): (R- -)(continuous with next box)

Unit type: aa

From R224-7.8 to R224-10.0, oxidized subangular to angular basaltic clasts (5 mm to 100 mm in longest dimension) are set in a weathered friable matrix with variable clay content.

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 5-10% - 2-4 mm - equant to tabular
- 7% at R225-2.8; 10% at R225-7.2; no obvious spinel inclusions; partially to completely oxidized within oxidized rubbly zone

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 5-10% - <1-5 mm - rounded to subangular - equant to elongate - an abundance of sheared vesicles below R225-6.0

Alteration: fresh to highly (<2-80% altered)
- Some fractures have white/yellow clay (?) coatings on surfaces.

Veins: none

Fractures: weakly fractured: 11/7.3 ft; measured below oxidized rubbly zone

Additional comments:
- see photo: "A" = dunite inclusion

BOX UNIT 1: moderately olivine phyric basalt

UNIT #:90

Contacts:
- Top (ft): (R- -)(continuous with previous box)
- Bottom (ft): (R- -)(continuous with next box)

Unit type: aa

From R224-7.8 to R224-10.0, oxidized subangular to angular basaltic clasts (5 mm to 100 mm in longest dimension) are set in a weathered friable matrix with variable clay content.

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 5-10% - 2-4 mm - equant to tabular
- 7% at R225-2.8; 10% at R225-7.2; no obvious spinel inclusions; partially to completely oxidized within oxidized rubbly zone

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 5-10% - <1-5 mm - rounded to subangular - equant to elongate - an abundance of sheared vesicles below R225-6.0

Alteration: fresh to highly (<2-80% altered)
- Some fractures have white/yellow clay (?) coatings on surfaces.

Veins: none

Fractures: weakly fractured: 11/7.3 ft; measured below oxidized rubbly zone

Additional comments:
- see photo: "A" = dunite inclusion
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (It): (R --')(continuous with previous box)
Bottom (It): (R226-3.1-1528.9')(flow contact) 
baked rubble base
Unit type: massive
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 6-8% - 1-4 mm - equant
100 pts counted at R225-8.8
Groundmass/Matrix: microcrystalline -
Color: NS med. gray - Structures: - Sorting: -
Vesicles: 10-20% - variable - sub-angular - horizontally elongated -
flow banded streaks of vesicles
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly to moderately: 6/4 ft to many
Additional comments:
wehrlite xenolith at R225-8.3; mild NaCl ppt (NaCl disappeared?)

BOX UNIT 2: moderately olivine phyric basalt
Contacts: Top (It): (R 226-3.1-1528.9')(flow contact)
Bottom (It): (R--)'(continuous with next box)
Unit type: aa
rubbly for 4 ft
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 7-9% - 2-4 mm - blocky (<3:1:1) -
Groundmass/Matrix: microcrystalline -
Color: NS med. gray - Structures: - Sorting: -
Vesicles: <5% - 1 mm - sub-angular - equant -
Alteration: moderately (10-40% altered) - clay
Veins: none
Fractures: rubbly to highly
Additional comments:
NaCl ppt
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (tt): (R --')(continuous with previous box)
Bottom (tt): (R--1(continuous with next box)

Unit type: aa

From R226-6.9 to R227-3.5 there are moderately to slightly oxidized subangular clasts set in a friable matrix that grades into massive material by R227-3.5.

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 18% - 3-5 mm - equant to tabular
- olivine phenocrysts contain spinel inclusions; in the clast-rich zone the extent of olivine oxidation is rather variable; in the massive portion of the unit, the olivines are relatively fresh

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray (fresh piece) - Structures: - Sorting: -

Vesicles: <1-5% - 1-5 mm - rounded to subangular - equant to elongate (no preferred orientation)
Alteration: fresh to moderately (<2-40% altered)
The extent of oxidation decreases gradually from the top to the bottom of the box.

Veins: none
Fractures: generally weakly fractured except for rubbly zones (see photo); white/yellow clays (?) coating some fracture surfaces

Additional comments:
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<th>Cores in box</th>
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<tr>
<td>229</td>
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</table>

**BOX UNIT 1**: moderately olivine phyric basalt

**Contacts:**
- Top (fl): (R--) (continuous with previous box)
- Bottom (fl): (R--) (continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 5-7% - 1-3 mm - equant
- multi-grain aggregates common

**Groundmass/Matrix:** microcrystalline

**Color:** N5 med. gray

**Vesicles:** 10-20% - 1-3 mm - sub-rounded - equant to horizontally elongated

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** weakly: 9/10 ft

**Additional comments:**
- dunite xenolith at R228-2;1; NaCl ppt
**BOX UNIT 1:** moderately olivine phyric basalt

Contacts:
- Top (ft): (R) (continuous with previous box)
- Bottom (ft): (R230-0.0-1558.8") (flow contact)
  - red rubble base

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine – 8-10% – 1-3 mm – equant

Groundmass/Matrix: microcrystalline

Color: N5 med. gray

Vesicles: 5-10% – 1-3 mm – sub-rounded – horizontally elongated

Alteration: fresh

Veins: none

Fractures: weakly to moderately: 1/2 It to 6/1 It; healed fracture with clay-like material; tubular material present on some fractures

Additional comments:
- NaCl ppt (redissolved?)

**BOX UNIT 2:** highly olivine phyric basalt

Contacts:
- Top (ft): (R230-0.0-1558.8”) (flow contact)
- Bottom (ft): (R) (continuous with next box)
  - red rubble top; red internal zone at R230-1.4

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine – 25-30% – 1-4 mm – equant
  - 100 pts counted at R230-2.0

Groundmass/Matrix: microcrystalline

Color: 5R 4/2 gray red

Vesicles: 20-30% – 1-5 mm – sub-rounded – equant

Alteration: slightly (2-10% altered)

Veins: none

Fractures: weakly: 6/3 ft

Additional comments:
**Box #:** 175  
**Cores in box:** 230  
231  

**Loggers:** MG  
**Date logged:** 11/18/93  
**Checked by:** MG  
**Check date:** 12/12/93  

**Driller's depth:top [feet]:** 1561.2  
**Driller's depth:bottom [feet]:** 1570.5  
**Core type:** HQ  

**Units in box:** 2

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**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**  
Top (R): (R-)(continuous with previous box)  
Bottom (R): (R-)(R230-7.8-1566.6')[flow contact]

**Unit type:** massive

**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 25-30% - 1-4 mm - equant -  
100 pts counted at R230-3.5

**Groundmass/Matrix:** microcrystalline -  
Color: N4 med. dk. gray - Structures: - Sorting: -  
Vesicles: 10-20% - 3-8 mm - spherical - equant -  
Alteration: slightly (2-10% altered) - oxidized

**Veins:** none  
**Fractures:** weakly: 5/4 ft

**Additional comments:** NaCl ppt

**BOX UNIT 2:** highly olivine phyric basalt

**Contacts:**  
Top (R): (R-)(R230-7.8-1566.6')[flow contact]  
Bottom (R): (R-)(continuous with next box)

**Unit type:** aa  
rubby top noted by blackened olivines in upper part of flow; no soil or red zone present

**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 20-25% - 1-4 mm - equant -  
100 pts counted at R231-1.5

**Groundmass/Matrix:** microcrystalline -  
Color: N4 med. dk. gray - Structures: - Sorting: -  
Vesicles: 10-20% - bimodal - spherical - horizontally elongated -  
<1 mm and 4-6 mm  
Alteration: slightly (2-10% altered) - oxidized, dark olivine

**Veins:** none  
**Fractures:** weakly: 4/3 ft

**Additional comments:** rare dunite xenoliths between R231-1.0 and 2.0; NaCl ppt
**BOX UNIT 1:** highly plagioclase-olivine phyric basalt

<table>
<thead>
<tr>
<th>Contacts: Top (ft): (R 6.5-1575.0') (flow contact)</th>
<th>Bottom (ft): (R 231-6.5-1575.0') (flow contact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubbly reddish brown, more vesicular base, internal flow contact at R231-3.9 (highly vesicular, gritty zone)</td>
<td></td>
</tr>
</tbody>
</table>

**Unit type:** massive

**Phenocrysts/Clasts:**
- Highly phric (>10%) - olivine - 15% - 1-3 mm - equant to blocky
- Plagioclase - <1% - <1 mm

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Vesicles:** 20-30% - variable - spherical - equant - grading downward from 5 mm to <1 mm at contact

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** weakly: 9/6 ft

**Additional comments:** NaCl around olivine

---

**BOX UNIT 2:** highly olivine phyric basalt

<table>
<thead>
<tr>
<th>Contacts: Top (ft): (R 231-6.5-1575.0') (flow contact)</th>
<th>Bottom (ft): (R 231-6.5-1575.0') (flow contact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubbly reddish brown, more vesicular top, reddish cast to rubble</td>
<td></td>
</tr>
</tbody>
</table>

**Unit type:** massive

**Phenocrysts/Clasts:**
- Highly phric (>10%) - olivine - 15% - 1-3 mm - equant to blocky
- Plagioclase - <1% - 1 mm - 100 pts counted at R231-3.5; some very large grains (5-6 mm)

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Vesicles:** 20-30% - variable - spherical - equant - grading downward from 5 mm to <1 mm at contact

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** weakly: 9/6 ft

**Additional comments:** NaCl around olivine

---

**Cores in box**

<table>
<thead>
<tr>
<th>231</th>
</tr>
</thead>
<tbody>
<tr>
<td>232</td>
</tr>
</tbody>
</table>

**Loggers:** MG

**Date logged:** 11/19/93

**Checked by:** MG

**Check date:** 12/12/93

**Driller's depth: top [feet]:** 1570.5

**Driller's depth: bottom [feet]:** 1579.7

**Core type:** HQ

**Units in box:** 2
Groundmass/Matrix: microcrystalline
Color: variable - Structures: - Sorting: -
Vesicles: >30% - 1-3 mm - sub-rounded - equant-
Alteration: slightly to moderately (2-40% altered) - clay + oxidation
Veins: none
Fractures: moderately
Additional comments:
  color varies from 10R 4/6 (med. reddish brown) in rubble zones to 10R 2/2 (very dusky red)

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (lt): (R.232-5.3-1584.1') (flow contact)
Bottom (lt): (R.232-5.3-1584.1') (continuous with next box)
Unit type: aa
Phenocrysts/Clasts:
  highly phyic (>10%) -
  olivine - 10-20% - 1-3 mm - equant to blocky - iddingsite and oxidation
  - - -
Groundmass/Matrix: microcrystalline -
Color: 5R 3/4 dusky red - Structures: - Sorting: -
Vesicles: 10-20% - <1-2 mm - spherical - equant-
Alteration: moderately (10-40% altered) -
Veins: none
Fractures: rubbly to weakly: 1/2 ft
Additional comments:
<table>
<thead>
<tr>
<th>Box #: 178</th>
<th>Cores in box</th>
<th>BOX UNIT 1: highly olivine phyric basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>233</td>
<td>Contacts: Top (ft): (R 233-1.1-1589.9') (flow contact)</td>
</tr>
<tr>
<td></td>
<td>234</td>
<td>Bottom (ft):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>highly phric (&gt;10%) -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>olivine - 10-15% - 1-4 mm - equant - iddingsite and oxidation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundmass/Matrix: microcrystalline -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Color: N3 dk. gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vesicles: 20-30% - 1-2 mm - sub-rounded - equant -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alteration: slightly (2-10% altered) - oxidation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veins: none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fractures: none</td>
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<tr>
<td></td>
<td></td>
<td>Additional comments:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaCl ppt, plagioclase xenocrysts at R233-0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BOX UNIT 2: moderately to highly olivine phyric basalt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contacts: Top (ft): (R 233-1.1-1589.9') (flow contact)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bottom (ft):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>moderately to highly phric (2-&gt;10%) -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>olivine - 8-12% - 1-3 mm - equant to blocky -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundmass/Matrix: microcrystalline -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Color: N4 med. dk. gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vesicles: 10-20% - 1-4 mm - sub-angular - horizontally elongated -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alteration: slightly (2-10% altered) -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veins: none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fractures: weakly: 12/7 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional comments:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaCl around olivine</td>
</tr>
</tbody>
</table>

**Loggers:** MG  
**Date logged:** 11/19/93  
**Checked by:** MG  
**Check date:** 12/12/93  
**Driller's depth: top [feet]:** 1588.5  
**Driller's depth: bottom [feet]:** 1598.5  
**Core type:** HQ  
**Units in box:** 3  
**Box 178 CONTINUED ON NEXT PAGE**
BOX UNIT 3: moderately to highly olivine phyric basalt

Contact: Top (ft): (R 233-10.0-1598.8)(flow contact)
Bottom (ft): (R--)(continuous with next box)
red baked rubbly top

Unit type: aa
Phenocrysts/Clasts: moderately to highly phyric (P>10%)
olivine - 10% - 1-3 mm - equant to blocky -

Groundmass/Matrix: microcrystalline -
Color: 10R 4/6 mod. red brown - Structures: - Sorting: -
Vesicles: 10-20% - 1-3 mm - spherical - equant -
Alteration: highly (40-80% altered) - clay
Veins: none
Fractures: none
Additional comments: rubbly aa top

UNIT #: 97

Cores in box:
233
234

Loggers: MG
Date logged: 11/19/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 1588.5
Driller's depth: bottom [feet]: 1598.5
Core type: HQ

Units in box: 3
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R --') (continuous with next box)

Unit type: aa
Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 8-10% - 1-3 mm - equant to blocky -
  - 100 pts counted at R234-4.0

Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-3 mm - sub-rounded - inclined (-30°)
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 11/8 ft
Additional comments:
- very rare gabbroic and spinel inclusions/xenocryst at R234-9.0

Box #: 179
Cores in box 234

Loggers: MG
Date logged: 11/19/93
Checked by: MG
Check date: 12/12/93

UNIT #: 179

Driller's depth: top [feet]: 1598.5
Driller's depth: bottom [feet]: 1607.9
Core type: HQ
Units in box: 1

Additional comments:
- very rare gabbroic and spinel inclusions/xenocryst at R234-9.0
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R - 77continuous with previous box)
Bottom (ft): [R235-6.7-1615.7'] [flow contact]
red rubble at base

Unit type: massive

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 8-10% - 1-4 mm - equant to blocky
100 pts counted at R235-1.5

Groundmass/Matrix: microcrystalline

Color: NS med. dk. gray - Structures: Sorting:
Vesicles: 10-20% - bimodal - sub-rounded - horizontally elongated
-1 and 4-10 mm

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly: 4/6 ft

Additional comments:

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (ft): (R 235-6.7-1615.7')(flow contact)
Bottom (ft): (R-77continuous with next box)
red rubble top

Unit type: aa (?)

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 8-10% - 1-3 mm - equant

Groundmass/Matrix: microcrystalline

Color: 5R 2/2 blackish red - Structures: Sorting:
Vesicles: 10-20% - 1-3 mm - sub-rounded - equant to horizontally elongated

Alteration: slightly (2-10% altered) - clay, oxidation

Veins: none

Fractures: rubbly

Additional comments:

NaCl ppt
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R 236-0.0 - 1618.0)(continuous with previous box)
Bottom (ft): (R 237-1.5 - 1624.5)(flow contact)
Flow contact defined by dramatic change in the extent of oxidation; top of bottom flow (R237-1.5 to bottom of box) consists of oxidized olivine phenocrysts and less oxidized basalt clasts set in a highly oxidized friable matrix.

Unit type: massive; unit may be transitional
Phenocrysts/Clasts:
- highly phyric (>10% - olivine - 15% - 2-4 mm - equant - no observed spinel inclusions, although the oxidized nature of the olivines may mask the spinels; olivine phenocrysts are partially oxidized and/or iddingsitized
- - - -
Groundmass/Matrix: microcrystalline
Color: 10R 5/4 - Structures: - Sorting: -
Vesicles: 5-10% - 1-2 mm - subrounded to subangular - equant to elongate - vesicle measurements taken from clasts
Alteration: very highly (80-95% altered) - oxidation is the form of alteration
Veins: none
Fractures: rubble: see photo
Additional comments: NaCl ppt

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 237-1.5 - 1624.5)(flow contact)
Bottom (ft): (R 238-0.0 - 1629.0)(continuous with next box)
flow contact described in the unit 1 description
Unit type: angular clasts set in a highly oxidized and baked friable matrix (see photo); clasts vary in size from <5 mm to tens of mm
Phenocrysts/Clasts:
- highly phyric (>10% - olivine - 3-5 mm - equant - The small size of most of the clasts made it difficult to determine the mode; mode taken from box 182, unit 1 description. Olivines are almost completely oxidized.
- - - -
Groundmass/Matrix: microcrystalline
Color: 10R 6/8 - Structures: - Sorting: -
Vesicles: 5-10% - 1-2 mm - subrounded to subangular - equant to elongate - alteration consists of groundmass oxidation
Veins: none
Fractures: moderate to highly fractured: see photo for location of rubble zones
Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (it): (R--)(continuous with previous box)
Bottom (it): (R--) (continuous with next box)

Unit type: aa

Below R238-4.0, the unit is massive; above R238-4.0 it consists of angular and subangular basalt clasts (partially oxidized) and oxidized olivines (black coloration) set in a friable, completely oxidized and baked matrix.

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 18% - 2-4 mm - equant to tabular
- 18% at R239-2.5; olivine phenocrysts contain spinel inclusions and occur as crystal clots; some olivine phenocrysts >5 mm;
- alteration includes oxidation and development of iddingsite.

Groundmass/Matrix: microcrystalline

Color: N5 medium gray - Structures: - Sorting: -

Vesicles: 2-10% - 1-3 mm - subrounded - equant to elongate

Clasts have a higher vesicle vol.% than the massive portion of the section.

Alteration: fresh to very highly altered
- Extent of oxidation decreases from top of box to R239-1.0, where the core is essentially fresh.

Veins: none

Fractures: weakly fractured: 4/6.2 ft; above R238-3.0 unit is rubbly

Additional comments:
- minor NaCl ppt, interior of flow fresh
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R -)(continuous with previous box)
- Bottom (ft): (R-)(continuous with next box)

Unit type: aa
- massive interior portion of an aa flow

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - 11-15% - 2-4 mm - equant to tabular -
  - 15% at R239-5.2; 11% at R240-1.8; olivine phenocrysts contain spinel inclusions; occur as crystal clots; rare olivines are >5 mm; degree of olivine oxidation increases from top to bottom of box, by R239-8.0 olivines have iridescent oxide (MnO) coating and are sometimes partially dickinsitized.

Groundmass/Matrix: microcrystalline -

Color: N5 medium gray - Structures: - Sorting:

Vesicles: 2-7% - 1-5 mm - subrounded to subangular - equant to horizontally elongate -

Alteration: fresh to moderately (<2-40% altered) -
- groundmass oxidation increases from top to bottom of box

Veins: none

Fractures: weakly fractured: 10/9.2 ft; some fracture surfaces display a reddish discoloration

Additional comments:
- NaCl ppt
- see photo: "A" = oxidized and vesicular basalt inclusion; "B" = ultramafic inclusion (dunite?); "C" = altered microgabbro (?) clot.

UNIT #99
**BOX UNIT 1: highly olivine phyric basalt**

Contacts: Top (ft): (R-40-4-1649.3') (flow contact)

Bottom (ft): (R240-4.0-1848.3') (flow contact)

Flow contact defined by a highly oxidized/baked zone (aeolian material or ash?) at the top of the lower flow. This baked zone lies atop oxidized vesicular material. The bottom of the upper flow consists of a zone of clinker material.

Unit type: aa

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 15% - 2-3 mm - equant to tabular
- 15% at R290-3.0, olivines contain spinel inclusions and are partially altered to iddingsite.

Groundmass/Matrix: microcrystalline

Color: N3 dark gray - Structures: - Sorting: -

Vesicles: 2-5% - 1-2 mm - subrounded -

Vesicle surfaces have red (iron-oxide) coatings

Alteration: slightly to moderately (2-40% altered)

Veins: none

Fractures: Moderately fractured core grades into rubbly clinker zone at very base of flow (see photo). Fracture surfaces are oxidized.

Additional comments:
- Moderately oxidized core
- gabbroic inclusion at 240.2-8

**UNIT #: 99**

**BOX UNIT 2: highly olivine phyric basalt**

Contacts: Top (ft): (R-40-4.0-1649.3') (flow contact)

Bottom (ft): (R-4.0-1649.3') (continuous with next box)

Unit type: pahoehoe

pahoehoe implied by the lack of a weathered clast-rich zone at the top of the flow and the absence of a massive vesicle-free interior zone.

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 12-15% - 2-4 mm - equant to tabular
- 12% at R240-6.0; 15% at R241-1.5. Olivines contain rare spinel inclusions. Near the contact, olivines are completely oxidized; they are relatively fresh below R240-6.0.

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 5-30% - 1-5 mm - rounded to subrounded - equant to subhorizontally elongate

- Vesicle size and vol.% are inversely correlated; highest vol.% near internal flow contact (labeled "A" on photo).

Alteration: fresh to very highly (~2-95% altered)

- Extent of groundmass oxidation decreases down section from contact; groundmass has lost reddish tint by R240-9.0.

Veins: none

Fractures: weakly fractured: 18/6.9 ft; measurement doesn't include rubbly zones marked on photo; white/yellow clays (?) on some fracture surfaces

Additional comments:
- NaCl ppt. "A" = possible internal flow contact, vesicle size increases in both directions away from this contact.
- Cave at top of R241; piece at bottom of R240 fits together with piece at top of R241.
BOX 185 CONTINUED ON NEXT PAGE
**Box #:** 185

**Contacts:**
- Top (R): (R 241-9.5-1665.0') (flow contact)
- Bottom (ft): (R--) (continuous with next box)

**Phenocrysts/Clasts:**
- highly olivine (>10%)
- olivine - 25% - 2-4 mm - equant to tabular
- 25% at R242-0.9; olivine phenocrysts contain spinel inclusions; olivines are partially oxidized and liddingsitized.

**Groundmass/Matrix:** microcrystalline

**Color:** NS medium gray

**Vesicles:** 10-20% - 2-10 mm - sub-rounded - equant to elongate

**Vesicles increase in size from R242-0.6 to bottom of box.

**Alteration:** slightly to highly (2-80% altered)
- Extent of weathering and oxidation decreases away from contact; clays present in the zone just below the lower contact; alteration is only slight by R242-0.6.

**Fractures:** weakly fractured: 9/2.9 ft; ivory-colored clays (?) present on some fractured surfaces

**Veins:** none

**Additional comments:**
Box #: 186

Cores in box: 242

Loggers: JCL
Date logged: 11/21/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 1666.5
Driller's depth: bottom [feet]: 1674.4

Core type: HQ

Units in box: 2

---

**BOX UNIT 1:** highly olivine phyric basalt  
**Contacts:** Top (fl): (R--')(continuous with previous box)  
Bottom (fl): (R242-7.7-1673.2') (flow contact)  
Bottom depth is approximate. Unit becomes rubbly, highly altered, but no clear baked zone below is visible. Some vesicular, clinkery breccia present near upper contact of lower unit.  
**Unit type:** massive  
grades to rubbly (aa?) breccia near lower contact  
**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 20-30% - 2-6 mm - blocky (<3:1:1) -  
24% at R242-2.2. Olivines are mostly fresh, though some are partially iddingsitized, especially along rims.  
**Groundmass/Matrix:** microcrystalline -  
**Color:** N5 medium gray - Structures: - Sorting: -  
**Vesicles:** 10-20% - <1-5 mm - rounded - equant to horizontally elongated - vesicles become smaller and more numerous with depth  
**Alteration:** fresh (<2% altered) -  
Unit becomes increasingly altered with yellow-white clay lining fractures and partially infilling vesicles near lower contact.  
**Veins:** none  
**Fractures:** weakly fractured (7/2 Il), grading to highly fractured/rubble near lower contact  
**Additional comments:**

---

**BOX UNIT 2:** highly olivine phyric basalt  
**Contacts:** Top (fl): (R 242-7.7-1673.2') (flow contact)  
Bottom (fl): (R--')(continuous with next box)  
Not much of a baked zone visible at upper contact, but some clinkery, vesicular breccia and decrease in olivine content suggest flow contact/unit contact.  
**Unit type:** rubble-aa  
**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - 10-20% - 1-5 mm - blocky (<3:1:1) - iddingsite  
14% at R242-9.0. Generally iddingsitized and/or oxidized.  
**Groundmass/Matrix:** microcrystalline (see below) -  
**Color:** 5YR 6/1 light brownish gray - Structures: - Sorting: -  
**Vesicles:** 5-10% - 1-10 mm - irregular - inclined 45° - mostly too altered with clay, etc., to determine vesicle content, orientation, etc.  
**Alteration:** moderately to highly (10-80% altered) --  
substantial gray clay coating/cementing fine rubble  
**Veins:** none  
**Fractures:** highly fractured/rubble  
**Additional comments:**

Original groundmass is mostly too altered to determine grain size. Larger pieces appear to be microcrystalline.
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (R): (R--) (continuous with previous box)
Bottom (R): (R--) (continuous with next box)

Unit type: massive (aa?)
R242-9.4 to R243-0.0 relatively unoxidized angular basalt clasts set in a weathered, but not highly oxidized, friable matrix; some clay (?) material present. Below R243-0.0 material is largely massive, except for two rubbly zones starting at R243-1.6 and R243-2.2.

Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - ~20% - 2-5 mm - equant to tabular -
20% at R243-3.4; 21% at R243-7.7; rare spinel (?) inclusions in olivine phenocrysts; olivines occur as crystal clots. Olivines throughout box are oxidized (sometimes completely) and are partially iddingsitized.

Groundmass/Matrix: microcrystalline -
Color: N3 - 5R4/2 - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - subrounded to subangular - equant to elongate -
From R243-0.0 to R243-9.4 (end of box) vesicle vol.% decreases as the size increases.
Alteration: moderately to very highly (10-95% altered) -
Degree of weathering decreases from R242-9.4 (top of box) to R243-0.0; below R243-0.0 groundmass shows moderate degrees of oxidation.

Fractures: weakly fractured: 25/8.5 ft; measurement does not include the two rubbly zones below R243-0.0 (see photo). Clay (?) on some fracture surfaces.

Additional comments:
NaCl ppt
BOX UNIT 1: highly olivine phryic basalt

Contacts: Top (ft): (R--) (continuous with previous box)

Bottom (ft): (R--) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:

- olivine - 18-20% - 2-5 mm - equant to tabular -
- 20% at R243-9.2; 18% at R244-6.7; rare spinel inclusions in olivine phenocrysts, olivines occur in crystal clots. Between R243-8.4 and R244-0.5 olivines are quite fresh; from R244-0.5 to bottom of box, olivines are variably oxidized and display minor iddingsite alteration.

- - - - -

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray

Structures: - Sorting: -

Vesicles: 3-5% - 2-5 mm - subrounded to subangular - equate to sub- horizontally elongate-

Vesicle size and vol.% is homogeneous throughout section.

Alteration: slightly (2-10% altered) -

Groundmass shows variable degrees of oxidation.

Veins: none

Fractures: weakly fractured; 20/8.4 ft; ivory-colored soft material (clay?) occurs as filaments on the surfaces of some vesicles

Additional comments:

NaCl ppt
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (R): (R - (continuous with previous box)
Bottom (R): (R244-8.9-1694.4)[flow contact]

Flow contact defined by a sharp change from relatively massive unoxidized material to oxidized highly vesicular material as well as a lithologic change (from highly to moderately phyric). Right at the contact there is a bright red baked zone (~2-3 mm in thickness).

Unit type: massive

Phenocrysts/Clasts:
- olivine - 30% - 2-4 mm - equant
- 30% at R244-7.3; no obvious spinel inclusions in the olivine phenocrysts; olivines are present in crystal clots. Olivines exhibit only slight oxidation.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - subrounded to subangular - equant to horizontally elongate -
Vesicle vol.% decreases below R244-7.5.
Alteration: slightly to moderately (2-40% altered) - groundmass oxidation
Veins: none
Fractures: weakly fractured: 5/1.9 ft; some of the fracture surfaces have a reddish iron-oxide discoloration

Additional comments:
Core becomes more friable below R244-7.5.

BOX UNIT 2: moderately olivine phyric basalt

Contacts:
Top (R): (R244-8.9-1694.4)[flow contact]
Bottom (R): (R245-0.8-1696.3)[flow contact]

See unit 1 for a description of top contact. Base marked by 1 mm thick, discontinuous glass layer.

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 7% - 2-4 mm - equant to tabular
- 7% at R245-0.3

Groundmass/Matrix: microcrystalline
Color: 10R 3/4 dark reddish brown - Structures: - Sorting: -
Vesicles: 10-30% - 1-5 mm - subrounded to subangular - equant to horizontally elongate -
Vesicle vol.% decreases below R245-7.5.
Alteration: moderately to very highly (10-95% altered) -
Extent of groundmass oxidation decreases away from contact; material from R245-4.0 to R245-4.6 is the least oxidized portion of the section.
Veins: none
Fractures: -50% of core below contact is rubbly; remaining core consists of 0.4 to 0.7' pieces with 0-3 fractures/piece.

Additional comments:
### BOX UNIT 3: highly olivine phryic basalt

**Contacts:**
- Top (T): (R 245-0.8-1696.3') (flow contact)
- Bottom (B): (R - - ) (continuous with next box)

**Unit type:** aa

**Phenocrysts/Clasts:**
- highly phryic (>10%)
- olivine - 10-15% - 1-3 mm - equant to blocky - 12% at R245-4.5

**Groundmass/Matrix:** microcrystalline

**Color:** N4 medium dark gray

**Structures:**
- Vesicles: 10-20% - 1-4 mm - sub-rounded - horizontally elongated
- Alteration: slightly (2-10% altered)
- Veins: none
- Fractures: moderately

**Additional comments:**

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**Box #:** 189

- **Cores in box:**
  - 244
  - 245

**Loggers:** MBB

**Date logged:** 11/21/93

**Checked by:** MG

**Check date:** 12/12/93

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**UNIT #: 105**

**Driller's depth: top (feet):** 1692.0

**Driller's depth: bottom (feet):** 1701.0

**Core type:** HQ

**Units in box:** 3
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R -- ) (continuous with previous box)
Bottom (ft): (R247-3.0-1710.9) (flow contact)

Unit type:
massive
transitional top

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-20% - 1-5 mm - blocky (<3:1:1) - iddingsite (minor)
15% at R246-5.6. Some spinel inclusions. Minor weathering of some grains.

Groundmass/Matrix:
microcrystalline

Color:
N4 medium dark gray

Vesicles:
10-20% - >5 mm - rounded - horizontally to vertically elongated
Vesicles become smaller, more equant, and more numerous near the upper and lower flow boundaries. Sub-population of equant microvesicles present throughout.

Alteration:
fresh (<2% altered)

Veins: none

Fractures:
Weakly fractured: 10/9 ft; except for highly fractured/rubby zone at top and bottom of unit. Some fractures have soft yellowish coating and minor infilling of surrounding vesicles.

Additional comments:
Lots of NaCl ppt on dried surfaces. 3 cm microgabbroic inclusion at R246-1.4 along fracture and at R246-3.1 on back side of core. Possible ultramafic xenolith at R246-2.8.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R 247 -3.0-1710.9') (flow contact)
Bottom (ft): (R--') (continuous with next box)
red rubble zone at top of box

Unit type: aa
mixed rubbly and massive portions; rubbly areas are red

Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - >10% - 1-5 mm - equant -
200 pts counted at R248-3.5

Groundmass/Matrix: microcrystalline -
Color: 5R 3/4 dusky red - Structures: - Sorting: -
Vesicles: <5% - 1-3 mm - sub-angular - vertically elongated-
Alteration: moderately (10-40% altered) - clay oxidation
Veins: none
Fractures: rubble
Additional comments:
NaCl ppt at R247-5.0; box of rubbly material with coherent clasts 0.5 ft across
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (R-)(continuous with previous box)
Bottom (R-)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
moderately to highly phyric - 8-12%
olivine - 8-12% - 1-5 mm - blocky (<2:1:1) -
11% at 249-0.4, 9% R250-0.4. Slightly oxidized/crystallized near top of box, decreasing with depth.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) -
Color: 5YR 6/1 light olive gray - Structures: - Sorting: -
Vesicles: 5-20% - <1-5 mm - sub-angular - inclined -
Some internal banding in terms of vesicle size/abundance. See zones A, B, and C in photo.
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 19/10 ft

Additional comments:
NaCl ppt on dried surfaces. A=zone with small, abundant vesicles B=vesicle-poor zone C=zone with large (1-5 mm) irregular vesicles.
**Box #: 193**

**Cores in box**

<table>
<thead>
<tr>
<th>250</th>
</tr>
</thead>
</table>

**Loggers:** MBB

**Date logged:** 11/22/93

**Checked by:** MG

**Check date:** 12/12/93

**Driller's depth: top [feet]:** 1730.1

**Driller's depth: bottom [feet]:** 1740.6

**Core type:** HQ

**Units in box:** 2

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**BOX UNIT 1: moderately olivine phyric basalt**

**Contacts:**
- Top (ft): (R:--)(continuous with previous box)
- Bottom (ft): (R:250-7.5-1735.2')(flow contact)

Flow contact defined by sharp change from massive material to highly weathered rubbly material. Clay material at the contact (in the lower unit) appears baked.

**Unit type:** aa

Unit type interpretation based on strongly sheared horizontally elongate vesicles

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
  - olivine -- 9% -- 2-4 mm -- equant to tabular
  - 9% at R250-3.3; 9% at R250-7.2; no obvious spinel inclusions. Olivines are relatively fresh, some oxidation coatings (MnO?) and iddingsite.
- - -

**Groundmass/Matrix:** microcrystalline

**Color:** N4 + 5R 4/2

**Structures:** - Sorting: -

**Vesicles:** 1-5% -- 3-10 mm -- subangular -- horizontally elongate

**Alteration:** slightly to moderately (2-40% altered)

**Veins:** none

**Fractures:** weakly fractured: 10/5.9 ft

**Additional comments:**
- see photo: "A" = more finely vesicular zone (autoliths?) that are more highly oxidized; plagioclase xenocryst at R250-4.6

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**BOX UNIT 2: moderately olivine phyric basalt**

**Contacts:**
- Top (ft): (R:250-7.5-1735.2')(flow contact)
- Bottom (ft): (R:--)(continuous with next box)

See unit 1 for a description of the flow contact.

**Unit type:** aa

The size of the clasts increases and the extent of weathering/oxidation decreases down section.

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
  - olivine -- 2-5% -- 2-5 mm -- equant to tabular
  - 3% at R251-0.3; olivines are completely oxidized down to R251-0.6
- - -

**Groundmass/Matrix:** microcrystalline

**Color:** 5R 3/4 + 10R 3/4

**Structures:** - Sorting: -

**Vesicles:** 5-20% -- 1 mm -- sub-rounded -- equant--clay

**Alteration:** moderately to very highly (10-95% altered)

The extent of oxidation/weathering decreases down section away from the contact.

**Veins:** none

**Fractures:** rubble

**Additional comments:**
- color determined on a piece near the contact
BOX UNIT 1: sparsely to moderately olivine phyric basalt

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R --') (continuous with next box)

Unit type: aa
interpretation based on massive character of the unit and the elongate and sheared nature of the vesicles

Phenocrysts/Clasts:
sparingly to moderately phyric (1-10%)
olivine - 1-3% - 2-4 mm - equant to tabular -
  3% at R251-2.5; 1% at R252-1.5; rare spinel inclusions in the olivine phenocrysts, olivine occur in crystal clots. Olivines are quite fresh, minor blue/black iridescent coatings and some liddingsite present.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 5-15% - <1-10 mm - subrounded to subangular -
two populations of vesicles: small vesicles are generally equant and subrounded; larger vesicles are more angular and elongate

Alteration: fresh (<2% altered)
slight alteration at the top of the section (R251-1.3 to R251-2.0)

Fractures: weakly fractured: 9/9.7 ft; some of the fracture surfaces have a brown discoloration

Additional comments:
very rare, small (~3 mm) microgabbros (open textured)
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
Top (ft): (R-�) (continuous with previous box)
Bottom (ft): (R-�) (continuous with lower unit)
Flow contact defined by a clinkery oxidized zone at the top of the lower unit (see photo) and an increase in the proportion of olivine below the contact

Unit type: aa
Unit type definition based on massive non-vesicular character of the core and the presence of highly sheared vesicles

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 2-5% - 2-3 mm - equant -
2.5% at R252-2.8; 3% at R253-2.2; no obvious spinel inclusions in the olivine phenocrysts. Above R253-0.0, olivines exhibit minor oxidation and iddingsite; below R253-0.0, olivines are highly to very highly altered.

Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: - Sorting: -
Equant vesicles are <1 mm. Vesicles with a high aspect ratio are horizontal.

Alteration: slightly to moderately (2-40% altered)
Extent of groundmass oxidation increases toward contact; core is moderately oxidized by R253-0.0; higher degrees of groundmass oxidation correlate with higher concentrations of elongate vesicles.

Veins: none
Fractures: weakly fractured: 12/5 ft; measurement does not include rubble zone labeled "A" on photo. Light brown discoloration on some fracture surfaces.

Additional comments:
very rare plagioclase and gabbroic inclusions

BOX UNIT 2: moderately olivine phyric basalt

Contacts:
Top (ft): (R-�) (continuous with previous box)
Bottom (ft): (R-�) (continuous with next box)
see unit 1 for a description of the flow contact

Unit type: aa

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 3% - 2-4 mm - equant to tabular -
7% at R254-1.7; no obvious spinel inclusions. Highly to moderately oxidized with some iddingsite developed along olivine rims and fractures. Degree of olivine alteration decreases away from contact; most altered in the interval R253-1.6 to R253-3.9.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
in more massive portion of the section, vesicles are subvertically elongate

Alteration: slightly to highly (2-60% altered)
Veins: none
Fractures: the section is largely rubble - see photo; ivory-colored clays are present on the surfaces many of the rubbly pieces

Additional comments:
see photo: "B" = piece with an ultramafic inclusion on the exterior cored surface; rare gabbroic clots
**Box #:** 196

**Cores in box:**
- 254
- 255
- 256

**Loggers:**
- MBB

**Date logged:**
- 11/23/93

**Checked by:**
- MG

**Check date:**
- 12/12/93

**Driller's depth:**
- top [feet]: 1763.2
- bottom [feet]: 1773.5

**Core type:** HQ

**Units in box:** 2

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**BOX UNIT 1: moderately olivine phyric basalt**

**Contacts:**
- Top (It): (R --'); ('continuous with previous box)
- Bottom (It): (R256-3.8-1772.8'); ('flow contact)

Flow contact defined by sharp transition from massive fresh material to highly oxidized rubbly material that appears baked near the contact; there is also a lithology change from moderately to highly olivine phyric.

**Unit type:**
- massive

unit maybe transitional - interpretation based on massive character of the core and the presence of both more spherical and highly elongate vesicles at the same depth.

**Phenocrysts/Clasts:**
- moderately phyric (2-10%) -
  - olivine - 6-7% - 2-4 mm - equant to tabular -
  - 7% at R254-4.3; 5% at R256-2.7; rare spinel in olivine phenocrysts. Throughout section, olivines are slightly to moderately oxidized and iddingsitized.

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Structures:**
- Vesicles: 5-10% - 1-10 mm - subrounded to angular - equant to elongate -
  - Vesicles are sheared and subhorizontally elongate in the interval R254-1.8 to R254-6.3, subrounded and equant below the depth R256-0.0.

**Alteration:**
- fresh to slightly (<-2-10% altered) -
  - Extent of alteration increases slightly toward contact. Groundmass has a faint reddish tint.

**Veins:**
- none

**Fractures:**
- weakly fractured: 10/7.8 ft; soft ivory-colored material (clays?) coating some fracture surfaces

**Additional comments:**
- very minor NaCl ppt

see photo: "A" = represents either an internal rubbly zone within the flow, or, because this material occurs at the top of a run, cave material. The presence of some rere worked surfaces and the different vesicle structure suggests that the material is cave.

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**BOX UNIT 2: highly olivine phyric basalt**

**Contacts:**
- Top (It): (R 256-3.8-1772.8'); ('flow contact)
- Bottom (It): (R--; continuous with next box)
  - see unit 1 for a description of the flow contact

**Unit type:**
- aa/transitional

The top of the flow consists of a clinkery baked zone. However some of the pieces appear to have more pahoehoe-like flow textures.

**Phenocrysts/Clasts:**
- highly phyric (>10%) -
  - olivine - >10% - 2-3 mm - equant -
  - Visual mode. Olivines are generally completely oxidized.

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- 10R 4/6 (weathered outer surface)

**Structures:**
- Vesicles: 5-20% - <1-2 mm - sub-rounded - equant -
  - clay

**Alteration:**
- highly to very highly (40-95% altered) -
  - weathered and oxidized

**Veins:**
- none

**Fractures:**
- rubbly - see photo

**Additional comments:**
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (t): (R - · - ) (continuous with previous box)
Bottom (b): (R - · - ) (continuous with next box)

Unit type: aa

Unit grades from unconsolidated clasts (<1-10 mm), to subangular clasts set in a friable matrix, to massive vesicle-poor material.

Phenocrysts/Clasts:
- highly phyric (>10%) -
  olivine - ~17% - 3-5 mm - equant to tabular -
  17% at R258-0.3; 17% at R258-3.6; no obvious spinel inclusions in the olivine phenocrysts, olivine occur in crystal clots. Rare olivines ≤10 mm in longest dimension. Olivines are slightly to moderately altered; below R257-2.0 olivines exhibit blue/black oxide coatings and minor iddingsite.

Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 3-7% - 1-5 mm - subrounded to subangular - equant to elongate -
most of the elongate vesicles are subvertical

Alteration: highly to very highly (40-95% altered)
- Extent of weathering and oxidation decreases down section. The groundmass is only slightly oxidized by R257-2.0.

Veins: none

Fractures: weakly fractured: 7/5.5 ft; measurement started at R257-1.6

Additional comments:
- NaCl ppt
- see photo: "A" = dunite inclusion

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (t): (R - · - ) (continuous with previous box)
Bottom (b): (R - · - ) (continuous with next box)

Unit type: aa

Unit grades from unconsolidated clasts (<1-10 mm), to subangular clasts set in a friable matrix, to massive vesicle-poor material.

Phenocrysts/Clasts:
- highly phyric (>10%) -
  olivine - ~17% - 3-5 mm - equant to tabular -
  17% at R258-0.3; 17% at R258-3.6; no obvious spinel inclusions in the olivine phenocrysts, olivine occur in crystal clots. Rare olivines ≤10 mm in longest dimension. Olivines are slightly to moderately altered; below R257-2.0 olivines exhibit blue/black oxide coatings and minor iddingsite.

Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 3-7% - 1-5 mm - subrounded to subangular - equant to elongate -
most of the elongate vesicles are subvertical

Alteration: highly to very highly (40-95% altered)
- Extent of weathering and oxidation decreases down section. The groundmass is only slightly oxidized by R257-2.0.

Veins: none

Fractures: weakly fractured: 7/5.5 ft; measurement started at R257-1.6

Additional comments:
- NaCl ppt
- see photo: "A" = dunite inclusion
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (tt): (R 259-1.0-1788.6') (flow contact)
Bottom (tt): (R 260-1.0-1788.6') (flow contact)
Flow contact defined by decrease in vesicle size in the upper unit and a ~10 mm thick clay(?)-layer that is not strongly baked at the top of the lower unit. The clay(?)-layer contains olivines. Below the clay(?)-layer is a 2 cm thick, faintly oxidized zone. No apparent lithologic change.

Unit type: aa/transitional

Phenocrysts/Clasts: highly phyric (>10%)
olivine - 15% - 2-4 mm - equant to tabular -
15% at R259-5.2; no obvious spinel inclusions in the olivine phenocrysts; slight olivine oxidation and iddingsite development

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting:
Vesicles: 2-10% - 1-5 mm - sub-rounded to subangular - equant to horizontally elongate - Vesicles increase in size and abundance below R259-6.0.
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 8/6.2 ft; ivory-colored material (clay?) on some of the fracture surfaces
Additional comments:
see photo: "A" = cm-sized olivine phenocryst

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (tt): (R 260-1.0-1788.6') (flow contact)
Bottom (tt): (R 260-1.0-1788.6') (flow contact)
See unit 1 for a description of the contact.

Unit type: rubble

Phenocrysts/Clasts: highly phyric (>10%)
olivine - 10-20% - 1-3 mm - equant -
18% at R260-1.2; rare spinel inclusions in olivine phenocrysts

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting:
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant to elongate -
Alteration: slightly to moderately (2-40% altered) -
Ivory-colored material (clay?) partially coating some of the rubbley pieces
Veins: none
Fractures: highly fractured/rubble
Additional comments:
"B" = pieces of more vesicular material; there may be a thin flow in the interval R260-2.0 to R261-0.0. Some clinkery/scoriaceous material at R260-3.3.
**Box #:** 199  
**Cores in box:** 261  

<table>
<thead>
<tr>
<th>Box Unit 1: Moderately to highly olivine phyric basalt</th>
</tr>
</thead>
</table>
| **Contacts:**  
| Top (ft): (R - :(R - :) (continuous with previous box)  
| Bottom (ft): (R - :(R - :) (continuous with next box)  
| **Unit type:** aa/transitional  
| Unconsolidated clasts from R261-0.7 to R261-2.0  
| **Phenocrysts/Clasts:**  
| Moderately to highly phyric (-10%) -  
| Olivine - 9-11% - 3-5 mm - equant - iddingsite  
| Very slightly altered olivine; red and blue coloration; no obvious spinel inclusions  
| Groundmass/Matrix: Microcrystalline  
| Color: N5 medium gray - Structures: Sorting:  
| Vesicles: 7-10% - 1-5 mm - sub-angular - equant and horizontally elongated - size increasing from R261-2.4 to R261-4.3  
| Alteration: Slightly (2-10%) altered -  
| Clasts highly weathered (70-80%); groundmass slightly altered from R261-4.3 to the lower part of the flow  
| Veins: None  
| Fractures: One large fracture extending from R261.5-1.0 to R261.5-2.4, filled by yellowish clay  
| Additional comments: |

**UNIT #: 110**

**Loggers:** NB  
**Date logged:** 11/24/94  
**Checked by:** MG  
**Check date:** 12/12/93  
**Driller's depth: top [feet]:** 1793.0  
**Driller's depth: bottom [feet]:** 1802.6  
**Core type:** HQ  
**Units in box:** 1
**BOX UNIT 1**: moderately to highly olivine phyric basalt

**Contacts**: Top (ft): (R 261.5-9.3-1806.0')(flow contact)
Bottom (ft): (R 261.5-9.3-1806.0')(continuous with previous box)

**Unit type**: aa/transitional

**Phenocrysts/Clasts**:
moderately to highly phyric (10-20%)
- olivine - 10-12% - equant - iddingsite

**Groundmass/Matrix**: microcrystalline

**Color**: N5 medium dark gray

**Vesicles**: 5-10 mm - sub-rounded - equant-elongated
- Vesicles horizontally elongated near the bottom contact (from R261.5-6.0 to the bottom contact)

**Alteration**: slightly (2-10% altered)

**Veins**: none

**Fractures**: three fractures filled by yellowish clay

**Additional comments**: one piece of dunite about 20 mm in diameter (see photo)

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**UNIT #10**

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**UNIT #110**

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**UNIT #111**

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**BOX UNIT 2**: moderately olivine phyric basalt

**Contacts**: Top (ft): (R 261.5-9.3-1806.0')(flow contact)
Bottom (ft): (R 261.5-9.3-1806.0')(continuous with next box)

**Unit type**: aa/transitional

**Phenocrysts/Clasts**:
- moderately phyric (2-10%)
- olivine - 5-7% - 3-5 mm - equant - iddingsite

**Groundmass/Matrix**: microcrystalline

**Color**: N4 medium dark gray

**Vesicles**: 20-25% - >5 mm - sub-rounded - equant - yellowish clay

**Veins**: none

**Fractures**: none

**Additional comments**: Vesicle size decreases from the contact toward the flow interior. The boundary between finely and coarsely vesiculated layers is sharp.
Box Unit 1: highly olivine phyric basalt

Contacts:
Top (tt): (R --')(continuous with previous box)
Bottom (tt): (R--')(continuous with next box)

Unit type: aa/transitional
clasts at R262-4.0

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 12-15% - 3-5 mm - equant - iddingsite
Some big (>10 mm) olivine crystals. Red and blue alteration.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 20-25% - 2-3 mm - sub-rounded - equant -
Vesicles size progressively decreases toward the bottom contact.
Alteration: moderately (10-40% altered) -
Veins: none
Fractures: weakly

Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (tt): (R 263-9.6-1824.6') (flow contact)
Bottom (tt): (R 263-9.6-1824.6') (flow contact)

Flow contact defined by an increase in vesicularity and a decrease in vesicle size down section toward contact; below contact material is weathered, oxidized and rubbly. There is a bright red baked zone right at contact.

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%) -
- olivine - 16% - 2-4 mm - equant -
- 16% at R263-8.9; no obvious spinel inclusions in the olivine phenocrysts; olivines are moderately oxidized and iddingsitized

Groundmass/Matrix: microcrystalline

Color: N5 medium gray - Structures: Sorting:

Vesicles: 10-20% - 1-5 mm - rounded to subrounded - equant -

Right above the contact, vesicles are filled with clays.

Alteration: slightly (2-10% altered) - groundmass oxidation

Veins: none

Fractures: weakly fractured: 5/2.6 tt; ivory-colored material (clays?) coating fracture surfaces

Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (tt): (R 265-3.3-1828.5') (flow contact)
Bottom (tt): (R 265-3.3-1828.5') (flow contact)

For a description of upper contact, see unit 1; bottom contact defined by increasing vesicularity down toward contact and a zone of rubbly friable material below the contact (this zone is not strongly baked).

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly phyric (>10%) -
- olivine - ~14% - 2-3 mm - equant -
- 14% at R265-2.3; no obvious spinel inclusions in the olivines; olivines are moderately oxidized and iddingsitized

Groundmass/Matrix: microcrystalline

Color: N3 dark gray - Structures: Sorting:

Vesicles: 15-25% - 1-5 mm - subrounded - equant to elongate -

basalt surfaces within the vesicles have a reddish, oxidized color; elongate vesicles show evidence of flow alignment

Alteration: moderately (10-40% altered) - groundmass oxidation

Veins: none

Fractures: Weakly to moderately fractured; see photo for location of rubble zones. Ivory-colored material (clay?) coating most of the fractured surfaces.

Additional comments:

internal contact at R265-0.2
**BOX UNIT 3: highly olivine phyric basalt**

**Contacts:**
- Top (It): (R 265-3.3-1828.5') (flow contact)
- Bottom (R): (R--) (continuous with next box)
  - Top contact described in unit 2; internal contact at R265-5.0 contact defined by increase in vesicularity/decrease in vesicle size above the contact, and by a weathered/oxidized friable baked zone (~10 cm thick) that grades into rubble material below the contact.

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- Highly phyric (>10%)
- Olivine - 10-20% - 2-4 mm - equant
  - Mode based on visual estimate; all of the olivines are highly oxidized.

**Groundmass/Matrix:** microcrystalline

**Color:** N3 dark gray (freshest material)

**Structures:**
- Sorting: -
- Vesicles: 20-30% - 1-3 mm - sub-rounded - equant to elongate

**Alteration:** moderately to very highly (10-95% altered)
- Groundmass alteration

**Veins:** none

**Fractures:** rubble - see photo; yellowish-cream clay-like coating

**Additional comments:**
- See photo: "A" = highly weathered friable zone below upper contact
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R --')(continuous with next box)

Unit type: an

n.b.-unit described as pahoehoe in previous box

Phenocrysts/Clasts:

moderately to highly phyric (~10%)
olivine - 8-12% - 3-5 mm - equant-laths - iddingsite
Olivine crystals highly altered. Some big (>10 mm) xenocrysts.

Groundmass/Matrix: microcrystalline

Color: 10R 3/4 dark reddish brown - Structures: - Sorting: -

Vesicles: 10-20% - 1-3 mm - sub-angular - elongated-

Alteration: slightly to very highly (2-95% altered) -
Veins: none

Fractures: weakly to rubbly

Additional comments:
highly altered rocks from the bottom an aa flow; NaCl ppt

UNIT #:113

Driller's depth:top [feet]: 1831.5
Driller's depth:bottom [feet]: 1842.0
Core type: HQ

Units in box: 1
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts:
- Top (ft): (R - -) (continuous with previous box)
- Bottom (ft): (R 268-1.9-1851.9') (flow contact)

Unit type: aa clasts on the bottom

Phenocrysts/Clasts:
- moderately to highly phyric (-10%) - olivine - 8-12% - 3-5 mm - equant - iddingsite
- Some olivines look fresh. No spinel inclusions visible.

Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - Structures: - Sorting: - Vesicles: 7-10% - 3-5 mm - sub-angular - equant -
- Regular distribution of vesicles in the flow.

Alteration: highly (40-60% altered) -

Vesicles: none
Fractures: none

Additional comments:
- Internal contacts at 267-0.7, 2.1

BOX UNIT 2: highly olivine phyric basalt

Contacts:
- Top (ft): (R 268-1.9-1851.9') (flow contact)
- Bottom (ft): (R - -) (continuous with next box)

Unit type: aa plastic deformation features

Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 10-15% - 3-7 mm - equant - iddingsite
- Crystals seem relatively fresh with a light green coloration.

Groundmass/Matrix: microcrystalline -

Color: 10R 4/2 grayish red - Structures: - Sorting: - Vesicles: 10-15% - 1-5 mm - sub-rounded - elongated -
- Vesicles are holes created during plastic deformation of molten rock.

Alteration: moderately (10-40% altered) -

Vesicles: none
Fractures: none

Additional comments:
- Typical aa-type of flow. Some big olivine xenocrysts (>15 mm).
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R 268-2.1 - 1859.6')(flow contact)
Bottom (ft): (R 269-2.1 - 1863.5')(flow contact)
Flow contact defined by a lithology change from more to less olivine phyric basalt; no weathered zone observed, some clinkery material at the bottom of the upper unit

Unit type: massive
An(? core consists of non-vesicular massive material

Phenocrysts/Clasts:
Highly phyrnic (>10%) -
Olivine = 14% - 3-5 mm - equant to tabular -
14% at R268-3.8; 14% at R270-0.9; no obvious spinel inclusions in the olivines; rare olivine phenocrysts >5 mm in longest dimension. Olivines are moderately oxidized down to R269-0.5.

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 5-10% - 2-5 mm - sub-rounded - elongate -
Alteration: slightly to highly (2-80% altered) -
Groundmass is oxidized to a pinkish color in the interval R268-2.2 to R270-0.0; from R270-0.0 to bottom contact, core is only slightly oxidized.

Veins: none
Fractures: moderately fractured; no substantial clay development on the fractured surfaces

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 270-2.1 - 1859.6')(flow contact)
Bottom (ft): (R 270-6.0 - 1863.5')(flow contact)
See unit 1 for a description of the top contact; bottom contact (at bottom of box) defined by a decrease in vesicle size in the upper unit and the remnant of a clay(? rich zone.

Unit type: pahoehoe
Interpretation based on the high vesicle content and the rounded vesicle shape

Phenocrysts/Clasts:
Aphyric (<1% -
Olivine = <1% - 1-2 mm - equant -
Minor oxidation in the fresher portion of the core; more highly oxidized in the regions where the groundmass is more strongly oxidized

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 20-50% - <1 to 3 mm - rounded - equant to elongate -
Alteration: slightly to moderately (2-40% altered) -
Groundmass oxidation

Veins: none
Fractures: weakly fractured zones grading sharply into rubbly zones (see photo)
Additional comments: internal flow contacts at R270-3.3, 4.8; contact is at base of box
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R 270-6.0-1863.5') (flow contact)
Bottom (ft): (R--) (continuous with next box)

very altered rocks

Unit type: aa

Phenocrysts/Clasts:
highly phyric (>10%) - olivine - 10-15% - 1-5 mm - equant - iddingsite

Groundmass/Matrix: microcrystalline
Color: 5R 3/4 dusky gray - Structures: - Sorting: -
Vesicles: 7-10% - 1-3 mm - sub-rounded - equant -
Alteration: moderately to highly (10-80% altered) -
Veins: none
Fractures: moderately to highly

Additional comments:
Numerous scattered pieces of rock having a very similar aspect. No correlation between the different pieces.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (It): (R --)(continuous with previous box)
- Bottom (It): (R--')(continuous with next box)

Unit type: aa
- plastic deformation features

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 10-15% - 2-5 mm - equant - iddingsite
  - Olivine crystals highly altered. Some big xenoliths (>10 mm). 100 pts counted at R275-4.0.

Groundmass/Matrix: microcrystalline
- Color: N4 red dark gray
- Structures: - Sorting:
- Great variations in vesicle content. Aa-type of flow with a massive core and highly vesicular borders.

Alteration:
- highly (40-80% altered)
- highly oxidized; some yellowish clay

Veins: none
- one fracture filled by yellowish clay at R274-2.8

Fractures: none

Additional comments:
- NaCl deposits; internal contacts at R275-1.5, 2.2
BOX UNIT 1: highly olivine phryic basalt

Contacts:
- Top (R): (R--) (continuous with previous box)
- Bottom (R): (R--)(continuous with next box)

Unit type: aa internal part of an aa flow, with cavities

Phenocrysts/Clasts:
- highly phryic (>10%) -
- olivine - 10-15% - 4-7 mm - equant - iddingsite
- high concentration (reach 30% in volume) of olivine crystals in clasts filling the cavities

Groundmass/Matrix: microcrystalline -

Color: 10R 4/2 grayish red - Structures: - Sorting:

Vesicles: 10-20% - 1-3 mm and 7-10 mm - sub-angular - elongated -

Alteration: highly (40-80% altered) -

Red oxidation of the entire unit. No clay visible.

Veins: none

Fractures: none

Additional comments:

NaCl deposits. Concentration of rock fragments and olivine crystals filling the flow cavities.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (fl): (R ---) (continuous with previous box)
Bottom (fl): (R ---) (continuous with next box)
No contact. Internal part of aa-type of flow with cavities.

Unit type: aa
Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 10-15% - 3-5 mm - equant - iddingsite
  - Highly altered olivine crystals. Some big anhedral xenoliths (see photo). 100 pts counted at R280-5.0.

Groundmass/Matrix: microcrystalline
Color: 10R 4/2 grayish red
Structures: Sorting:
Vesicles: 10-15% - 5-15 mm - sub-angular - elongated - Great variations in vesicles size.
Alteration: moderately to highly (10-80% altered) - Red oxidation. Some yellowish clay coated on the clasts surfaces.
Veins: none
Fractures: moderately
Additional comments:
- NaCl deposits; internal contacts at R280-6.3, R281-2.4; gabbroic inclusion at R281-1.2, R280-4.2
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (t): (R --) (continuous with previous box )
Bottom (t): (R281 -0.0 -1922.0') (flow contact )
Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)  
olivine - 10-15% - 3-5 mm - equant - iddingsite
Olivine crystals horizontally elongated

Groundmass/Matrix: microcrystalline
Color: 10R 4/2 grayish red - Structures: - Sorting: -
Vesicles: 7-10% - 3-5 mm - sub-angular - horizontally elongated
Variations in size and volume of vesicles
Alteration: moderately (10-40% altered)
Oxidation of the clastic material. Inner part of the flow relatively fresh.
Veins: none
Fractures: none
Additional comments:
NaCl coating. Plastic deformation features. Olivine and vesicles are both horizontally elongated in the most massive part of the flow, between R262-1.5 and R263. Rare gabbroic inclusions.

BOX UNIT 2: moderately plagioclase-olivine phyric basalt
Contacts: Top (t): (R283 -0.0 -1922.0') (flow contact )
Bottom (t): (R --) (continuous with next box )
Unit type: aa
Phenocrysts/Clasts:
moderately phyric (2-10%)  
olivine - 5-8% - 1-3 mm - equant to blocky  
plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
Color: dusky red - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - sub-angular - equant
Alteration: slightly (2-10% altered)
Veins: none
Fractures: rubbly
Additional comments:
rare gabbroic clots
**BOX UNIT 1:** moderately plagioclase-olivine phric basalt

**Contacts:** Top (R): (R-7) [continuous with previous box]  
Bottom (R): (R:285 -1.0 -1932.1') [flow contact]  
approximate location; rubble zone

**Unit type:** aa  
**Phenocrysts/Clasts:**  
moderately phric (2-10%)  
olivine  
5-7%  
3-5 mm  
equant  
iddingsite  
Olivine crystals relatively fresh in the massive part of the flow. Blue/red alteration color.  
plagioclase  
<1%  
1 mm  
tabular (>3:1:1)  

**Groundmass/Matrix:** microcrystalline  
**Color:** N4 medium dark gray  
**Structures:**  
**Sorting:**  
**Vesicles:** 10-15%  
1-5 mm  
sub-rounded  
equant  
some big sub-angular vesicles  
Alteration: moderately (10-40% altered)  
high red oxidation of most of the vesicular clasts  
Veins: none  
Fractures: none  
Additional comments:  
*A* = reddish block at A285-3.5 finely vesiculated; rare, small (3 mm) open-textured gabbros; NaCl deposits on the massive part of the flow.

**BOX UNIT 2:** moderately olivine phric basalt

**Contacts:** Top (R): (R:285 -1.0 -1932.1') [flow contact]  
Bottom (R): (R-7) [continuous with next box]  

**Unit type:** aa  
**Phenocrysts/Clasts:**  
moderately phric (2-10%)  
olivine  
5-10%  
1-3 mm  
equant to blocky  

100 pts counted at R285-3.5  

**Groundmass/Matrix:** microcrystalline  
**Color:** N4 medium dark gray  
**Structures:**  
**Sorting:**  
**Vesicles:** 5-10%  
1-2 mm  
sub-rounded  
equant  
Alteration: fresh to slightly (<2-10% altered)  
Veins: none  
Fractures: weakly to rubble  
Additional comments:  
NaCl ppt
Box #: 212

Cores in box:
- 286
- 287

Loggers: NB
Date logged: 11/25/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 1938.0
Driller's depth: bottom [feet]: 1949.2
Core type: HQ
Units in box: 2

**BOX UNIT 1:** highly olivine phyric basalt

Contacts:
- Top (ft): (R ---) (continuous with previous box)
- Bottom (ft): (R 286 -7.4 -1942.4') (flow contact)
Contact made up of highly altered lava fragments.

Unit type: aa
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 12-15% - 3-7 mm - equant - iddingsite
Olivine crystals seems fresher than in the upper part of the unit.

Groundmass/Matrix: microcrystalline -
Color: N4 med. dark gray - Structures: - Sorting: -
Vesicles: 10-15% - 1-5 mm - sub-angular - equant -
Some vesicles are horizontally elongated.
Alteration: moderately (10-40% altered) -
- red oxidation of the clastic material
Veins: none
Fractures: none

Additional comments:
- One big olivine xenolith (dunite?) (see photo). Pieces of basalt embedded in the massive part of the flow. Rare plagioclase microphenocrysts.

**BOX UNIT 2:** aphyric basalt

Contacts:
- Top (ft): (R 286 -7.4 -1942.4') (flow contact)
- Bottom (ft): (R ---) (continuous with next box)
Highly weathered contact

Unit type: aa
Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - 1-3 mm - equant - iddingsite
- very rare olivine crystals

Groundmass/Matrix: microcrystalline -
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 10-15% - 1-3 mm - sub-rounded - equant -
- clay
- vesicles are filled by yellowish clay from R286-7.5 to R287-1.4
Alteration: highly (40-80% altered) -
- oxidation of clasts and yellowish clay in vesicles
Veins: none
Fractures: weakly: 1/2 ft

Additional comments:
- NaCl deposits.
- Very low content of olivine.
**Box #:** 213  
**Cores in box:** 287, 288  
**Loggers:** NB  
**Date logged:** 11/26/93  
**Checked by:** MG  
**Check date:** 12/12/93  

**BOX UNIT 1:** Aphyric basalt  
**Contacts:** Top (R-)(R---)(continuous with previous box)  
Bottom (R-)(R---)(continuous with next box)  
no contact  
**Unit type:** aa/transitional  
**Phenocrysts/Clasts:**  
aphyric (<1%)  
olivine <1% - 3-5 mm - equant - iddingsite, clay  
Very rare olivine crystals. One big crystal at R287-7.1 (see photo).  
**Groundmass/Matrix:** Microcrystalline to fine-grained (<1 mm)  
**Color:** N5 medium gray  
**Vesicles:** 15-30% - 3-7 mm - sub-rounded - equant - clay  
Great variations in vesicle shape and volume  
**Alteration:** Moderately (10-40% altered)  
Finely vesicular zones are more altered than the massive inner part of the flow.  
**Veins:** None  
**Fractures:** None  
**Additional comments:**  
Internal flow contact at R288-1.0
**BOX UNIT 1:** aphyric basalt

**Contacts:**
- Top (Tt): (R -') (continuous with previous box)
- Bottom (Bt): (R -') (continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- aphyric (<1%)
- olivine (<1%) - 1-2 mm - equant
  - no obvious spinel inclusions in the olivines; minor oxidation and ildefonsite development

**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)

**Color:** N4 medium dark gray

**Structures:**

- Vesicles: 3-20% - 1-5 mm - rounded to subrounded - equant to elongate
  - Vol.% decreases as size increases down section; elongate subhorizontal vesicle trains are present below R288-6.0; below R288-5.0, <1 mm sized angular voids are present in the groundmass; above R288-3.5, basalt surfaces within the vesicles are oxidized.

**Alteration:**
- fresh to slightly (<2-10% altered)
  - Core appears fresh below R288-5.0; slight groundmass oxidation above that depth.

**Veins:** none

**Fractures:**
- Weakly fractured below R288-5.0; between R288-2.3 and R288-5.0 core is moderately fractured to rubbly. Ivory colored material (clays?) coat many of the fracture surfaces

**Additional comments:**
- NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R289-4.8 -1967.3') (flow contact)

Unit type: aa/transitional
base of a flow

Phenocrysts/Clasts:
aphyric (<1%) - olivine - <1% - 3-5 mm - equant - iddingsite
very rare olivine crystals

Groundmass/Matrix: microcrystalline

Color: N3 dark gray

Vesicles: 2-5% - 1-3 mm - sub-rounded - elongated

Alteration: moderately (10-40% altered)

Veins: none

Fractures: weakly: 1/1.6 ft

Additional comments:

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (ft): (R 289-4.8 -1967.3') (flow contact)
Bottom (ft): (R --') (continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 4-6% - 2-5 mm - equant - iddingsite, clay
100 pts counted at R290-5.0

Groundmass/Matrix: microcrystalline

Color: N5 medium gray

Vesicles: 2-5% - 1-3 mm - sub-rounded - elongated - clay
tiny vesicles with a very irregular shape

Alteration: highly (40-60% altered)

Veins: none

Fractures: none

Additional comments:

UNIT #1: 119

UNIT #120

Cores in box
289
290

Loggers: NB
Date logged: 11/26/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 1967.8
Driller's depth: bottom [feet]: 1976.8
Core type: HQ

Units in box: 2
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: aa
inner part of a thick lava flow

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 3-6% - 2-5 mm - equant - iddingsite
200 pts counted at R291-3.0

Groundmass/Matrix: microcrystalline
Color: 5YR 4/1 brownish gray
Vesicles: 7-10% - 5-10 mm - angular - inclined
Alteration: moderately (10-40% altered)
Fractures: Weakly: 8/10 ft; one fracture filled by yellowish clay (see photo).

Additional comments:
NaCl deposits from R290-6.0 to R290-8.2.
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R291-5.4 and R291-10.3; rubble in R292 (see photo)
Bottom (ft): (flow contact) flow contact defined by lithologic change (from more to less olivine phyric) and flow textures on the piece labeled "E" on the photo

Unit type: massive to r..ubbly

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 7% - 2-4 mm - equant to tabular
- 7% at R292-6.1; rare spinel inclusions in the olivine phenocrysts; olivines present in crystal clots

Groundmass/Matrix: microcrystalline

Vesicles: 1-10% - <1-5 mm - subrounded to subangular
- Vesicles are inhomogeneously distributed; smaller vesicles are equant.

Alteration: fresh to slightly (<2-10% altered) - slight groundmass oxidation within 2 ft of the contact

Veins: none

Fractures: weakly fractured: 6/4.8 ft; ivory-colored material coating some of the fractured surfaces

Additional comments:
- extremely rare plagioclase - usually associated with olivine in crystal clots
- see photo: "A" = grain with dunite inclusion on the exterior surface; "B" = vesicular microgabbro; "C" = autolith; "D" = vesicular microgabbro (?)

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (ft): (R292-1.6-1992.8)(flow contact)
Bottom (ft): (R292-3.0-1994.2)(flow contact)

see unit 1 for a description of the upper contact; lower contact defined by remnant of a weathered zone, which does not have a strongly baked appearance, a thin patch of vesicular "glassy" material, and a lithologic change from less to more highly phyric basalt

Unit type: rubble
with exception of a 1' section (see photo), the unit consists of rubbly/clinkery material

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 2-4% - 1-2 mm - equant
- olivines are slightly oxidized

Groundmass/Matrix: microcrystalline

Color: N4 - Structures: - Sorting: -

Vesicles: 10-30% - 1-3 mm - rounded to subrounded - equant - some larger subangular vesicles

Alteration: moderately (10-40% altered) - groundmass oxidation

Veins: none

Fractures: rubbly (see photo)

Additional comments:
- see photo: "F" = small patch of glassy/cryptocrystalline material on the lower surface

BOX 217 CONTINUED ON NEXT PAGE
Box #: 217

Cores in box:
291
292

Loggers: MBB
Date logged: 11/26/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 1986.1
Driller's depth: bottom [feet]: 1997.0
Core type: HQ

Units in box: 3

BOX UNIT 3: highly olivine phyric basalt

Contacts:
Top (t): (R 292-3.0-1994.2')(flow contact)
Bottom (b): (R--')(continuous with next box)
See unit 2 for a contact description.

Unit type: rubble
Clinkery material with minor baked zone; most of the pieces are <5 cm in longest dimension.

Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 2-3 mm - equant -
visual estimate of mode

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N3 to 10R 4/1
Structure:
Sorting:
Vesicles: 5-30% - <1-3 mm - sub-rounded - equant-
Alteration: moderately (10-40% altered)
Veins: none
Fractures: rubble
Additional comments:
Some of the pieces have "glassy" selvages. This unit appears to be a mix of material.
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R293.1) continuous with previous box
- Bottom (ft): (R293.1-1.0-1998.0) (flow contact)

*Flow contact defined by flow textures and clinkery material above the contact and highly vesicular (<1 mm-sized vesicles) zone below contact*

**Unit type:** rubble

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - 10-15% - 1-3 mm - equant - visual estimate of mode

**Groundmass/Matrix:** microcrystalline

**Color:** 5R 3/4 dusky red

**Vesicles:** 5-30% - <1-3 mm - sub-rounded - equant

**Alteration:** slightly to moderately (2-40% altered)

**Veins:** none

**Fractures:** rubble

**Additional comments:**

### BOX UNIT 2: moderately olivine phyric basalt

**Contacts:**
- Top (ft): (R293.1-1.0-1998.0) (flow contact)
- Bottom (ft): (R294.1-1.5-2000.8) (flow contact)

*See unit 1 for upper contact description; lower contact defined by zone of increasing vesicularity and decreasing vesicle size above the contact.*

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 7% - 2-5 mm - equant to tabular - 7% at R294.0; no obvious spinels; moderately oxidized; MnO coatings

**Groundmass/Matrix:** microcrystalline

**Color:** 10R 4/2

**Vesicles:** 20-30% - <1-10 mm - rounded to subrounded - equant to elongate (random orientation)

**Alteration:** moderately (10-40% altered)

**Veins:** none

**Fractures:** moderately fractured - see photo for location of rubbly zones

**Additional comments:**
# BOX UNIT 3: highly olivine phyric basalt

## Contacts:
- **Top (ft):** R294-1.5-2000.9 (flow contact)
- **Bottom (ft):** R294-6.5-2005.8 (flow contact)
- See unit 2 for top contact description

## Unit Type:
aa/transitional

## Classification:
Based on the presence of clinkery material which grades into massive core with highly sheared/elongate vesicles

## Phenocrysts/Clasts:
- Highly phyric (>10%)
- Olivine ~ 11% ~ 2-3 mm ~ equant ~
  - 11% at R294-5.4, rare spinel inclusions in the olivine phenocrysts; olivines occur in crystal clots; some phenocrysts are >5 mm in longest dimension; olivines are moderately to slightly oxidized; freshest below R294-5.0
- 11% at R294-5.4; rare spinel inclusions in the olivine phenocrysts; olivines occur in crystal clots; some phenocrysts are >5 mm in longest dimension; olivines are moderately to slightly oxidized; freshest below R294-5.0

## Groundmass/Matrix:
- Microcrystalline

## Color:
- N4 medium dark gray

## Structures:
- Sorting:

## Vesicles:
- 5-10% ~ <1-5 mm ~ subrounded to angular ~ equant to elongate ~
  - Smallest vesicles are equant; extent of vesicle shearing increases away from the contact; below R294-5.0 vesicles are highly sheared and give an indication of a circular flow pattern

## Alteration:
- Fresh to moderately (~2-40% altered) ~
  - Extent of groundmass oxidation decreases down section away from the contact; fresh core below R294-3.0

## Veins:
- None

## Fractures:
- Weakly fractured: 0'/4.2 ft, measured below R294-2.3, doesn't include rubbly zone labeled "A" on photo

## Additional Comments:
- See photo: "B" = vug?
- Minor NaCl ppt
**Box #:** 219

**Cores in box**
- 294
- 297
- 295
- 296

**Loggers:** NB
**Date logged:** 11/26/93
**Checked by:** MG
**Check date:** 12/12/93
**Units in box:** 1

**Driller's depth: top [feet]:** 2006.5
**Driller's depth: bottom [feet]:** 2017.8
**Core type:** HQ

**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 294-6.5-2005.6' flow contact)
- Bottom (ft): (R-') (continuous with next box)
  approximately at top of box

**Unit type:** aa
clastic and massive part of aa-type of flow

**Phenocrysts/Clasts:**
- highly phyric (>10%)
  - olivine: 12-15% - 3-5 mm - equant - iddingsite
- Olivine crystals highly altered in the clasts and fairly fresh in the inner part of the flow.

**Groundmass/Matrix:** microcrystalline

**Color:** N4 medium dark gray
** Structures:**

**Vesicles:** 5-20% - 1-5 mm - sub-rounded - equant
  - Low vesicle content in the massive part of the flow

**Alteration:** slightly (2-10% altered)
- oxidation

**Veins:** none

**Fractures:** weakly (1/2 ft) in massive part of flow

**Additional comments:**
- Some NaCl deposits on the massive inner part of the flow from R297-2.5.
**BOX UNIT 1:** highly olivine phyric basalt  
Contacts:  
Top (ft): (R --')(continuous with previous box )  
Bottom (ft): (R.298-6.5-2026.0')(flow contact )  
contact between 2 clastic zones having different coloration  
Unit type: aa  
Phenocrysts/Clasts: highly phyric (>10%)  
olivine - 10-13% - 3-5 mm - equant - iddingsite  
Spinel inclusions. Olivine crystals fairly fresh in the inner part of the flow.  
Groundmass/Matrix: microcrystalline -  
Color: N5 medium gray - Structures: - Sorting: -  
Vesicles: 5-10% - 2-5 mm - sub-angular - horizontally elongated -  
Great variations in vesicles content. Holes formed by deformation of the molten rock.  
Alteration: slightly (2-10% altered) -  
Flow relatively fresh. Clasts highly altered.  
Veins: none  
Fractures: weakly: 9/7 ft  
Additional comments:

**UNIT #: 125**

**BOX UNIT 2:** highly olivine phyric basalt  
Contacts:  
Top (ft): (R 298-6.5-2026.0')flow contact )  
Bottom (ft): (R--')(continuous with next box )  
Variations in clast coloration at the contact.  
Unit type: aa  
Phenocrysts/Clasts: highly phyric (>10%)  
olivine - 15-20% - 1-5 mm - equant - iddingsite  
highly altered olivine crystals  
Groundmass/Matrix: microcrystalline -  
Color: 10R 4/2 grayish red - Structures: - Sorting: -  
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant -  
Alteration: highly (40-80% altered) -  
red oxidation of the clasts  
Veins: none  
Fractures: rubble  
Additional comments:
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)
Unit type: aa
  top of aa-type of flow
Phenocrysts/Clasts:
highly phryic (>10%)
olivine - 15-50% - 4-7 mm - equant - iddingsite
olivine crystals almost black
Groundmass/Matrix: microcrystalline
Color: 5YR 4/1 brownish gray
Vesicles: 1-10% - 7-10 mm - sub-angular - elongated
Alteration: moderately (10-40% altered)
  Clasts are 100% altered. Alteration decreases from R302 to R302-2.0 in the inner part of the flow.
Veins: none
Fractures: Moderately: 7/2 ft; some fractures are filled by yellowish clay.
Additional comments:

UNIT #: 126
Cores in box:
299 302
300 303
301

BOX 221
Cores in box:
299 302
300 303
301

Loggers: NB
Date logged: 11/26/93
Checked by: MG
Check date: 12/12/93

Driller's depth: top [feet]: 2028.8
Driller's depth: bottom [feet]: 2042.6
Core type: HQ
Units in box: 1
**BOX UNIT 1**: highly olivine phyric basalt

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
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<tr>
<td><strong>Contacts</strong>:</td>
<td>Top (ft): (R--')(continuous with previous box)</td>
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<tr>
<td></td>
<td>Bottom (ft): (R--')(continuous with next box)</td>
</tr>
<tr>
<td><strong>Unit type</strong>:</td>
<td>aa/transitional</td>
</tr>
<tr>
<td><strong>Phenocrysts/Clasts</strong>:</td>
<td>highly phyric (&gt;10%) - olivine - 15-20% - 3-7 mm - equant - iddingsite - relatively fresh olivine crystals; 100 pts counted at R303-3.0</td>
</tr>
<tr>
<td><strong>Groundmass/Matrix</strong>:</td>
<td>microcrystalline</td>
</tr>
<tr>
<td><strong>Color</strong>:</td>
<td>N5 medium gray</td>
</tr>
<tr>
<td><strong>Vesicles</strong>:</td>
<td>5-7% - 3-7 mm - sub-rounded - elongated - Great variations in vesicles size and shape.</td>
</tr>
<tr>
<td><strong>Alteration</strong>:</td>
<td>moderately (10-40% altered) - relatively fresh flow</td>
</tr>
<tr>
<td><strong>Veins</strong>:</td>
<td>none</td>
</tr>
<tr>
<td><strong>Fractures</strong>:</td>
<td>weakly: 6/10 ft; fractures filled by yellowish clay</td>
</tr>
</tbody>
</table>

**Additional comments**: Fairly fresh inner part of a thick aa-type of flow.
Box #: 223  
Cores in box: 304

Loggers: NB  
Date logged: 11/26/93  
Checked by: MG  
Check date: 12/12/93

Driller's depth: top [feet]: 2052.0  
Driller's depth: bottom [feet]: 2061.2

Core type: HQ

Units in box: 2

---

**BOX UNIT 1**: highly olivine phyric basalt

**Contacts**:  
Top (ft): (R -) (continuous with previous box)  
Bottom (ft): (R304-7.3-2059.4') (flow contact)  
very sharp contact with red oxidized material

**Unit type**: massive  
no clasts at bottom of the flow

**Phenocrysts/Clasts**:  
highly phyric (>10%)  
olivine - 15-20% - 3-5 mm - equant and laths - iddingsite  
some big crystals >10 mm (xenocrysts?)

**Groundmass/Matrix**: microcrystalline

**Color**: N4 medium dark gray  
**Structures**: - Sorting: -  
Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated - long flattened vesicles

**Alteration**: moderately (10-40% altered)  
fairly fresh flow

**Veins**: none  
**Fractures**: weakly: 5/6 ft

**Additional comments**:  

---

**BOX UNIT 2**: aphyric basalt

**Contacts**:  
Top (ft): (R304-7.3-2059.4') (flow contact)  
Bottom (ft): (R -) (continuous with next box)  
red alteration of the first 20 cm of the flow

**Unit type**: aa  
top of aa-type of flow

**Phenocrysts/Clasts**:  
aphyric (<1%) -

**Groundmass/Matrix**: microcrystalline to fine-grained (<1 mm) -

**Color**: 5YR 4/1 brownish gray  
**Structures**: - Sorting: -  
Vesicles: 10-15% - 1-5 mm - spherical - equant - clay  
important variations in vesicle content

**Alteration**: slightly to highly (2-80% altered) -  
highly altered clasts with yellowish clay and red oxidation

**Veins**: none  
**Fractures**: moderately

**Additional comments**:  

---
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R305-6.1-2068.2')(flow contact)
Very brecciated contact with yellowish clay and red oxidation.

Unit type: aa
aa-type of flow with cavities

Phenocrysts/Clasts:
aphyric (<1%)

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray

Structures: Sorting:

Vesicles: 5-20% - 1-10 mm - sub-rounded - equant -
clay
Large variations in vesicle shape and volume. Clay coatings inside vesicles when close to the bottom and to fractures.

Alteration: moderately (10-40% altered)
Clasts are almost 100% altered.

Veins: none
Fractures: 2 -horizontal fractures filled with yellowish clay.

Additional comments:
NaCl deposits between R305-1.0 and R305-6.0

BOX UNIT 2: sparsely olivine phyric basalt

Contacts: Top (ft): (R 305-6.1-2068.2')(flow contact)
Bottom (ft): (R --')(continuous with next box)
Highly weathered contact. Yellowish clay and angular clasts.

Unit type: aa

Phenocrysts/Clasts:
sparsely phyric (1-2%)
olivine - 1-2% - 2-3 mm - equant - iddingsite
Relatively fresh olivines close to the flow contact.

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray

Structures: Sorting:

Vesicles: 10-20% - 1-5 mm - sub-rounded - equant - clay
Vesicles irregularly distributed in the flow. Yellowish clay filling vesicles at the contact.

Alteration: moderately (10-40% altered)
highly oxidized; clay

Veins: none
Fractures: rubbly

Additional comments:
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (ft): (R --) continuous with previous box. Bottom (ft): (R307-2.6 - 2082.8) flow contact. Bottom of unit is marked by broken & rubbly zone and a change in vesicularily but no baked zone is observed.

Unit type: aa - pahoehoe. Upper part of unit down to R306-5.65 is an aa flow with rubble at its top and included autoliths. The bottom part of the unit is composed of several pahoehoe flows with internal ropy contacts at R306-7.4 and R307-0.7. Same lithology across all internal flow contacts.

Phenocrysts/Clasts: sparsely phyric (1-2%) - olivine - 1-2% - 1-5 mm - equant - iddingsite. Iddingsite occurs rimming grains or along fractures. Iddingsite is most prevalent just below each internal flow contact.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm) - Groundmass is rich in plagioclase (20-30%).

Color: N4 med. dark gray - Structures: - Sorting: -

Vesicles: 10-20% - 1-5 mm - spherical to sub-angular - equant - The vesicles in the aa flow at the top of the unit are generally sub-angular and more irregular with a larger diameter than those seen in the pahoehoe flows in the bottom portion of the unit. In the pahoehoe flows, the vesicles are spherical and small (<1 mm) near the internal flow contact and get larger with depth.

Alteration: slightly (2-10% altered) - hematite, clay(?). Minor hematite near top and bottom of internal flows. Fracture surfaces and insides of adjacent vesicles are coated with a yellowish white clay(?).

Veins: none

Fractures: Fractures are generally narrow with opposite sides fitting together and coated with a yellowish-white clay(?). Unit is weakly fractured with a rubbly zone from R306-2.5 to R306-3.0 that also has yellowish-white clay(?), coatings on the rubble surfaces.

Additional comments: Bottom of unit coincides with the bottom of the box. Salt crusts readily form with drying on the cut surfaces of the pahoehoe sections.
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (ft): (R 307-2.8 - 2082.9') (flow contact)
Bottom (ft): (R 306-4.8 - 2090.7') (flow contact)
Flow contact defined by a moderately oxidized clinky zone above the contact and very highly oxidized basaltic clasts set in an oxidized matrix below the contact; this material is baked tight at the contact.

Unit type: aa
Classification based on the presence of clinky material that grades into poorly vesicular massive core by R307-4.7

Phenocrysts/Clasts:
- sparsely phytic (1-2%) -
- olivine - 1-2% - 1-2 mm - equant -
- 2% at R308-0.7; 1% at R308-3.7

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 5-10% - <1-5 mm - rounded to angular - equant to elongate -
Below R308-2.0, vesicles increase in size and decrease in vol.% and are subhorizontal; above this depth, vesicles are subvertical.
Alteration: slightly to moderately (2-40% altered) -
Extent of groundmass oxidation increases toward contact.
Veins: none
Fractures: Between R307-2.8 and R308-4.8, core is rubbly; between R307-5.0 and R308-4.0, core is weakly fractured: 4/4.7 ft.
Additional comments:
- groundmass plagioclase laths

BOX UNIT 2: sparsely olivine phyric basalt

Contacts: Top (ft): (R 308-4.8 - 2090.7') (flow contact)
Bottom (ft): (R 309-4.8) (continuous with next box)
Flow contact described in unit 1

Unit type: aa

Phenocrysts/Clasts:
- sparsely phytic (1-2%) -
- olivine - 1-2% - 1-2 mm - equant -
- visually estimated mode; no obvious spinel inclusions

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: 10R 3/4 dark reddish brown - Structures: - Sorting: -
Vesicles: <15% - <1-3 mm - sub-angular - elongate -
Alteration: very highly to completely (80-100% altered) -
groundmass oxidation
Veins: none
Fractures: rubble
Additional comments:
Box #: 227

Cores in box

309
310

Loggers: MBB
Date logged: 11/28/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2098.4
Driller's depth: bottom [feet]: 2105.6
Core type: HQ

Units in box: 1

BOX UNIT 1: sparsely olivine phyric basalt

Contacts:
Top (ft): (R--A)(continuous with previous box)
Bottom (ft): (R--B)(continuous with next box)

Unit type: aa
Highly oxidized rubbly zone grades into massive material by R309-3.7.

Phenocrysts/Clasts:
sparsely phyric (1-2%) -
olivine - 1-2% - 1-2 mm - equant -
2% at R309-7.4; 1% at R309-9.6; spinel inclusions in the olivine phenocrysts; only very minor olivine oxidation

Groundmass/Matrix: microcrystalline -
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 5-15% - <1-5 mm - subrounded to subangular - equant to elongate -
Orientation of elongate vesicles changes within section; vertical between R309-4.3 and 5.5 and generally horizontal between R309-6.0 and bottom of box.
Alteration: fresh to completely (>2-100% altered) -
Extent of groundmass oxidation decreases from top of box to R309-7.0 where the core is essentially fresh.
Veins: none
Fractures: weakly fractured: 18/ft; ivory-colored filaments partially cover some of the fracture surfaces
Additional comments:
plagioclase laths faintly visible in the groundmass
BOX UNIT 1: sparsely olivine phyric basalt
Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R 310 - 6.2 - 2111.2') (flow contact)
red base and lithology change
Unit type: massive
Phenocrysts/Clasts:
sparsely phyric (1-2%) -
olivine - 1-2% - 1-3 mm - equant to blocky -
200 pts counted at R310-2.0
- - - - -
Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10% above R310-1.5, <5% below - <1 to 3 mm - spherical - horizontally elongated -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly: 18/6 ft
Additional comments:
- rare, small (-3 mm) gabbroic inclusions; rare plagioclase microphenocrysts (0.5 mm)

BOX UNIT 2: aphyric basalt
Contacts: Top (ft): (R 310-6.2-2111.2') (flow contact)
Bottom (ft): (R --') (continuous with next box)
orangish brown rubble on top
Unit type: pahoehoe
round, abundant vesicles
Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - <1 mm - equant -
- - - - -
Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-20% - 2-3 mm - spherical - equant -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly: 4/2 ft
Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R--')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: pahoehoe
glassy flow surface at base of box

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - <1 mm - equant -

Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 med. gray
Vesicles: 20-30% - 1-3 mm - spherical - equant -
Alteration: slightly (2-10% altered) -
minor oxidation
Veins: none
Fractures: weakly: 11/8 ft

Additional comments:
NaCl ppt; possible K/Ar candidate
BOX UNIT 1: aphyric basalt
Contacts: Top (fl): (R--) (continuous with previous box)
          Bottom (fl): (R 312-1.3-2127.4') (flow contact)
          red oxidized zone at base; lithology change
Unit type: pahoehoe
          internal flow contact at R311-9.2
Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - <1 mm - equant -

Groundmass/Matrix: fine-grained (<1 mm) -
Color: N5 med. gray - Structures: -
Vesicles: 20-30% - 1-3 mm - spherical - equant -
Alteration: slightly (2-10% altered) -
oxidation
Veins: none
Fractures: weakly; 5/3 It
Additional comments:
NaCl ppt

UNIT #1:31

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (fl): (R 312-1.3-2127.4') (flow contact)
          Bottom (fl): (R--) (continuous with next box)
          lithology change
Unit type: aa
          rubbly, mildly oxidized top
Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 10-15% - 1-3 mm - equant to blocky -

Groundmass/Matrix: microcrystalline -
Color: N4 med. dk. gray - Structures: -
Vesicles: 10-20% - 1-2 mm - sub-rounded - equant -
Alteration: moderately (10-40% altered) - clay and oxidation
Veins: none
Fractures: rubbly
Additional comments:
**BOX UNIT 1**: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R--1(continuous with next box)

**Unit type:** aa

**Phenocrysts/Clasts:**
- highly phyric (>10%) -
  - olivine - 10-15% - 1-5 mm - equant to blocky -
  - 200 pts counted at R313-6.5, rare 1 cm crystals

**Groundmass/Matrix:** microcrystalline -

**Color:** N4 med. dk. gray - **Structures:** - **Sorting:** -

**Vesicles:** 5-10% - 1-2 mm - sub-rounded - equant -
mostly small except between R313-2.0 to 4.0

**Alteration:** slightly (2-10% altered) -
oxidation with clay on fractures

**Veins:** none

**Fractures:** weakly (6/4 ft), but rubbly at top

**Additional comments:**
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R-\)-(continuous with previous box)
  Bottom (ft): (R--\)-(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
  highly phyric (>10%) -
  olivine - 10-15% - 1-4 mm - equant to blocky -
  200 pts counted at R313-9.0

Groundmass/Matrix: microcrystalline -

Color: N4 med. dk. gray - Structures: -

Vesicles: <5% to 5-10% - 1-2 mm - sub-angular - equant -
  change below R314 6.0 to: 10-20 %, 2-4 mm, sub rounded, horizontally elongate

Alteration: fresh (<2% altered) -

Veins: none

Fractures: weakly: 5/6 tt

Additional comments:
  NaCl ppt

Box #: 232

Cores in box:
  313
  314

Loggers: MG

Date logged: 11/28/93

Checked by: MG

Check date: 12/13/93

UNIT #: 132

Driller's depth: top [feet]: 2142.5

Driller's depth: bottom [feet]: 2151.8

Core type: HQ

Units in box: 1
BOX UNIT 1: highly olivine phyric basalt

Contacts:  Top (R-)(continuous with previous box)
Bottom (R-)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - 10-15% - 1-4 mm - equant to blocky
  - 200 pts counted at R315-3.0, multi-grain clusters

Groundmass/Matrix: microcrystalline

Color: N5 med. gray

Vesicles: 10-20% - bimodal - sub-rounded - inclined (20°)
  - <1 and 2-4 mm

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly: 7/8 It

Additional comments:
- NaCl ppt

Box #:

233

Cores in box:

314
315

Loggers:

MG

Date logged:

11/28/93

Checked by:

MG

Check date:

12/13/94

Driller's depth: top [feet]:

2151.8

Driller's depth: bottom [feet]:

2161.1

Core type: HQ

Units in box:

1
BOX UNIT 1: highly olivine phyric basalt

Contacts:  
Top (ft): (R - --)(continuous with previous box)  
Bottom (ft): (R316-1.8-2168.0')(flow contact)  
base marked by 5 cm thick red soil/ash; glassy base

Unit type: massive

Phenocrysts/Clasts:  
highly phyric (>10%) -  
olivine - 14-16% - 1-4 mm - equant to blocky -  
100 pts counted at R315-7.5; multi-grain clusters

Groundmass/Matrix: microcrystalline -  
Color: N5 med. gray - Structures: - Sorting: -  
Vesicles: 5-10% - 1-3 mm - sub-rounded - horizontally elongated to inclined -  
Alteration: fresh (<2% altered) -  
Veins: none

Fractures: weakly: 4/6 ft

Additional comments:  
NaCl ppt; glass at base of flow at R316-1.8

BOX UNIT 2: moderately olivine phyric basalt

Contacts:  
Top (ft): (R316-1.8-2168.0')(flow contact)  
Bottom (ft): (R316-3.6-2169.8')(flow contact)  
flow type change; distinct red contacts

Unit type: pahoehoe

Phenocrysts/Clasts:  
moderately phyric (2-10%) -  
olivine - 4-6% - 1-3 mm - equant to blocky -  
100 pts counted at R316-3.0

Groundmass/Matrix: microcrystalline -  
Color: 10R 3/4 dk. red brown - Structures: - Sorting: -  
Vesicles: >30% - 1-2 mm - spherical - equant -  
Alteration: moderately (10-40% altered) - clay and oxidation

Veins: none

Fractures: weakly: 6/2 ft

Additional comments:

NaCl ppt; glass at base of flow at R316-1.8
**BOX UNIT 3:** moderately olivine phyric basalt

**Contacts:**
- Top (ft): (R 316-3.6-2169.8') (flow contact)
- Bottom (ft): (R--) (continuous with next box)

- red, rubbly top

**Unit type:** aa

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 2-4% - 1-3 mm - equant

- Groundmass/Matrix: microcrystalline

- Color: 10Y 3/4 dk. red brown

- Vesicles: 10-20% - <1-3 mm - sub-rounded - vertically elongated

- Alteration: moderately (10-40% altered) - clay and oxidation

- Veins: none

- Fractures: rubbly

**Additional comments:**

**Box #:** 234  
**Cores in box:** 315, 316  
**Loggers:** MG  
**Date logged:** 11/28/93  
**Checked by:** MG  
**Check date:** 12/13/94  

**UNIT #: 134**

**Driller's depth: top [feet]:** 2161.1  
**Driller's depth: bottom [feet]:** 2169.8

**Core type:** HQ

**Units in box:** 3

**Cores in box:** 315, 316
# Box 235

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<th>Loggers</th>
<th>Driller's depth: top [feet]</th>
<th>Core type</th>
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<td>MG</td>
<td>2169.8</td>
<td>HQ</td>
</tr>
<tr>
<td>317</td>
<td></td>
<td>2179.2</td>
<td></td>
</tr>
</tbody>
</table>

**Date logged:** 11/28/93  
**Checked by:** MG  
**Check date:** 12/13/93

**Box UNIT 1:** moderately olivine phyric basalt

- **Contacts:**
  - Top (ft): (R=..)(continuous with previous box)
  - Bottom (ft): (R316-7.2-2173.4')(flow contact)
- **Unit type:** massive
- **Phenocrysts/Clasts:**
  - moderately phyric (2-10%)
  - olivine - 2-4% - 1-3 mm - equant to blocky
  - 100 pts counted
- **Groundmass/Matrix:** microcrystalline
- **Color:** 5YR 4/1 brownish
- **Vesicles:** 10-20% - <1 to 10 mm - spherical - equant to inclined
- **Alteration:** slightly (2-10% altered)
- **Additional comments:**
  - NaCl ppt

**Box UNIT 2:** sparsely olivine phyric basalt

- **Contacts:**
  - Top (ft): (R316-7.2-2173.4')(flow contact)
  - Bottom (ft): (R316-8.7-2174.9')(flow contact)
- **Unit type:** pahoehoe
- **Phenocrysts/Clasts:**
  - sparsely phyric (1-2%)
  - olivine - 1-2% - 1-2 mm - equant to blocky
- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)
- **Color:** 10R 2/2 very dusky red
- **Vesicles:** 20-30% - 1-2 mm - spherical - equant
- **Additional comments:**
  - weakly: 5/3 ft

**Box 235 CONTINUED ON NEXT PAGE**
BOX UNIT 3: moderately olivine phyric basalt

Contacts: Top (ft): (R 316-8.7 - 2174.9')(flow contact)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 5-7% - 1-3 mm - equant

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray

Structures:

Vesicles: 20-30% - 1-5 mm - sub-rounded

Alteration: slightly (2-10% altered)

Veins: none

Fractures: rubbly

Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 15% - 1-3 mm - equant
- 300 pts counted at R317-6.0

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray

Structures:

Sorting:

Vesicles: 10-20% - 2-8 mm - spherical - equant

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly: 6/7 ft in lower part; upper part moderately fractured

Additional comments:
- rare small (~3 mm) gabbroic inclusions; NaCl ppt
- glassy interval at R317-1.6 to 2.0
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R- -')(continuous with previous box )
Bottom (ft): (R318 -2.5 -2189.6')(flow contact)
distinct red base

Unit type: massive
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 5-7% - 1-3 mm - equant to blocky
200 pts counted at R318-1.0

Groundmass/Matrix: microcrystalline -
Color: N4 med. dk. gray - Structures: - Sorting:
Vesicles: 10-20% - 1-4 mm - spherical - equant -
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 2/2 ft
Additional comments:
NaCl ppt

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R318 -2.5 -2189.6')(flow contact)
Bottom (ft): (R- -')(continuous with next box )
red oxidized rubbly top

Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-15% - 1-3 mm - equant -
visual estimate

Groundmass/Matrix: microcrystalline -
Color: N4 med. dk. gray - Structures: - Sorting:
Vesicles: 10-20% - 1-4 mm - sub-angular - variable -
mostly rubble
Alteration: slightly to highly (2-80% altered)
Veins: none
Fractures: rubbly
Additional comments:
**Box Unit 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 10.7) (continuous with previous box)
- Bottom (ft): (R 319-10.7-2205.77) (flow contact)

**Unit Type:** massive

**Phenocrysts/Clasts:**
- Highly phyric (>10%)
- Olivine - 15-20% - 1-3 mm - equant to blocky - 100 pts counted at R319-8.5

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Structures:**
- Sorting:

**Vesicles:**
- 10-20% - <1-5 mm - sub-rounded - horizontally elongated

**Alteration:**
- Slightly (2-10% altered)

**Veins:** none

**Fractures:** weakly: 15/10 ft

**Additional Comments:**
- NaCl ppt; rare plagioclase microphenocrysts

---

**Box #: 238**

**Cores in Box:** 319

**Loggers:** MG

**Date Logged:** 11/28/93

**Checked by:** MG

**Check Date:** 12/13/93

**Driller's Depth:**
- Top [feet]: 2195.2
- Bottom [feet]: 2205.5

**Core Type:** HQ

---

**Units in Box:** 1
Box #: 239

**Cores in box**
- 320
- 321

**Loggers:** MG  
**Date logged:** 11/28/93  
**Checked by:** MG  
**Check date:** 12/13/93

**BOX UNIT 1:** highly olivine phyric basalt

- **Contacts:** Top (ft): (R 320-0.0-2205.7') (flow contact)  
  Bottom (ft): (R --) (continuous with next box)  
  Upper ~1.0 ft of run (top of box) is rubble of mixed origin (cave?).

- **Unit type:** massive
- **Phenocrysts/Clasts:** highly phyric (>10%) - olivine - 10-15% - 1-3 mm - equant -
- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm) -
- **Color:** N5 med. gray - Structures: - Sorting: -
- **Vesicles:** 10-20% - 1-5 mm - spherical - equant -
- **Alteration:** fresh (<2% altered) -
- **Veins:** none
- **Fractures:** weakly, 1/4 ft
- **Additional comments:** NaCl ppt

**UNIT #138**

- **Driller's depth:**
  - Top [feet]: 2205.5
  - Bottom [feet]: 2216.1
- **Core type:** HQ
- **Units in box:** 1

- **Contacts:** Top (ft): (R 320-0.0-2205.7') (flow contact)  
  Bottom (ft): (R --) (continuous with next box)

- **Upper ~1.0 ft of run (top of box) is rubble of mixed origin (cave?).**

- **Unit type:** massive
- **Phenocrysts/Clasts:** highly phyric (>10%) - olivine - 10-15% - 1-3 mm - equant -
- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm) -
- **Color:** N5 med. gray - Structures: - Sorting: -
- **Vesicles:** 10-20% - 1-5 mm - spherical - equant -
- **Alteration:** fresh (<2% altered) -
- **Veins:** none
- **Fractures:** weakly, 1/4 ft
- **Additional comments:** NaCl ppt

- **Box:** 239
BOX UNIT 1: highly olivine phryic basalt

Contacts:
- Top (ft): (R--) (continuous with previous box)
- Bottom (ft): (R--) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- highly olivin (>10%)
- olivine: 10-15% - 1-3 mm - equant
- 100 pts counted at R322-3.5

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray

Vesicles: <5 to 5-10% - 1-5 mm - spherical - equant

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly 10/10 ft

Additional comments:
- beautiful rock; autolith at R321-8.3
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (ft): (R -)(continuous with previous box)
Bottom (ft): (R 322-8.0-2227.7')(flow contact)
red oxidized base; lithology change
Unit type: massive
Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 6-8% - 1-3 mm - equant
100 pts counted at R322-6.5
Groundmass/Matrix: microcrystalline
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - spherical - equant
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 1/2 ft
Additional comments:
NaCl ppt, glass at base
less olivine than overlying rock of same unit

BOX UNIT 2: aphyric basalt
Contacts: Top (ft): (R 322-8.0-2227.7')(flow contact)
Bottom (ft): (R -)(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%)
Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N4 med. dk. gray - Structures: - Sorting: -
Vesicles: >30% - 1-3 mm - spherical - equant
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 7/6 ft
Additional comments:
NaCl ppt; internal contacts at R322-9.5 and R323-0.8 (glassy contacts but no lithology change)
<table>
<thead>
<tr>
<th>Box #:</th>
<th>242</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores in box</td>
<td>323 324</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOX UNIT 1: aphyric basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts: Top (ft): (R 323-9.5-2239.4') (flow contact)</td>
</tr>
<tr>
<td>Bottom (ft): (R 323-9.5-2239.4') (flow contact)</td>
</tr>
<tr>
<td>Basal surface oxidized rubble</td>
</tr>
<tr>
<td>Unit type: massive</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td>aphyric (&lt;1%) - olivine (&lt;1%) - 1-2 mm equant -</td>
</tr>
<tr>
<td>Groundmass/Matrix: microcrystalline to fine-grained (&lt;1 mm)</td>
</tr>
<tr>
<td>Color: N5 med. gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td>Vesicles: 10-20% (&lt;1 and 3-5 mm) - spherical - equant to horizontally elongated - some &gt; 1 cm size; plagioclase crystals in vesicles</td>
</tr>
<tr>
<td>Alteration: fresh (&lt;2% altered) -</td>
</tr>
<tr>
<td>Veins: none</td>
</tr>
<tr>
<td>Fractures: weakly 4/4 ft</td>
</tr>
<tr>
<td>Additional comments: NaCl ppt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOX UNIT 2: aphyric basalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contacts: Top (ft): (R 323-9.5-2239.4') (flow contact)</td>
</tr>
<tr>
<td>Bottom (ft): (R 323-9.5-2239.4') (flow contact)</td>
</tr>
<tr>
<td>reddish stain on rubble</td>
</tr>
<tr>
<td>Unit type: aa</td>
</tr>
<tr>
<td>Phenocrysts/Clasts:</td>
</tr>
<tr>
<td>aphyric (&lt;1%) - olivine (&lt;1%) - 2-3 mm blocky (&lt;3:1) - xenocrysts?</td>
</tr>
<tr>
<td>Groundmass/Matrix: microcrystalline</td>
</tr>
<tr>
<td>Color: N5 med. gray - Structures: - Sorting: -</td>
</tr>
<tr>
<td>Vesicles: 20-30% 1-5 mm sub-rounded equant -</td>
</tr>
<tr>
<td>Alteration: slightly (2-10% altered) - oxidation</td>
</tr>
<tr>
<td>Veins: none</td>
</tr>
<tr>
<td>Fractures: rubbly to weakly 6/3 ft</td>
</tr>
<tr>
<td>Additional comments:</td>
</tr>
</tbody>
</table>
BOX UNIT 1: aphyric basalt

Contacts:
- Top (ft): (R -)(continuous with previous box)
- Bottom (ft): (R324-9.0-2249.0')(flow contact)

Unit contact picked based on lithology change (rare plagioclase); internal contacts (flow surfaces) with red stain at R324-4.5, 5.3, 7.0

Unit type: transitional

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - 2 mm - blocky (<3:1:1) -
- plagioclase - <1% - 1 mm - tabular (>3:1:1) -

Groundmass/Matrix: microcrystalline

Color: N4 med. dk. gray - Structures: - Sorting: -

Vesicles: >30% - 1-3 mm - spherical - equant -

Alteration: slightly to moderately (2-40% altered) - clay oxidation

Veins: none

Fractures: rubbly to moderately: 5/1 ft

Additional comments:

BOX UNIT 2: aphyric basalt

Contacts:
- Top (ft): (R 324-9.0-2249.0')(flow contact)
- Bottom (ft): (R -)(continues with next box)

Unit type: aa

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine - <1% - 2-3 mm - blocky (<3:1:1)
- plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting: -

Vesicles: 10-20% - <1 to 3 mm - sub-angular - inclined - highly variable %

Alteration: fresh to moderately (<2-40% altered) - clay rubble zone most altered

Veins: none

Fractures: rubble

Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R-~)(continuous with previous box)
Bottom (ft): (R-~)(continuous with next box)

Unit type: aa
Phenocrysts/Clasts:
aphyric (<1%) —
olivine – <1% – 1-5 mm – blocky (<3:1:1)
plagioclase – <1% – 1-5 mm – tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
Vesicles: <5% – <1 mm – sub-angular – inclined–
Veins: none
Fractures: weakly (1/2 It) to rubbly

Additional comments:
internal rubble zone at R325-3.3, but no change in this distinct lithology (rare plagioclase and olivine)
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R --')(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- sparsely phyric (1-2%)
- olivine - >1% - 2-4 mm - blocky (<3:1:1)
- plagioclase - >1% - 1-2 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline

Color: N4 to N5, med. dk. to med. gray

Structures:
- Sorting: -
- Vesicles: 5-10% - <1 mm - sub-rounded - horizontally elongated - decreasing towards base of box

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly: 9/10

Additional comments:
- rare large olivine and plagioclase crystals (xenocrysts?)

Loggers: MG
Date logged: 11/29/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2262.2
Driller's depth: bottom [feet]: 2274.7
Core type: HQ

Units in box: 1

Box #: 245
Cores in box:
327
328

UNIT #: 141

loggers: MG
Date logged: 11/29/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2262.2
Driller's depth: bottom [feet]: 2274.7
Core type: HQ

Units in box: 1
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R--')(continuous with previous box)
Bottom (ft): (R328-1.9-2272.5')(flow contact)

minor lithology change (less olivine and no plagioclase), but strong red baked zone

Unit type: aa
Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - 2-3 mm - blocky (<3:1:1) -

Groundmass/Matrix: microcrystalline -
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: <5% - 1-3 mm - spherical - equant-
Alteration: fresh (<2% altered) -
Veins: none
Fractures: moderately: 2/0.4 ft
Additional comments:

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 328-1.9-2272.5')(flow contact)
Bottom (ft): (R--')(continuous with next box)

red baked top

Unit type: aa
Phenocrysts/Clasts:
aphyric (<1%) -
olivine - <1% - 1-2 mm - equant -

Groundmass/Matrix: microcrystalline -
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-20% - <1 to 3 mm - sub-angular - inclined-
Alteration: slightly (2-10% altered) - clay
decreasing alteration with depth
Veins: none
Fractures: weakly: 6/2 ft to rubbly
Additional comments:
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R -)(continuous with previous box)
Bottom (ft): (R331 -0.0-2291.5')(flow contact)
contact lost at base of run 330

Unit type: massive
Phenocrysts/Clasts:
aphyric (<1%) -

Groundmass/Matrix: microcrystalline -
Color: N5 med. gray - Structures: - Sorting: -
Vesicles: <5% to 10-20% - <1-5 mm - sub-angular- inclined-
Alteration: slightly (2-10% altered) - oxidation
Veins: none
Fractures: weakly; 6/5 ft

Additional comments:

UNIT #: 142

Box 247

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R331 -0.0-2291.5')(flow contact)
Bottom (ft): (R -)(continuous with next box)

Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 10-20% - 1-3 mm - equant to blocky - visual estimate

Groundmass/Matrix: microcrystalline -
Color: N6 lt. gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - angular - equant-
Alteration: moderately to highly (10-80% altered) - clay
Veins: none
Fractures: rubble

Additional comments:
Box #: 248

Cores in box:
331
332

Loggers: MG

Date logged: 11/29/93

Checked by: MG

Check date: 12/13/93

Driller's depth: top [feet]: 2296.4

Driller's depth: bottom [feet]: 2309.2

Core type: HQ

Units in box: 2

BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (t): (R -' (continuous with previous box)
Bottom (b): (R332-1-6-2303.6')(flow contact)
Internal flow contact at R331-6.1

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 15% - 1-4 mm - equant to blocky -
100 pts at R331-5.0

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting: -
Vesicles: 10-20% - <1 to 4 mm - spherical - equant - zones have 20-30%
Alteration: slightly (2-10% altered) -
oxidation

Veins: none
Fractures: weakly

Additional comments:
NaCl ppt

BOX UNIT 2: highly olivine phyric basalt

Contacts:
Top (t): (R 332-1-6-2303.6')(flow contact)
Bottom (b): (R--')(continuous with next box)
rubbly oxidized top

Unit type: aa

Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 10-15% - 1-4 mm - equant to blocky -

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting: -
Vesicles: >30% - 1-3 mm -
Alteration: moderately to highly (10-80% altered) - clay oxidized

Veins: none
Fractures: rubbly

Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R--) (continuous with previous box)
Bottom (ft): (R--) (continuous with next box)

Unit type: aa
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 15-20% - 1-3 mm - equant to blocky
- 
- 
Groundmass/Matrix: microcrystalline

Color: N5 med. gray

Structures: 
- Sorting: 
- Vesicles: 10-20% - 1-4 mm - sub-angular - inclined - variable %

Alteration: fresh (<2% altered) - clay on surfaces except in rubble at top
Veins: none
Fractures: weakly: 6/6 ft

Additional comments:
- mild NaCl ppt around olivine

Box #: 249

UNIT #: 144

Cores in box
332
333

Loggers: MG
Date logged: 11/29/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2309.2
Driller's depth: bottom [feet]: 2317.9
Core type: HQ

Units in box: 1
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R - -)(continuous with previous box)
Bottom (ft): (R334-0.2-2319.7)(flow contact)
base marked by red, oxidized zone

Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 15-20% - 1-3 mm - equant
- 100 pts counted at R333-7.3

Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting:
Vesicles: <5% - <1-2 mm - sub-rounded - inclined
Alteration: slightly (2-10% altered)
- oxidized
Veins: none
Fractures: weakly to rubbly at base
Additional comments:

UNIT #144

UNIT #145

BOX UNIT 2: highly olivine phyric basalt

Contacts:
Top (ft): (R334-0.2-2319.7)(flow contact)
Bottom (ft): (R - -)(continuous with next box)
red baked rubbly top; internal contact at R334-6.9

Unit type: aa at top; pahoehoe at base
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-5 mm - equant
- 100 pts counted at R334-4.5

Groundmass/Matrix: microcrystalline
Color: N5 med. gray - Structures: - Sorting:
Vesicles: >30% - 1-3 mm - spherical - equant
- variable bands of highly vesicular material
Alteration: slightly (2-10% altered)
- oxidized with clay in vesicles
Veins: none
Fractures: weakly: 7/2 ft to rubbly
Additional comments:
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R - ) (continuous with previous box)
Bottom (ft): (R335-5.5-2335.1') (flow contact)

? on bottom contact; flow boundaries are unclear. Numerous red zones with vesicularity change but no lithology change;
unit 146 (below R335-5.5) is described in Box 252

Unit type: transitional
rubby base

Phenocrysts/Clasts:
moderately to highly phyric (-10%)
olivine - 8-12% - 1-3 mm - equant -
100 pts counted at R335-4.0; some large 0.5-0.8 cm grains

Groundmass/Matrix: microcrystalline

Color: 5R 2/2 grayish red - Structures: - Sorting:
Vesicles: >30% - <1-3 mm - spherical - equant -
Alteration: slightly (2-10% altered) -
oxidized

Fractures: weakly

Additional comments:
Internal contacts at R334-7.9, 8.6, 9.3 and R335-2.0; autoliths common

Box 251
Box #: 252
Cores in box: 336 339

BOX UNIT 1: moderately to highly olivine phyric basalt
Contacts: Top (ft): (R 335 - 5.5 - 2335.1)'flow contact')
Bottom (ft): (R 337 - 0.0 - 2341.0)'flow contact')
-1/2' of this unit is present in Box 251
Unit type: massive
Phenocrysts/Clasts:
- moderately to highly phyric (-10%)
- olivine - 6-12% - 1-3 mm - equant
- 100 pts at R 336-1.3
Groundmass/Matrix: microcrystalline
- Vesicles: 10-20% - 1-3 mm - sub-angular - horizontally elongated
- Alteration: slightly (2-10% altered)
- oxidized
Fractures: moderately (4/1 ft) to rubble
Additional comments:
cave material (green sand) from above; NaCl ppt

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 337 -0.0 - 2341.0)'flow contact')
Bottom (ft): (R -)'continuous with next flow')
flow top missing; internal contacts at R337-1.4 and 2.9 (red, vesicular zone)
Unit type: aa
Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 10-12% - 1-4 mm - blocky (<3:1:1)
- 100 pts at R 339-1.0
Groundmass/Matrix: microcrystalline
- Color: N4 med. dk. gray - Structures: - Sorting:
- Vesicles: 5-10% to >30% - 1-5 mm - sub-angular - horizontally elongated
- Alteration: fresh to slightly (<2-10% altered)
- Veins: none
Fractures: moderately: 16/2 ft
Additional comments:
Olivines in this unit are larger than in the overlying unit.
Box Unit 1: highly olivine phyric basalt

Contacts: Top (ft): (R - - - continuous with previous box)
Bottom (ft): (R - - - continuous with next box)
Internal flow contact at R339-4.3

Unit type: aa

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 10-15% - 1-3 mm - equant
- 100 pts at R340-5.5

Groundmass/Matrix: microcrystalline

Color: N5 med. gray - Structures: - Sorting: -

Vesicles: 10-20% - variable - sub-rounded - elongate - highly variable but decreasing down section to <5% at R340-5.5

Alteration: fresh to moderately (<2 to 40% altered) - oxidation

Veins: none

Fractures: weakly: 5/6 ft

Additional comments:
- few pieces of cave material at top of run 340; autoliths in upper part of core (above R340-3.0)

Box #: 253
Cores in box: 339 340

Loggers: MG
Date logged: 11/29/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2356.4
Driller's depth: bottom [feet]: 2365.8
Core type: NQ

Units in box: 1
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R 341-5.2-2372.0') (flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - 10-15% - 1-4 mm - equant
- 100 pts at R340-8.5

**Groundmass/Matrix:** microcrystalline

**Color:** 5YR 4/1 brownish gray

**Vesicles:** 10-20% - variable - spherical - horizontally elongated - 1-15 mm

**Alteration:** slightly to moderately (2-40% altered)

**Veins:** none

**Fractures:** moderately: 9/2 ft

**Additional comments:**
- autoliths present near base

---

**BOX UNIT 2:** aphyric basalt

**Contacts:**
- Top (ft): (R 341-5.2-2372.0') (flow contact)
- Bottom (ft): (R --')(continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- aphyric (<1%)
- olivine - <1% - 1 mm - equant

**Groundmass/Matrix:** microcrystalline

**Color:** N4 med. dk. gray

**Vesicles:** <5% - 1-3 mm - sub-rounded - equant

**Alteration:** fresh (<2% altered)

**Veins:** none

**Fractures:** weakly: 4/4 ft

**Additional comments:**
- autoliths present near base
BOX UNIT 1: aphyric basalt

Contacts: Top (tt): (R --) (continuous with previous box)
Bottom (tt): (R 342-0.6-2377.1') (flow contact)
thin red zone; lithology change

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1-2 mm - equant

Groundmass/Matrix: fine-grained (<1 mm)
Color: 5YR 4/1 brownish gray - Structures: - Sorting:
Vesicles: 10-20% - <1 to 4 mm - spherical - equant
Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly: 6/3 It

Additional comments:

UNIT #: 148

BOX UNIT 2: sparsely to moderately olivine phyric basalt

Contacts: Top (tt): (R 342-0.6-2377.1') (flow contact)
Bottom (tt): (R --) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
sparsely to moderately phyric (1-10%)
olivine - 1-3% - 1-2 mm - equant
decreasing down section but irregularly

Groundmass/Matrix: microcrystalline
Color: N4 med. dk. gray - Structures: - Sorting:
Vesicles: 20-30% - 1-3 mm - sub-rounded - equant
Alteration: slightly (2-10% altered)
oxidized
Veins: none
Fractures: weakly: 6/4 it to rubbly

Additional comments:
internal rubble zone at R342-6.0; no lithology change

Units in box: 2
Box #: 256
Cores in box: 342 343

Loggers: MG
Date logged: 11/29/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2384.2
Driller's depth: bottom [feet]: 2394.6
Core type: NQ

BOX UNIT 1: moderately to highly olivine phyric basalt
Contacts: Top (ft); (R-') (continuous with previous box)
         Bottom (ft); (R-') (continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
moderately to highly phyric (~10%)
olivine - 8-12% - 1-3 mm - equant -
   variable %, increasing down section

Groundmass/Matrix: fine-grained (<1 mm)
Color: NS medium gray - Structures: - Sorting:
Vesicles: 20-30% - 1-3 mm - sub-rounded - horizontally elongated -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly: 6/10 ft
Additional comments:
NaCl ppt; beautiful rock

UNIT #:149

UNIT 149
Box 256
BOX UNIT 1: moderately olivine phyric basalt

Contacts:
- Top (ft): (R344·5.2-2402.2') (flow contact)
- Bottom (ft): (R344·5.2-2402.2') (flow contact)

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N3 dark gray

Structures: Sorting:

Vesicles: 10·30% - 1-4 mm - rounded - equant -
size of vesicles and vesicle vol.% increase away from contact

Alteration: moderately (10-40% altered)
- groundmass oxidation;
- "B" = zones of increased clay(?) development

Veins: none

Fractures: weakly fractured: 217 ft; does not include rubbly zones labeled "A" on the photo

Additional comments:
- minor NaCl ppt
- see photo: "C" = possible internal flow contact

BOX UNIT 2: highly olivine phyric basalt

Contacts:
- Top (ft): (R344·5.2-2402.2') (flow contact)
- Bottom (ft): (R344·5.2-2402.2') (continuous with next box)

Unit type: transitional

Groundmass/Matrix: microcrystalline

Color: N5 medium dark gray

Structures: Sorting:

Vesicles: 5-20% - 1·5 mm - rounded to subrounded - equant -
size of vesicles and vesicle vol.% increase away from contact

Alteration: fresh to very highly (<2·95% altered)
- groundmass oxidation and weathering/clay development is highest in the interval R344·5.2 to R344·6.0 and decreases away from contact

Veins: none

Fractures: weakly fractured: 3·17 ft

Additional comments:
- check for NaCl ppt on dry surfaces
Box #: 258

Cores in box:
- 344
- 345
- 346

Loggers: GFE
Date logged: 12/1/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2404.0
Driller's depth: bottom [feet]: 2418.5
Core type: NQ

Units in box: 2

---

BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R 346-1.0 - continuous with previous box)
- Bottom (ft): (R346-1.0 - 2412.8') (flow contact)

Flow contact defined by slightly baked region and clinkery rubble

Unit type: massive
- in region from R345-2.0 to R346-1.0, textures indicative of aa flow, i.e. angular, elongate sub vertical vesicles

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - 15% - 1-5 mm - blocky (<3:1:1)
  - no obvious spinel inclusions inside the olivine; 100 points counted at R345-1.0

Groundmass/Matrix:
- fine-grained (<1 mm)

Color:
- N4 medium dark gray

Structures:
- Sorting:

Vesicles:
- 5-20% - 1-5 mm - sub-rounded to sub-angular - horizontally elongated
- vesicle distribution variable; >5 mm from R344-7.0 to 8.60, sub-vertical

Alteration:
- fresh (<2% altered)

Veins: none
Fractures: weakly fractured

Additional comments:
- NaCl ppt at R345-4.6
- autoliths between R344-9.0 and R345-3.0

---

BOX UNIT 2: highly olivine phyric basalt

Contacts:
- Top (ft): (R 346-1.0 - 2412.8') (flow contact)
- Bottom (ft): (R - 346-1.0 - continuous with next box)

Unit type: massive
- some clinkery rubble at top indicating aa flow

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - 10-15% - 1-5 mm - blocky (<3:1:1) - iddingsite
  - olivine is highly altered making determination of inclusions difficult

Groundmass/Matrix:
- fine-grained (<1 mm)

Color:
- 3/4 moderate brown

Structures:
- Sorting:

Vesicles:
- 20-30% - <1 mm - sub-rounded - equant

Alteration:
- moderately (10-40% altered) - clay (?)
- reddish/brown oxidation with some yellowish areas

Veins: none
Fractures: weakly fractured

Additional comments:
-
**BOX UNIT 1:** highly olivine phyric basalt  

**Contacts:**  
Top (ft): (R-3.4-continuous with previous box)  
Bottom (ft): (R-3.4-continuous with next box)  
Flow contact defined by sharp transition from massive material (upper flow) to ~2' of rubbly clast-rich material (lower flow) that grades into massive material in box 150. No evidence of a baked zone.

**Unit type:** aa  
**Phenocrysts/Clasts:**  
highly phyric (>10%) —  
olivine — 10-20% — 1-5 mm — equant to tabular —  
10% at R346-4.3; 20% at R347-2.5; olivine phenocrysts are inhomogeneously distributed; no obvious spinel inclusions; olivines are moderately oxidized/iodded/izided

**Groundmass/Matrix:** microcrystalline  
**Color:** N4 medium dark gray  
**Structures:** —  
**Sorting:** —  
**Vesicles:** 5-10% — <1-5 mm — subrounded to angular — equant to horizontally elongate —  
highly sheared vesicles in the interval R346-4.0 to R347-2.0 are up to 1 cm in length

**Alteration:** fresh to slightly (<2-10% altered) —  
groundmass oxidation associated with small sheared vesicles; groundmass least oxidized in the interval R347-0.0 to R347-3.0

**Veins:** none

**Fractures:** weakly fractured: 8/7 ft; varying amounts of ivory-colored clay material coating some of the fracture surfaces

**Additional comments:**
see photo: "A" = microgabbroic inclusion

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**UNIT #: 151**

**BOX UNIT 2:** highly olivine phyric basalt  

**Contacts:**  
Top (ft): (R 347.3-4-continuous with previous box)  
Bottom (ft): (R-3-continuous with next box)  
see unit 1 for contact description

**Unit type:** rubble  
**Phenocrysts/Clasts:**  
highly phyric (>10%) —  
olivine — >10% — >1-5 mm — equant to tabular —  
visually estimated mode; olivine phenocrysts are completely oxidized

**Groundmass/Matrix:** microcrystalline  
**Color:** N4 + 10R 4/6  
**Structures:** —  
**Sorting:** —  
**Vesicles:** >5% — 1-5 mm —  
Clasts are sufficiently small and extensively altered that vesicle description is difficult.

**Alteration:** highly to very highly (40-95% altered) —  
groundmass oxidation; ivory-colored material (clay?) sprinkled over the rubbly pieces

**Veins:** none

**Fractures:** rubble

**Additional comments:**

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**UNIT #: 152**
**Box #: 260**

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>Logs in box</th>
<th>Loggers</th>
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<tr>
<td>348</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Driller's depth: top [feet]:** 2428.2  
**Driller's depth: bottom [feet]:** 2438.3  
**Units in box:** 2

---

**BOX UNIT 1:** highly olivine phyric basalt  
**Contacts:**  
Top (fl): (R:--) (continuous with previous box)  
Bottom (fl): (R:348-2.6-2435.1') (flow contact)  
Flow contact defined by a red oxidized zone at the top of the bottom flow and a rapid decrease in vesicle size down toward the contact and clinkery material at the bottom of the top flow. There is also a lithologic change, a decrease in the abundance of olivine phenocrysts.

**Unit type:** massive  
**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine – 14-16% – 2-4 mm – equant to tabular  
16% at R347-6.5; 14% at R348-0.2; no obvious spinel inclusions in the olivine phenocrysts; olivines are slightly to moderately oxidized

**Groundmass/Matrix:** microcrystalline  
**Color:** N5 medium gray  
**Structures:**  
**Sorting:**  
**Vesicles:** 5-10% – <1-5 mm – subrounded to subangular – equant to elongate –  
vesicle size decreases toward contact  
**Alteration:** fresh to moderately (<2-40% altered)  
extent of groundmass oxidation increases toward contact; freshest material in the interval between A347-5.5 and A347-9.5

**Veins:** none  
**Fractures:** weakly fractured: 14/7 It

**Additional comments:**

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**BOX UNIT 2:** moderately plagioclase-olivine phyric basalt  
**Contacts:**  
Top (fl): (R 348-2.6-2435.1') (flow contact)  
Bottom (fl): (R:--) (continuous with next box)  
see unit 1 for a description of the contact

**Unit type:** massive  
**Phenocrysts/Clasts:**  
moderately phyric (2-10%)  
olivine – 4% – <1 mm – equant  
4% at R348-3.8; olivines are highly altered  
plagioclase – <1% – <1 mm – tabular (>3:1:1)  

**Groundmass/Matrix:** microcrystalline  
**Color:** 5R 4/2  
**Structures:**  
**Sorting:**  
**Vesicles:** 10-15% – 1-5 mm – subrounded to subangular – equant to elongate –  
smaller vesicles are equant; larger vesicles are elongate  
**Alteration:** highly (40-80% altered)  
extent of groundmass oxidation decreases away from contact  
**Veins:** none  
**Fractures:** moderately to weakly fractured - see photo  
**Additional comments:**  
minor NaCl ppt; plagioclase microphenocrysts; rare microgabbroic inclusions
BOX UNIT 1: sparsely to moderately plagioclase-olivine phryic basalt

Contacts: Top (t): (R- --)(continuous with previous box)
Bottom (b): (R- --)(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
sparsely to moderately phryic (1-10%)
olivine - 1-4% - 1-3 mm - equant to tabular
4% at R349-2.8; 2% at R349-7.8
plagioclase - <1% - equant (>3:1:1)

Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 1-10% - 1-5 mm - subrounded to angular - equant to elongate -
vesicle vol.% decreases dramatically below R349-7.6; elongate vesicles are horizontal to subhorizontal
Alteration: fresh to very highly (<2-95% altered) -
groundmass oxidation; core is essentially fresh by R349-1.0
Veins: none
Fractures: weakly fractured: 16/7.5 ft; fractures per foot decreases below R349-2.0; some ivory-colored material (clay?) partially
coating some of the fractured surfaces
Additional comments:
minor NaCl ppt; <3 mm microgabbroic clots
see photo: "A" = rubbly zones
Box #: 262

Cores in box
349
350

Loggers: GFE
Date logged: 12/4/93
Checked by: MG
Check date: 12/13/93

Driller's depth:top [feet]: 2448.1
Driller's depth:bottom [feet]: 2457.9

Core type: NQ

Units in box: 1

BOX UNIT 1: sparsely plagioclase-olivine phyric basalt

Contacts: Top (ft); (R -')(continuous with previous box)
Bottom (ft); (R-')(continuous with next box)

Unit type: massive
Possible aa flow. Clinkery at some separation boundaries. Also sub-horizontal, elongated vesicles.

Phenocrysts/Clasts:
sparalyic phryic (1-2%)
olivine - 1% - 1-3 mm - blocky (<3:1:1)
plagioclase - 1% - 1 mm -

Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: Sorting:
Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: sparsely fractured
Additional comments:
rare open-textured microgabbroic inclusions
BOX UNIT 1: sparsely plagioclase-olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R350-8.0-2457.5')(flow contact)

Unit type:
Phenocrysts/Clasts:
- sparsely phytic (1-2%)
- olivine - 1-2% - 1-3 mm - equant
- plagioclase - 1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray
Structures: Sorting:
Vesicles: 10-20% - 1-3 mm - sub-rounded - horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: 
Additional comments:

UNIT #153

UNIT #154

BOX UNIT 2: sparsely olivine phyric basalt

Contacts: Top (ft): (R 350-8.0-2457.5')(flow contact)
Bottom (ft): (R --')(continuous with next box)

Unit type: pahoehoe
Phenocrysts/Clasts:
- sparsely phytic (1-2%)
- olivine - 1-2% - 1-5 mm - blocky (<3:1:1)
100 pts counted

Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 medium gray
Structures: Sorting:
Vesicles: 20-30% - 1-5 mm - spherical - equant
extremely vesicular; small, equant, round vesicles
Alteration: slightly to moderately (2-40% altered)
alteration from R350-8.0 to R351-1.0
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl ppt
**BOX UNIT 1:** moderately to highly olivine phryic basalt

**Contacts:**
- Top (ft): (R: -) (continuous with previous box)
- Bottom (ft): (R: 352-1.8-2471.1) (flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- moderately to highly phryic (≥10%) — olivine — 10-15% — 1-5 mm — equant — iddingsite
- 10% @ R352-0.3; no obvious spinel inclusions; olivines are moderately iddingsitized; 15% @ R352-0.6

**Groundmass/Matrix:** microcrystalline

**Color:** N4 medium dark gray — Structures: — Sorting: —

**Vesicles:** 10-20% — 1-5 mm — sub-rounded to sub-angular — equant to elongate

- top of box has larger average vesicle size (~5 mm) grading to smaller at base of unit; zone “A” (on photo) contains only ~2% vesicles

**Alteration:** fresh to highly (~2-80% altered)

- grades from fresh at top of box to highest at base of unit; high begins at R352-6.4

**Veins:**
- Fractures: weakly fractured: 10/3.8 ft; ivory colored, coatings along fractures (clays?)

**Additional comments:**
- NaCl ppt

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**UNIT #: 154**

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**BOX UNIT 2:** sparsely olivine phryic basalt

**Contacts:**
- Top (ft): (R: 352-1.8-2471.1) (flow contact)
- Bottom (ft): (R: -) (continuous with next box)

**Unit type:** aa

**Massive material with sheared vesicles plus rubble zone from R352-1.8 to R355-0.7**

**Phenocrysts/Clasts:**
- sparsely phryic (1-2%) —
- olivine — 1-2% — 1-3 mm — equant to tabular — iddingsite
- 1% @ R355-1.4; no obvious spinel inclusions; moderate to highly iddingsitized

**Groundmass/Matrix:** microcrystalline

**Color:** N5 medium gray — Structures: — Sorting: —

**Vesicles:** <5% — 1-5 mm — sub-angular — horizontally elongated — oxidation

- vesicle fillings decrease from top of flow downward

**Alteration:** fresh to highly (~2-80% altered)

- flow unit is fresh; rubble zone ranges from slightly to highly altered

**Veins:**
- Fractures: weakly fractured: 3/1.8 ft; does not include rubbly zone from R352-1.8 to R355-0.7; ivory-colored (clay?) veinlets on fracture surfaces

**Additional comments:**
BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (t): (R--')(continuous with previous box)
         Bottom (b): (R--')(continuous with next box)

Unit type: aa
massive material with highly sheared vesicles

Phenocrysts/Clasts:
sparsely phyric (1-2%) —
olivine — 1% — 1-2 mm — equant to tabular —
mode estimated visually; no obvious spinel inclusions; slight to moderate oxidation of the olivine phenocrysts; large xenocrysts?

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray — Structures: — Sorting: —
Vesicles: 3-10% — 1-5 mm — subrounded to angular — equant to elongate — orientation of the elongate vesicles varies from inclined to horizontal
Alteration: fresh to slightly (<2-10% altered) —
most of the groundmass oxidation associated with the highly sheared vesicle trains

Veins: none
Fractures: moderately fractured: 45/9.6 ft; hint of groundmass oxidation on some of the fractured surfaces; ivory/white-colored material (clay?) dusting some of the fractured surfaces

Additional comments:
minor NaCl ppt; <2 mm microgabbroic inclusions; rare plagioclase microphenocrysts
Groundmass/Matrix: microcrystalline -
Color: N6 medium light gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - subrounded to subangular - equant to elongate -
smaller vesicles are equant; no preferred orientation to the elongate vesicles
Alteration: slightly to highly (2-80% altered) -
extent of groundmass oxidation decreases down section from contact; core becomes only slightly oxidized by R357-2.6
Veins: none
Fractures: weakly fractured; 9/3 ft; measurement doesn't include rubbly zones labeled "A" on the photo

Additional comments:

BOX UNIT 1: sparsely olivine phyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R357-0.3-2498.3')(flow contact)
flow contact defined by lithologic change (increase in olivine abundance), differences in vesicularity; and red top to underlying flow
Unit type: aa
classification based on massive character of core and the presence of sheared vesicles
Phenocrysts/Clasts:
sparaly phyric (1-2%) -
olivine - 1-2% - 1-2 mm - equant -
1% at R356-6.4; no spinel inclusions observed; olivine phenocrysts are slightly oxidized
--

Groundmass/Matrix: microcrystalline -
Color: N6 medium light gray - Structures: - Sorting: -
Vesicles: 1-3% - 1-5 mm - sub-angular - horizontally elongated -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured; 13/5.7 ft

Additional comments:

BOX UNIT 2: highly olivine phyric basalt

Contacts:
Top (ft): (R 357 -0.3 -2498.3') (flow contact)
Bottom (ft): (R --')(continuous with next box)
see unit 1 for contact description
Unit type: transitional
classification based on the presence of both equant and highly sheared vesicles
Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 16% - 1-5 mm - equant to tabular -
16% at R357-1.6; no spinel inclusions observed in the olivines
--

Groundmass/Matrix: microcrystalline -
Color: N6 medium light gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - subrounded to subangular - equant to elongate -
smaller vesicles are equant; no preferred orientation to the elongate vesicles
Alteration: slightly to highly (2-80% altered) -
extent of groundmass oxidation decreases down section from contact; core becomes only slightly oxidized by R357-2.6
Veins: none
Fractures: weakly fractured; 9/3 ft; measurement doesn't include rubbly zones labeled "A" on the photo

Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R.--) (continuous with previous box)
- Bottom (ft): (R.--) (continuous with next box)
- possible internal contact at R357-4.3

Unit type: massive
- unit may be transitional; core contains a mix of equant and sheared vesicles

Phenocrysts/Clasts:
- highly phyric (>10%)
  - olivine - 20-22% - 2-5 mm -
  - 20% at R358-3.3; 22% at R358-8.7; no obvious spinels in olivine phenocrysts; olivines are highly to moderately oxidized, freshest olivines occur below R358-4.0

Groundmass/Matrix:
- microcrystalline

Color: N5 medium dark gray (fresh piece)
- Structures: Sorting:
- Vesicles: 10-25% - <1-5 mm - subrounded to subangular - equant to elongate -
  - no preferred orientation of the elongate vesicles; vesicle population includes a mixture of both small equant and larger elongate vesicles

Alteration: slightly to moderately (2-40% altered)
- extent of groundmass oxidation decreases over the interval R357-4.3 to R358-2.0.

Veins: none

Fractures: Weakly fractured: 9/8.6 ft; measurement doesn't include rubbly zones labeled "A" on the photo. Basalt exposed at the fractures is more highly oxidized.

Additional comments:
- NaCl ppt; internal flow contact at R357-4.3; autoliths common
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R359-4.2-2520.2) (flow contact)
  - Flow contact defined by weathered red rubbly zone at top of unit 2 and lithologic change

**Unit type:** aa

**Phenocrysts/Clasts:**
- highly phyric (>10%)
  - olivine >10% - 1-5 mm - equant - iddingsite, oxidation
  - 12% @ R359-0.7; olivine phenocrysts moderately altered; no obvious spinel inclusions

**Groundmass/Matrix:** microcrystalline

**Color:** N6 medium light gray

**Structures:**
- Sorting: -

**Vesicles:** 10-20% - 2-7 mm - rounded to sub-rounded - equant -
  - oxidation; rusty weathering product
  - rare vesicles >1 cm

**Alteration:**
- slightly (2-10% altered)
  - oxidation to reddish alteration

**Veins:** none

**Fractures:** weakly fractured; 74.8 ft; oxidation coating on fracture surfaces

**Additional comments:**
- NaCl ppt near bottom of flow

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**BOX UNIT 2:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R359-4.2-2520.2) (flow contact)
- Bottom (ft): (R--)(continuous with next box)
  - See unit 1 for top contact description.

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phyric (>10%)
  - olivine - 10-15% - 1-3 mm - equant to tabular - iddingsite, oxidation
  - visual estimate

**Groundmass/Matrix:** microcrystalline

**Color:** N6 medium gray

**Structures:**
- Sorting: -

**Vesicles:** 20-30% - 1-5 mm - sub-rounded to sub-angular - equant -
  - white clay, red oxidation

**Alteration:**
- slightly to highly (2-60% altered)
  - highly altered at top of unit (R359-4.4); rest of unit slightly altered

**Veins:** none

**Fractures:** highly fractured/rubble (see photo)

**Additional comments:**
- NaCl ppt
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R -') (continuous with previous box)
Bottom (ft): (R359-9.1-2525.1') (flow contact)
flow contact defined by red baked zone
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-3 mm - equant - iddingsite
11% @ R360-4.7
Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-3 mm - sub-rounded - equant - oxidation
only occasional vesicle oxidation; increases towards contact at R359-9.1
Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly fractured: 1/0.7 ft; white clays coat fractures; phenocrysts highly altered along fracture
Additional comments:
BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R359-9.1-2525.1') (flow contact)
Bottom (ft): (R-') (continuous with next box)
see unit 1 for top contact description
Unit type: aa
highly rubbly top of an aa flow
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-3 mm - equant - iddingsite, oxidation
11% @ R360-4.7; olivine slightly iddingsitized below baked zone, highly oxidized and iddingsitized in baked zone
Groundmass/Matrix: microcrystalline
Color: 10R3 dark reddish brown to N5 medium gray - Structures: - Sorting: -
Vesicles: <5% - <1 mm - sub-angular - vertically elongated
Alteration: slightly to completely (2-100% altered)
baked zone at flow top completely altered, steady gradation into slightly altered by R360-4.4
Veins: none
Fractures: heavily fractured to rubbly (see photo)
Additional comments:
grades from reddish brown at top of flow to medium gray by R360-4.0
BOX UNIT 1: highly olivine phyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive
There is a clinkery rubble zone that implies that the flow could be an aa flow. Also, elongate horizontal vesicles.

Phenocrysts/Clasts:
highly phyric (>10%)
- olivine - 15-20% - 1-5 mm - blocky (<3:1:1) -
100 pts counted at R362-2.5 rare large (1 cm) crystals

Groundmass/Matrix: microcrystalline

Color: N5 medium gray

Vesicles: 5-10% - 1-5 mm - sub-angular - horizontally elongated

Alteration: slightly (2-10% altered)

Veins: none
Fractures: weakly; 3/4 ft

Additional comments:
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R 362-0.3-2551.0')(flow contact)
Bottom (ft): (R 363-0.3-2551.0') (flow contact)
red baked rubble zone
Unit type: massive
probably an aa flow, angular elongate vesicles and clinkery rubble
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-15% - 1-5 mm - blocky (<3:1:1)

Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: <5% - 1-5 mm - angular - horizontally elongated-
Alteration: slightly (2-10% altered) -
Veins: none
Fractures: weakly: 1/1 ft
Additional comments:
From R363-0.3 to 0.2, there is an altered contact consisting of reddish brown clinkery rubble.
Vesicles very sparse, but become a little more numerous in patches randomly in core.

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 363-0.3-2551.0')(flow contact)
Bottom (ft): (R 363-0.3-2551.0') (continuous with next box)
Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-15% - 1-5 mm - blocky (<3:1:1)
100 pts counted at R365-0.3

Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-5mm - sub-angular - horizontally elongated-
Alteration: slightly (2-10% altered) -
Veins: none
Fractures: weakly: 5/5 ft
Additional comments:
Box #: 272  
Cores in box: 365  
366  

Loggers: MBB  
Date logged: 12/3/93  
Checked by: MG  
Check date: 12/13/93  

Driller's depth: top [feet]: 2566.3  
Driller's depth: bottom [feet]: 2579.9  
Core type: NQ  

Units in box: 1  

BOX UNIT 1: highly olivine phyric basalt  

Contacts:  
Top (ft): (R - -') (continuous with previous box)  
Bottom (ft): (R - -') (continuous with next box)  

Unit type: massive  

Phenocrysts/Clasts:  
highly phyric (>10%)  
olivine - 14-16% - 2-5 mm - -  
14% at R365-5.6; 16% at R366-0.5; olivines are moderately to highly oxidized, some iddingsite  

Groundmass/Matrix: microcrystalline  

Color:  

Structures:  

Vesicles: 3-10% - <1-5 mm - subrounded to angular - equant to elongate-  
elongate vesicles have no preferred orientation  

Alteration: slightly to moderately (2-40% altered) -  
groundmass oxidation localized around the vesicles, especially the <1 mm size fraction  

Veins: none  
Fractures: weakly fractured: 5/9.7 ft; fractured surfaces are slightly more oxidized than the basalt exposed on the slabbed surface  
Additional comments:  
NaCl ppt
**Box #:** 273

| Cores in box | 366 | 367 |

**Loggers:** LLW  
**Date logged:** 12/3/93  
**Checked by:** MG  
**Check date:** 12/13/93  
**Core type:** NQ  
**Units in box:** 2

**BOX UNIT 1:** highly olivine phyric basalt  
**Contacts:** Top (ft): (R --')(continuous with previous box)  
Bottom (ft): (R367-2.6-2585.6')(flow contact)  
**Unit type:** massive  
**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - >10% - 1-5 mm - equant to tabular  
- 16% @ R366-4.8; very fresh; spinel inclusions in olivine  
-  -  -  -  -

**Groundmass/Matrix:** microcrystalline  
**Color:** N6 medium light gray to N4 medium dark gray  
**Vesicles:** <5% - 1-5 mm - sub-rounded to sub-angular - horizontally elongated  
**Alteration:** fresh to moderately (<2-40% altered)  
- fresh at top of box, moderately altered at R366-5.8 through rubbly zone, back to fresh at R367-0.1  
**Veins:** none  
**Fractures:** weakly fractured: 7/4.5 ft; not including rubbly zone marked “A” in photo  
**Additional comments:**  
Flow contains rubbly zone from R366-7.3 to R367-0.0 (marked “A” on photo), but core on either side is similar so it has been mapped as a single unit. N6 grading into N4 above rubbly zone “A” on photo

**BOX UNIT 2:** highly olivine phyric basalt  
**Contacts:** Top (ft): (R 367-2.6-2585.6')(flow contact)  
Bottom (ft): (R --')(continuous with next box)  
**Unit type:** pahoehoe  
**Phenocrysts/Clasts:**  
highly phyric (>10%)  
olivine - >10% - 1-5 mm - equant - iddingsite, oxidation  
11% @ R367-2.8; moderately altered  
-  -  -  -  -

**Groundmass/Matrix:** microcrystalline  
**Color:** 5YR2 dusky brown - Structures: - Sorting: -  
**Vesicles:** 10-20% - 1-7 mm - sub-rounded - equant - occasional red clays  
occasionally horizontally elongate, especially near top of unit  
**Alteration:** very highly (80-95% altered) -  
matrix altered to red oxidized material  
**Veins:** none  
**Fractures:** moderately fractured: 9/1.7 ft; light colored to rusty (clay?) coatings on some fracture surfaces  
**Additional comments:**
**BOX UNIT 1**: highly olivine phyric basalt

**Contacts**: Top (ft): (R 368-5.7-2596.7') (flow contact)
Bottom (ft): (R 368-5.7-2596.7') (flow contact)

Evven though there is a very weathered layer, lower unit does not appear very baked.

**Unit type**: massive

**Phenocrysts/Clasts**: highly phryic (>10%) - olivine - 10-15% - 1-5 mm - blocky (<3:1:1) - 100 pts counted at R368-1.5

**Groundmass/Matrix**: microcrystalline

**Color**: N5 gray - **Structures**: - **Sorting**: -

**Vesicles**: 10-20% - 1-5 mm - sub-rounded - horizontally elongated

**Alteration**: fresh (<2% altered)

**Veins**: none

**Fractures**: weakly: 9/6

**Additional comments**: NaCl ppt

**BOX UNIT 2**: highly olivine phyric basalt

**Contacts**: Top (ft): (R 368-5.7-2596.7') (flow contact)
Bottom (ft): (R 368-8.8-2599.8') (flow contact)

top and bottom marked by rubble zone

**Unit type**: massive

Small equant vesicles implying possible pahoehoe flow.

**Phenocrysts/Clasts**: highly phryic (>10%) - olivine - 10-12% - 1-5 mm - blocky (<3:1:1) - 100 pts counted at R368-7.0

**Groundmass/Matrix**: microcrystalline

**Color**: N4 med. dark gray - **Structures**: - **Sorting**: -

**Vesicles**: 5-10% - >5 mm - sub-rounded - equant

**Alteration**: fresh (<2% altered)

**Veins**: none

**Fractures**: weakly fractured: 5/4

**Additional comments**: NaCl ppt

**BOX 274 CONTINUED ON NEXT PAGE**
Box UNIT 3: highly olivine phryic basalt

Contacts: Top (ft): (R 368-8.8-2599.8')(flow contact)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive
Possible pahoehoe flow after very weathered soil-like contact.

Phenocrysts/Clasts:
highly phryic (>10%) -
olivine - 10-15% - 1-5 mm - blocky (<3:1:1) -
visual estimate

Groundmass/Matrix: microcrystalline
Color: 5YR 2/2 reddish brown - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - sub-rounded - equant -
Alteration: moderately to highly (10-80% altered) -
Veins: none
Fractures: sparsely fractured
Additional comments:

BOX UNIT 3: highly olivine phryic basalt
Contacts: Top (ft): (R 368-8.8-2599.8')(flow contact)
Bottom (ft): (R--')(continuous with next box)

Unit type: massive
Possible pahoehoe flow after very weathered soil-like contact.

Phenocrysts/Clasts:
highly phryic (>10%) -
olivine - 10-15% - 1-5 mm - blocky (<3:1:1) -
visual estimate

Groundmass/Matrix: microcrystalline
Color: 5YR 2/2 reddish brown - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - sub-rounded - equant -
Alteration: moderately to highly (10-80% altered) -
Veins: none
Fractures: sparsely fractured
Additional comments:
**BOX UNIT 1: highly olivine phyric basalt**

Contacts: Top (ft): (R --') (continuous with previous box)

Bottom (ft): (R369-3.3-2604.3') (flow contact)

flow contact defined by decrease in vesicle size over a short distance in the upper flow and oxidized, clinkery material at the top of the lower flow

Unit type: massive

Phenocrysts/Clasts:
- highly phric (>10%)
- olivine - 16% - <2-4 mm - equant
- 16% at R369-0.7; no obvious spinel inclusions in the olivine; olivines are moderately to highly oxidized; MnO coatings

Groundmass/Matrix: microcrystalline

Color: N4 + 10R 3/4 Structures: Sorting:

Vesicles: 5-10% - <1-6 mm - subrounded to angular - equant to elongate - elongate vesicles have no preferred orientation

Alteration: slightly to highly (2-60% altered) - groundmass oxidation

Veins: none

Fractures: moderately fractured: 15/3.1 ft; fractures are zones of increased oxidation

Additional comments:
- minor NaCl ppt

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**UNIT #: 162**

**BOX UNIT 2: moderately olivine phyric basalt**

Contacts: Top (ft): (R369-3.3-2604.3') (flow contact)

Bottom (ft): (R370-1.3-2612.3') (flow contact)

See unit 1 for upper contact description; lower contact defined by clinkery, oxidized material at the top of the lower flow. This clinkery zone is not strongly baked.

Unit type: pahoehoe transitional pahoehoe flow textures

Phenocrysts/Clasts:
- moderately phric (2-10%)
- olivine - 9% - 2-5 mm - equant
- 9% at R369-0.7; no obvious spinel inclusions in the olivine; olivines are moderately to highly oxidized; MnO coatings

Groundmass/Matrix: microcrystalline

Color: Structures: Sorting:

Vesicles: 20-40% - <1-3 mm - rounded to subrounded - equant -

Alteration: moderately to very highly (10-95% altered) - groundmass oxidation

Veins: none

Fractures: moderately fractured

Additional comments:
- this unit may consist of multiple flows - no lithologic change

see photo: "A" - two pieces with substantially larger vesicles (5-10 mm in longest dimension)
BOX UNIT 3: highly olivine phyric basalt

Contacts: Top (t): (R 370-1.3-2612.3')(flow contact)
          Bottom (b): (R--')(continuous with next box)
          see unit 2 for contact description

Unit type: massive
aa(?)

Phenocrysts/Clasts:
highly phyric (>10%)
  olivine - 13% - 2-3 mm - equant -
  13% at R370-2.8; olivine phenocrysts are moderately to highly oxidized; MnO coatings

Groundmass/Matrix: microcrystalline -
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: <5% - <1-3 mm - subangular to angular - equant to elongate -
Alteration: slightly to highly (2-80% altered) -
  groundmass oxidation
Veins: none
Fractures: weakly fractured; rubbly zone at the top of the flow
Additional comments:
  very rare plagioclase xenocrysts
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R --)(continuous with next box)

**Unit type:** massive

**Phenocrysts/Clasts:**
- highly phryic (>10%)
- olivine — 1-5 mm — blocky (<3:1:1)
- spinel inclusions in olivine crystals; 100 pts counted at R370-4.5

**Groundmass/Matrix:** microcrystalline

**Color:** N5 medium gray

**Structures:**
- Sorting:
- Vesicles: <5% — 1-5 mm — sub-rounded — sub-horizontally elongated
- Vesicles are increasingly abundant after R371-3.0.

**Alteration:** fresh to slightly (<2-10% altered)

**Fractures:** weakly: 5/10 ft

**Additional comments:**
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R372-1.0-2632.0')(flow contact)
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine — 15% — 1-5 mm — tabular (>3:1:1)
— 100 pts counted at R371-9.5
—
—
Groundmass/Matrix: fine-grained (<1 mm)
Color: N5 medium gray — Structures: — Sorting:
Vesicles: 5-10% — 1-5 mm — sub-rounded — horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl ppt; base is darker gray in color

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R372-1.0-2632.0')(flow contact)
Bottom (ft): (R--')(continuous with next box)
red, baked rubble zone at top
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine — 15-16% — 1-5 mm — blocky (<3:1:1) — iddingsite
— 100 pts counted at R373-5.5
—
—
Groundmass/Matrix: microcrystalline
Color: N5 medium gray — Structures: — Sorting:
Vesicles: <5% — 1-5 mm — sub-rounded — equant
Alteration: slightly (2-10% altered)
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl ppt; besides rubble adjacent to the contact, there are additional rubbly areas.
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R -->) (continuous with previous box)
- Bottom (ft): (R -->) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- olivine (>10%) - 1-5 mm - equant to tabular - iddingsite
- 16% @ R374-6.9; occasional spinel inclusions; minor alteration; multi-grain clusters

Groundmass/Matrix: microcrystalline

Color: N5 medium gray - Structures: Sorting:

Vesicles: <5% - 1-2 mm - sub-rounded to sub-angular - equant - vertically elongated at R374-1.6 - marked "A" on photo

Alteration: fresh (<2% altered) -

Fractures: weakly fractured: 5/10 ft; some oxidation and light gray clays on fracture surfaces

Additional comments:
- NaCl ppt
BOX UNIT 1: highly olivinephyric basalt

| Contacts: | Top (it): (R --')(continuous with previous box) |
| Bottom (it): (R--')(continuous with next box) |

| Unit type: | massive |

| Phenocrysts/Clasts: | highly phyric (>10%) - |
| olivine - >10% - 1-5 mm - equant to tabular - iddingsite |
| 18% @ R374-9.4; spinel inclusions observed in fresh olivine; alteration of olivine increases downcore |

| Groundmass/Matrix: | microcrystalline - |
| Color: | N4 medium dark gray - Structures: - Sorting: - |
| Vesicles: | <5% to 5% - <1 to 3 mm - sub-angular - equant to horizontally elongated - |
| red oxidation starting R375-4.0 |
| vesicle content and size gradually increase downcore |
| Alteration: | fresh (<2% altered) - |
| alteration gradually increase downcore |
| Veins: | none |
| Fractures: | weakly fractured: 9/10 ft; some fractures fresh, some slightly oxidized, occasional light gray clays |
| Additional comments: | NaCl ppt |

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Units in box: 1

| Box #: | 279 |
| Cores in box: | 374 |
| Date logged: | 12/3/93 |
| Checked by: | MG |
| Check date: | 12/13/93 |

Driller's depth: top [feet]: 2654.9
Driller's depth: bottom [feet]: 2665.6
Core type: NQ
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R - -)(continuous with previous box)
Bottom (ft): (R375-8.7 - 2664.4')(flow contact)
Unit type: massive
Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 10-20% - 1-5 mm - tabular (>2:1:1) - visual estimate
Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: Sorting:
Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 2/1 ft
Additional comments:
NaCl ppt

BOX UNIT 2: moderately to highly olivine phyric basalt
Contacts: Top (ft): (R375-8.7 - 2664.4')(flow contact)
Bottom (ft): (R- -)(continuous with next box)
Unit type: massive
Phenocrysts/Clasts:
- moderately to highly phyric (-10%) - olivine - 8-12% - 1-5 mm - blocky (3:1:1) - 200 pts counted at R376-5.0
Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: Sorting:
Vesicles: 5-10% - 1-3 mm - sub-rounded - horizontally elongated
VEsicle distribution is very uneven - patchy
Alteration: slightly (2-10% altered)
baked at contact, decreasing to fresh by R376-3.0
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl ppt; rare plagioclase xenocrysts (R376-2.0)
**Box #:** 281  
**Loggers:** GFE, MG  
**Date logged:** 12/4/93  
**Checked by:** MG  
**Check date:** 12/13/93  
**Cores in box:** 376, 377  
**Driller's depth:top [feet]:** 2675.8  
**Driller's depth:bottom [feet]:** 2687.0  
**Core type:** NQ  
**Units in box:** 2

### BOX UNIT 1: highly olivine phyric basalt

- **Contacts:**  
  Top (ft): (R --) (continuous with previous box)  
  Bottom (ft): (R377.6-0.2682.9) flow contact  
- **Unit type:** massive  
- **Possibly an aa flow because of elongate, sheared vesicles.**  
- **Phenocrysts/Clasts:**  
  - highly phonocrystals (>10%)  
  - olivine - >10% - 1-5 mm - blocky (<3:1:1)  
  - up to 1 cm crystals, 100 pts counted at R377-5.0  
- **Groundmass/Matrix:** microcrystalline  
- **Color:** N5 gray  
- **Vesicles:** 5-10% - 1-5 mm - sub-angular - horizontally elongated  
- **Vesicles mostly horizontal**  
- **Alteration:** fresh (<2% altered)  
- **Fractures:** weakly: 7/9 ft  
- **Additional comments:** NaCl ppt

### BOX UNIT 2: sparsely plagioclase-olivine phyric basalt

- **Contacts:**  
  Top (ft): (R 377-6.0-2682.9) flow contact  
  Bottom (ft): (R --) (continuous with next box)  
- **Unit type:** massive clinkery rubble  
- **Phenocrysts/Clasts:**  
  - sparsely phonocrystals (1-2%)  
  - olivine - 1-2% - 1-5 mm - blocky (<3:1:1)  
  - plagioclase - <1% - 1-2 mm - tabular (>3:1:1)  
- **Groundmass/Matrix:** fine-grained (<1 mm)  
- **Color:** 5YR 3/4 reddish-brown  
- **Vesicles:** <5% - 1-5 mm - sub-rounded - equant  
- **Alteration:** moderately (10-40% altered)  
- **Fractures:** rubble  
- **Additional comments:** rare small gabbroic inclusions
**Box #**: 282  
**Cores in box**: 378, 379  

**Loggers**: LLW  
**Date logged**: 12/4/93  
**Checked by**: MG  
**Check date**: 12/13/93  

**Driller's depth: top [feet]**: 2687.0  
**Driller's depth: bottom [feet]**: 2698.4  
**Core type**: NQ

**BOX UNIT 1**: moderately plagioclase-olivine phryic basalt  
**Contacts**:  
- Top (ft): (R--) continuous with previous box  
- Bottom (ft): (R--) continuous with next box  

**Unit type**: aa  
- Unit defined by rubbly top grading into flow with horizontally elongate vesicles

**Phenocrysts/Clasts**:  
- Moderately phyrlic (2-10%)  
- Olivine: 2-10% - 1-5 mm - tabular (>3:1:1) - oxidation  
- 5% at R379-2.1; oxidation decreases with degree of groundmass alteration  
- Plagioclase: <1% - 1 mm - tabular (>3:1:1) -  

**Groundmass/Matrix**: microcrystalline  
**Color**: 5YR3 grayish brown to N4 medium dark gray  
**Structures**: Sorting:  
**Vesicles**: 5-10% - 1-10 mm - sub-angular - equant to horizontally elongated - light colored clay  
**Alteration**: slightly (2-10% altered)  
- Very highly oxidized in rubbly zone at top of box (R378-0.0 to 0.7), to slightly altered by R379-0.0  

**Veins**: none  
**Fractures**:  
- R378-0.0 to R378-2.0: rubbly  
- R378-2.0 to R378-3.4: highly fractured  
- R378-3.4 to R378-7.9 (end of box): weakly fractured  
- Fractures show occasional oxidation and light gray clay coating.

**Additional comments**:  
- Microgabbro inclusions
BOX UNIT 1: moderately plagioclase-olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R380-3.2-2704.3')(flow contact)
clinkery rubble with change of lithology

Unit type: massive
Phenocrysts/Clasts:
moderately plagioclase (2-10%)
olivine - 4% - 1-5 mm - blocky (>3:1:1)
100 pts counted at R379-8.2
plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
Color: N6 gray - Structures: - Sorting: -
Vesicles: <5% - 1-5 mm - sub-rounded - horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly: 5/6 ft
Additional comments:
NaCl ppt. Core has areas of increased vesicularity, especially near fractures.

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 380-3.2-2704.3')(flow contact)
Bottom (ft): (R380-5.4)(continuous with next box)
internal contact at R380-5.4

Unit type: pahoehoe
Although clinkery at contact, vesicles are round and equant implying a pahoehoe flow.

Phenocrysts/Clasts:
highly plagioclase (>10%)
olivine - 10-15% - 1-5 mm - blocky (<3:1:1)
visual estimate

Groundmass/Matrix:
Color: N5 gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-5 mm - sub-rounded - equant
Alteration: slightly (2-10% altered)
Veins: none
Fractures: moderately: 10/4 ft
Additional comments:
NaCl ppt
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R -) (continuous with previous box)
Bottom (ft): (R381 -2.8 -2712.8) (flow contact)
Flow contact defined by baked zone at top of unit 2 and lithologic change
Unit type: pahoehoe
defined by abundance of sub-rounded vesicles
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-5 mm - equant to tabular - iddingsite
11% @ R381-2.0

Groundmass/Matrix: microcrystalline -
Color: N3 dark gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - sub-rounded - equant (but see comment)
minor red oxidation
marked "A" on photo - area where vesicles appear to have coalesced
Alteration: slightly (2-10% altered)
Veins: none
Fractures: moderately fractured: 10/2.7 ft; oxidation along fractures
Additional comments:

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R381 -2.8 -2712.8) (flow contact)
Bottom (ft): (R -) (continuous with next box)
see unit 1 for top contact description
Unit type: massive
baked zone at top of unit grading into rubbly zone then into massive flow (see photo)
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-5 mm - tabular (>3:1:1) - iddingsite
10% @ R381-1.5; 15% @ R382-1.5; huge olivines (-1 cm)

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: few - 1-3 mm - sub-rounded to sub-angular - equant to vertically elongated
minor oxidation
Alteration: fresh to completely (<2-100% altered)
Veins: none
Fractures: weakly - not including rubbly zone from R381-3.0 to R382-0.9 and R382-3.3 to 3.7 (see photo)
Additional comments:
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R383-0.4-2726.7')(flow contact)
base marked by reddish soil

Unit type: massive

Phenocrysts/Clasts:
highly phyric (>10%) -
olivine - 2-4% - 1-5 mm - tabular (>3:1:1) -
100 pts counted at R382-9.5

Groundmass/Matrix: microcrystalline -
Color: N5 gray - Structures: - Sorting:
Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated -
Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 4/5 ft
Additional comments:
NaCl ppt

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (ft): (R 383-0.4-2726.7')(flow contact)
Bottom (ft): (R --')(continuous with next box)

Unit type: aa

Phenocrysts/Clasts:
moderately phyric (2-10%) -
olivine - 2-4% - 1-5 mm - blocky (<3:1:1) - iddingsite

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 5-10% - 1-5 mm - spherical - equant -
Alteration: moderately (10-40% altered) -
Altered areas are dark red/brown - 5YR-3/4 on USGS color chart.
Veins: none
Fractures: No fractures, just weathered, soil-like rubble.
Additional comments:

Driller's depth: top [feet]: 2722.0
Driller's depth: bottom [feet]: 2737.0
Core type: NQ
**BOX UNIT 1: moderately olivine phyric basalt**

- **Contacts:**
  - Top (ft): R (continuous with previous box)
  - Bottom (ft): R (continuous with next box)

- **Unit type:** massive

- **Phenocrysts/Clasts:**
  - moderately phyc (2-10%)
  - olivine - 3-4% - 1-5 mm - blocky (<3:1:1) - iddingsite
  - 100 pts at R385-4.2

- **Groundmass/Matrix:** microcrystalline

- **Color:** NS gray - Structures: - Sorting: - Vesicles: <5% - 1-5 mm - sub-rounded - horizontally elongated

- **Alteration:** slightly (2-10% altered)
  - Altered zone in top 2 feet of core, from R385-1.0 to 3.0.

- **Veins:** none

- **Fractures:** weakly: S/10 ft

- **Additional comments:**
  - NaCl ppt

---

**Box #:** 286  
**Cores in box:** 385, 386  
**Loggers:** GFE, MG  
**Date logged:** 12/4/93  
**Checked by:** MG  
**Check date:** 12/13/93

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**UNIT #: 170**

- **Driller's depth:**
  - Top [feet]: 2737.0
  - Bottom [feet]: 2746.3

- **Core type:** NQ

- **Units in box:** 1
BOX UNIT 1: moderately olivine phryic basalt

Contacts: Top (fl): (R -') (continuous with previous box)
Bottom (fl): (R-') (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
- moderately phryic (2-10%) -
- olivine - 2-10% - 1-3 mm - equant to tabular - occasional oxidation
- 4% @ R386-8.2; rare xenocrysts (?)
- plagioclase - <1% - 1 mm - tabular (>3:1:1) -

Groundmass/Matrix: microcrystalline -

Color: N5 medium gray - Structures: - Sorting: -

Vesicles: <5% - 1-5 mm - sub-rounded to sub-angular - horizontally elongated -
- occasional >1 cm vesicles; one chert (?) filling (see photo for location)

Alteration: fresh to slightly (~2-10% altered) -

Veins: none

Fractures: weakly fractured: 11/8.8 ft; some light colored clays on fracture surfaces

Additional comments:
- rare olivine-plagioclase clots
BOX UNIT 1: moderately olivine phyric basalt
Contacts: Top (tt): (R -)(continuous with previous box)
Bottom (tt): (R387-1.1-2757.1)(flow contact)
Weathered, baked at contact. Lithologic change between sections (see photo).
Unit type: massive
Phenocrysts/Clasts:
moderately phric (2-10%)
olivine - 2-10% - 1-5 mm - blocky (<3:1:1)
olivine phenocrysts contain some spinel inclusions
plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: fine-grained (<1 mm)
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated-
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly
Additional comments: autoliths

BOX UNIT 2: sparsely olivine phyric basalt
Contacts: Top (tt): (R 387-1.1-2757.1)(flow contact)
Bottom (tt): (R388-2.2-2764.5)(flow contact)
red baked rubbly top
Unit type: transitional
Phenocrysts/Clasts:
sparsely phric (1-2%)
olivine - 1% - 1-5 mm - blocky (<3:1:1)
200 pts counted at R387-6.0

Groundmass/Matrix: microcrystalline -
Color: N5 gray - Structures: - Sorting: -
Vesicles: 10-20% - >5 mm - spherical - equant-
Some vesicles are large, >5 mm until about R388-0.0, where they decrease from around 3 to 1 mm. Also, some dark highly vesicular basalt inclusions within this section of core.
Alteration: moderately to highly (10-80% altered)
Alteration extreme at contact, but decreases gradationally.
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl ppt; autoliths

BOB 288 CONTINUED ON NEXT PAGE
BOX UNIT 3: aphyric basalt

Contacts: Top (ft): (R 388-2.2–2764.5')(flow contact)
Bottom (ft): (R -')(continuous with next box)

Unit type: rubble
Friable mostly with some more coherent pieces in section (See box 289).

Phenocrysts/Clasts:
aphyric (<1%)
oblivins – <1% – <1 mm – blocky (<3:1:1)

Groundmass/Matrix: fine-grained (<1 mm)
Color: N3 gray
Color determination made from coherent pieces of basalt. Color of weathered matrix close to 10YR-2/2 on USGS color chart.

Alteration: highly (40-60% altered)
Veins: none
Fractures: sparsely fractured
Additional comments:
Determination made from small pieces inside friable, weathered matrix.
**BOX UNIT 1: aphyric basalt**

Contacts:
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R --) (continuous with next box)
  Possible flow contact at R390-0.0, but dubious since no bake zone is seen.

Unit type:
- With distinct zones of clinkery rubble.

Phenocrysts/Clasts:
- aphyric (<1%)
- olivine (<1% - <1 mm - blocky <3:1:1) -
- -

Groundmass/Matrix:
- microcrystalline

Color:
- N4 medium dark gray

Structures:
- Sorting:

Vesicles:
- 5-10% - 1-5 mm - sub-rounded - equant
  Vesicles are sheared and sub-vertical elongate moving down the core from R389-1.0.

Alteration:
- moderately (10-40% altered) - clay (?) -
  friable matrix with possible clay

Veins:
- none

Fractures:
- moderately

Additional comments:
- NaCl ppt
Box #: 290

Cores in box:
390 393
391 394
392

Loggers: MG
Date logged: 12/4/93
Checked by: MG
Check date: 12/13/93

Driller's depth: top [feet]: 2779.6
Driller's depth: bottom [feet]: 2802.3
Core type: NO

Units in box: 2

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**BOX UNIT 1: aphyric basalt**

Contacts: Top (ft): (R \text{--}) (continuous with previous box)
Bottom (ft): (R394-0.2-2799.2') (flow contact)
base picked on red color and vesicularity change

Unit type: aa

Phenocrysts/Clasts:
aphyric (<1%)
o olivine (<1%) - 1 mm - equant -
plagioclase (<1%) - 1 mm - tabular (>3:1:1) -

Groundmass/Matrix:

Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-3 mm - sub-angular - inclined -
variable orientation
Alteration: slightly (2-10% altered) -
Veins: none
Fractures: moderately
Additional comments:

---

**BOX UNIT 2: aphyric basalt**

Contacts: Top (ft): (R394-0.2-2799.2') (flow contact)
Bottom (ft): (R \text{--}) (continuous with next box)
internal contacts at R394-0.2 and 1.0

Unit type: pahoehoe

Phenocrysts/Clasts:
aphyric (<1%)
o olivine (<1%) - 1-5 mm - blocky (<3:1:1) -

Groundmass/Matrix:
fine-grained (<1 mm) -

Color: 5YR 3/2 gray-brown - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - spherical - equant -
Alteration: slightly (2-10% altered) -
Veins: none
Fractures: sparsely fractured
Additional comments:
**Box #:** 291

**Cores in box:**
- 394
- 395

**Loggers:** GFE

**Date logged:** 12/4/93

**Checked by:** MG

**Check date:** 12/13/93

**Driller's depth:**
- Top [feet]: 2802.3
- Bottom [feet]: 2812.7

**Core type:** NQ

**Units in box:** 1

**BOX UNIT 1:** aphyric basalt

**Contacts:**
- Top (ft): (R-)(continuous with previous box)
- Bottom (ft): (R-)(continuous with next box)

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- aphyric (<1%) - no visible phenocrysts

**Groundmass/Matrix:** microcrystalline

**Color:** N5 gray

**Structures:**
- Sorting: -
- Vesicles: 20-30% - 1-3 mm - spherical - equant -
- Vesicles become smaller at rubbly area that is possibly an internal contact zone. Vesicles vary in size in a non-systematic fashion throughout box.

**Alteration:** slightly (2-10% altered)
- Alteration found at internal contacts.

**Veins:** none

**Fractures:** weakly (6/4 ft) to rubbly

**Additional comments:**
- NaCl ppt

**UNIT #173**
**BOX UNIT 1: aphyric basalt**

- **Contacts:**
  - Top (T): (R--')(continuous with previous box)
  - Bottom (B): (R--')(continuous with next box)
  - Possible internal flow contacts marked by oxidized rubbly zones at R395-4.4, R395-5.2, R395-7.1, R395-8.0, R395-9.2, R396-0.9 (marked on photo) but no lithologic change or other evidence for time break observed; fluid-like, glassy surface on some

- **Unit type:** pahoehoe
- **Phenocrysts/Clasts:** abundant sub-rounded vesicles
- **Aphyric (<1%)**

- **Groundmass/Matrix:** microcrystalline
- **Color:** N3 dark gray
- **Structures:**
- **Sorting:**
  - Oxidation near possible internal flow contacts
- **Alteration:** fresh to moderately altered
- **Veins:** none
- **Fractures:** weakly fractured between possible internal flow contacts, rubbly near possible internal flow contacts (see photo)

**Additional comments:**
- NaCl ppt
Box #: 293
Cores in box:
396
397

Date logged: 12/4/93
Driller's depth: top [feet]: 2821.4
Checked by: MG
Driller's depth: bottom [feet]: 2828.6
Check date: 12/13/93
Core type: NQ

Units in box: 1

BOX UNIT 1: aphyric basalt
Contacts:
Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R --)(continuous with next box)
possible internal flow contacts marked by oxidized, rubbly zones at R396-6.3 and R397-0.4 (see photo) but no lithologic change or other evidence for a time break observed

Unit type: pahoehoe
abundant sub-rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%) -

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray -
Vesicles: >30% - 1-4 mm - rounded to sub-rounded - equant - some oxidation
Alteration: fresh (<2% altered) -
Veins: none
Fractures: moderate to rubbly

Additional comments:
NaCl ppt
**BOX UNIT 1**: aphyric basalt  
**Contacts**: Top (It): (R -)(continuous with previous box)  
Bottom (It): (R 397-7.2-2834.2')(flow contact)  
flow contact defined by presence of soil  
**Unit type**: pahoehoe  
defined by presence of large sub-rounded vesicles  
**Phenocrysts/Clasts**:  
aphyric (<1%)  
olivine - <1% - 1-2 mm - equant -  
**Groundmass/Matrix**: microcrystalline -  
**Color**: N3 medium dark gray  
**Structures**:  
**Sorting**:  
**Vesicles**: 10-20% - 1-5 mm - rounded to sub-rounded - equant -  
occasional vesicle to >1 cm especially from R397-3.5 to R397-4.2  
**Alteration**: fresh (<2% altered)  
**Veins**: none  
**Fractures**: weakly fractured: 3/5.4 it; white clay on fracture at top of box  
**Additional comments**:  
NaCl ppt

**BOX UNIT 2**: moderately olivine phyric basalt  
**Contacts**: Top (It): (R 397-7.2-2834.2')(erosional)  
Bottom (It): (R -)(continuous with next box)  
contact defined by beginning of weathered soil layer  
**Unit type**: pahoehoe  
defined by presence of large, sub-rounded vesicles  
**Phenocrysts/Clasts**:  
moderately phyric (2-10%)  
olivine - 2-10% - 1-4 mm - equant - iddingsite  
5% @ R398-0.6; slight alteration to iddingsite; no spinel observed

**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2

**Driller's depth: top [feet]**: 2828.6  
**Driller's depth: bottom [feet]**: 2838.0  
**Core type**: NO

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**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2

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**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2

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**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2

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**Check date**: 12/13/93

**Units in box**: 2

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**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2

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**Loggers**: LLW  
**Date logged**: 12/5/93  
**Checked by**: MG  
**Check date**: 12/13/93

**Units in box**: 2
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R - -)(continuous with previous box)
Bottom (ft): (R398-7.2-2844.2')(flow contact)

Unit type: massive
Except for rubbly zone between R398-1.0 to R398-2.0.

Phenocrysts/Clasts:
- olivine (>10%) -
- olivine - 15% - 1-5 mm - blocky (<3:1:1) -
100 pts @ R398-2.5

Groundmass/Matrix: microcrystalline

Color: N5 medium gray

Vesicles: 5-10% - 1-5 mm - sub-rounded - equant-
Some yellowish brown clay lines the insides of some of the vesicles and also appears at fracture boundaries.

Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly: 5/4 ft

Additional comments:
NaCl ppt

BOX UNIT 2: well-sorted, fine-grained volcanic sand

Contacts: Top (ft): (R 398-7.2-2844.2') (flow contact)
Bottom (ft): (R398-8.3-2845.8') (depositional)

Unit type: volcaniclastic sand

Phenocrysts/Clasts:
- olivine - 20-30% - 1-5 mm - blocky (<3:1:1) -
- glass - <1 mm - tabular (>3:1:1) - clay completely replaces glass

Groundmass/Matrix: fine-grained (<1 mm)

Color: 5YR-6/1 light brownish-gray

Vesicles: none

Alteration: highly (40-60% altered)
Veins: none
Fractures: none

Additional comments:
NaCl ppt; olivine-rich volcanic sand

BOX 295 CONTINUED ON NEXT PAGE
BOX UNIT 3: aphyric basalt
Contacts: Top (ft): (R 398 -8.8 -2845.8') (depositional)
Bottom (ft): (R - ') (continuous with next box)
Unit type: massive
Possibly a pahoehoe flow because of rounded, equant vesicularity.
Phenocrysts/Clasts:
aphyric (<1%) - olivine - <1% - 1-2 mm - blocky (<3:1:1) -
Groundmass/Matrix: fine-grained (<1 mm) -
Color: N4 dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-3 mm - sub-rounded - equant - Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 1/2 ft
Additional comments:
NaCl ppt
BOX UNIT 1: aphyric to moderately phyric basalt  

Contacts:  
Top (ft): (R399-8.5-2855.5) (continuous with previous box)  
Bottom (ft): (R399-8.5-2855.5) (flow contact)  
lithology change and red zone at base  

Unit type: pahoehoe  
abundant sub-rounded vesicles  

Phenocrysts/Clasts:  
aphyric to moderately phyric (<1-10%)  
olivine - <1% - 1-3 mm - equant  
- phenocrysts rare, but increase down section; spinel inclusions present  
- - -  

Groundmass/Matrix: microcrystalline -  
Color: N4 medium dark gray - Structures: - Sorting: -  
Vesicles: 20-30% - <1-10 mm - sub-rounded - equant -  
oxidation  
vesicle size highly variable within unit; oxidation greatest at R399-0.3 to R399-0.9 and R399-7.8 to R400-0.3  
Alteration: fresh to slightly (<2-10% altered) -  
reddish color from vesicle coatings  

Veins: none  
Fractures: weakly fractured: 77.5 ft, from R399-0.3 to R399-7.8, highly fratured to rubbly from R399-7.8 to R400-0.3; red oxidation on rubbly surface  
Additional comments:  
vesicle fillings: from R399-3.4 to R399-4.6 - some vesicles are filled with euhedral interlocking crystals (plagioclase?), larger vesicles often show evidence of bottom coating by later liquid (marked on photo); NaCl ppt  

BOX UNIT 2: aphyric basalt  

Contacts:  
Top (ft): (R399-8.5-2855.5) (continuous with next box)  
Bottom (ft): (R399-8.5-2855.5) (flow contact)  

Unit type: aa  
rubbly top  

Phenocrysts/Clasts:  
aphyric (<1%) -  
olivine - <1% - 1 mm - equant -  
- - -  

Groundmass/Matrix: microcrystalline -  
Color: 5R 3/4 dusky red - Structures: - Sorting: -  
Vesicles: 20-30% - 1-2 mm - sub-rounded - equant -  
Alteration: moderately (10-40% altered) -  
Veins: none  
Fractures: rubble  
Additional comments:  
aa flow top
BOX UNIT 1: aphyric basalt

Contacts:
- Top (ft): (R--')(continuous with previous box)
- Bottom (ft): (R--')(continuous with next box)

Unit type: pahoehoe
- abundant sub-rounded vesicles; internal contact at R400-7.8 marked by glass

Phenocrysts/Clasts:
- aphyric (<1%)
- olivines: <1% - 2 mm - equant

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray
- Structures: - Sorting:
- Vesicles: 15-30% - 1-4 mm - sub-rounded - equant
- some oxidation
- vesicle size increases downcore
- Alteration: fresh (<2% altered)
- Veins: none
- Fractures: highly; some light to orange clays coating fracture surfaces

Additional comments:
- NaCl ppt
Box #: 298
Cores in box: 401

Loggers: LLW
Date logged: 12/6/93
Checked by: MG
Check date: 12/13/93

UNIT #: 177

BOX UNIT 1: aphyric basalt
Contacts: Top (t): (R--)(continuous with previous box)
Bottom (b): (R--)(continuous with next box)

Unit type: pahoehoe
abundant sub-rounded vesicles; R401-5.7 to R401-7.5 is more massive

Phenocrysts/Clasts:
aphyric (<1%) -
olivine (<1%) - 1-2 mm - equant - iddingsite -
phenocrysts very rare

Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 20-30% - 1-3 mm - sub-rounded - equant -
yellowish coating @ R401-1.4 -
5% in massive zone from R401-5.7 to R401-7.5

Alteration: fresh to moderately (<2-40% altered) - oxidation
moderately from R401-8.7 to R401-9.7

Veins: none
Fractures: highly fractured - R401-0.0 to R401-0.8; weakly fractured - R401-0.8 to R401-9.7 (see photo); some yellowish coatings on fracture surfaces

Additional comments:
minor NaCl ppt
BOX UNIT 1: aphyric basalt
Contacts: Top (ft): (R-)(continuous with previous box)
Bottom (ft): (R-)(flow contact)
Unit type: pahoehoe
Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1-2 mm - equant - iddingsite

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 10-20% - 1-4 mm - sub-rounded - equant -
some oxidation
Alteration: slightly (2-10% altered) -
slight groundmass oxidation
Veins: none
Fractures: moderately; 11/1.7 ft; fracture surfaces oxidized

Additional comments:

UNIT #: 177

UNIT #: 178

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R-)(flow contact)
Bottom (ft): (R-)(continuous with next box)
see unit 1 for top contact description
Unit type: aa
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 10-15% - 1-5 mm - equant to tabular - iddingsite, oxidation
visual estimate

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 5-10% - 1-5 mm - sub-rounded to sub-angular - see comment -
mostly equant; some vertically elongate (R402-3.0 to R402-5.2); one area of horizontally elongate (R403-2.2)
Alteration: fresh to slightly (<2-10% altered) -
one highly altered region @ R403-0.0 to R403-0.3
Veins: none
Fractures: some rubbly zones, otherwise weakly fractured (see photo)
Additional comments:
Note glass clasts at contact. Piece from R403-0.9 to R403-1.9 is more weathered, vesicular and phyric than surrounding unit - misplaced? I don't see an obvious place to put it.
**BOX UNIT 1:** highly olivine phyric basalt

Contacts: Top (ft): (R 403-7.9 continuous with previous box)
Bottom (ft): (R 404-1.3-2894.8’)(flow contact)

Unit type: massive

Phenocrysts/Clasts:
- highly phyc (10%)
- olivine (<10%) - 1-5 mm - equant - iddingsite
- 11% @ R403-4.3; spindle inclusions present; alteration of phenocrysts minor

Groundmass/Matrix: microcrystalline
Color: N5 medium gray - Structures: - Sorting:
Vesicles: 5% - 1-5 mm - sub-rounded - equant to horizontally elongate - occasional vesicles to >1 cm
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 5/7.3 ft; heavy white coating on fracture at R403-7.9

Additional comments:
- NaCl ppt. Some rounded, ~ 1 cm olivine clasts (dunite); example on back of core at R403-3.6 appears to contain another mineral (pyroxene?) - marked on photo.

**BOX UNIT 2:** highly olivine phyric basalt

Contacts: Top (ft): (R 404-1.3-2894.8’)(flow contact)
Bottom (ft): (R 404-1.3-2894.8’)(continuous with next box)

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly phyric (>10%) - olivine (>10%) - 1-3 mm - equant to tabular - iddingsite
- 10-15% @ R404-3.2; some olivines are fresh; towards base spindle inclusions observed

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant
Alteration: fresh to highly (2-80% altered) - oxidation
- highly altered from R404-1.3 to R404-1.7 grading into fresh flow
Veins: none
Fractures: moderately fractured: ~10/2.2 ft; does not include rubbly zone at top of flow (see photo); some light colored clay on fracture surfaces

Additional comments:
- NaCl ppt.
<table>
<thead>
<tr>
<th>Box #:</th>
<th>301</th>
</tr>
</thead>
</table>
| Cores in box | 404  
405 |

**Loggers:** LLW  
**Date logged:** 12/6/93  
**Checked by:** MG  
**Check date:** 12/13/93  
**Driller's depth: top [feet]:** 2900.5  
**Driller's depth: bottom [feet]:** 2911.9  
**Core type:** NQ  
**Units in box:** 2

**BOX UNIT 1:** highly olivine phyric basalt  
**Contacts:**  
- **Top (ft):** (R-2)(continuous with previous box)  
- **Bottom (ft):** (R405-2.5-2907.5)(flow contact)  
  contact defined by weathered soil-like zone at base of unit 1; no lithologic change  
**Unit type:** pahoehoe  
**Phenocrysts/Clasts:**  
- highly phyric (>10%)  
- olivine -10% - 1-3 mm - equant - iddingsite  
- 14% @ R404-6.3; occasional -1 cm dunite clasts as described in box 300 log  
**Groundmass/Matrix:** microcrystalline  
**Color:** N5 medium gray  
**Structures:** - Sorting: -  
**Vesicles:** 20-30% - 1-5 mm - sub-rounded to sub-angular - equant  
**Alteration:** slightly (2-10% altered)  
**Veins:** none  
**Fractures:** weakly fractured: 12/6 ft; some rubble present at R404-6.5; some fractures have oxidized coatings  
**Additional comments:** NaCl ppt

**UNIT #179**

**BOX UNIT 2:** highly olivine phyric basalt  
**Contacts:**  
- **Top (ft):** (R-405-2.5-2907.5)(flow contact)  
- **Bottom (ft):** (R405-6.4-2911.4)(flow contact)  
  see unit 1 for top contact description  
**Unit type:** pahoehoe  
**Phenocrysts/Clasts:**  
- abundant sub-rounded vesicles  
- highly phyric (>10%)  
- olivine -15-20% - 1-5 mm - equant - iddingsite  
  - 100 pts @ R405-4.2  
**Groundmass/Matrix:** microcrystalline  
**Color:** 5YR4/1 brownish gray  
**Structures:** - Sorting: -  
**Vesicles:** 20-30% - 1-2 mm - sub-rounded - equant  
**Alteration:** highly to completely (40-100% altered)  
  - completely weathered at contact grading into highly oxidized  
**Veins:** none  
**Fractures:** moderate  
**Additional comments:** NaCl ppt
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R 405-3.0-2911.4') (flow contact at top of box)
Bottom (ft): (R 406-1.8-2916.1') (flow contact)
upper contact defined by a highly oxidized/weathered zone followed by a zone of small vesicles that increase in size down section (away from the contact); lower contact defined by a decrease in vesicle size to either side of the contact, an increase in oxidation as well as ropy flow textures.

Unit type: pahoehoe
classification based on vesicle morphology and size variation within the flow.

Phenocrysts/Clasts:
moderately to highly phyric (2-10%) -
olivine - 7-38% - 1-5 mm - equant -
7% at R405-7.7; 38% at R405-9.0 large variation in abundance suggests flow differentiation; olivines are highly to very highly oxidized/iddingsitized

Groundmass/Matrix: microcrystalline -
Color: 10R 4/2 + N4 - Structures: - Sorting: -
Vesicles: 15-40% - <1-5 mm - rounded to subrounded - equant -
some of the vesicles in the center of the flow are 5-10 mm in longest dimension
Alteration: slightly to highly (1-80% altered) -
groundmass oxidation

Veins: none
Fractures: moderately fractured: 17/4.6 ft

Additional comments:
NaCl ppt

UNIT #: 181

BOX UNIT 2: moderately to highly olivine phyric basalt

Contacts: Top (ft): (R 406-1.6-2916.1') (flow contact)
Bottom (ft): (R - -') (continuous with next box)
see unit 1 for contact description; internal flow contact at R406-4.4

Unit type: pahoehoe
classification based on vesicle morphology and size variation within the flow.

Phenocrysts/Clasts:
moderately to highly phyric (>10%) -
olivine - 2->10% - 2-3 mm - equant -
22% at R406-3.3; 9% at R406-5.8; flow differentiation? Some olivines have a bladed morphology. Olivines are highly to very highly oxidized and iddingsitized

Groundmass/Matrix: microcrystalline -
Color: N4 + 10R 3/4 - Structures: - Sorting: -
Vesicles: 10-40% - <1-5 mm - subrounded - equant -
some vesicles are elongate; vesicles increase in size and decrease in abundance away from the contact
Alteration: slightly to highly (2-80% altered) -
extent of groundmass oxidation decreases away from the contact; core is only slightly altered by R406-3.0; there are thin oxidized zones labeled "B" on the photo; basalt surfaces in the vesicles are oxidized

Veins: none
Fractures: weakly fractured: 10/4.7 ft, doesn't include rubbly zone labeled "A" on the photo

Additional comments:
NaCl ppt
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R -7·5)(continuous with previous box)
Bottom (ft): (R 407.3-2926.5')(flow contact)
no apparent lithology change; red baked rubble zone at base
Unit type: massive
Phenocrysts/Clasts:
highly phric (>10%) -
olive - >10% - 1-5 mm - blocky (3:1:1) - oxidized
Olive crystals are very oxidized and black in color.
Groundmass/Matrix: fine-grained (<1 mm) -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 5-10% - 1-5 mm - sub-rounded - equant -
Alteration: moderately (10-40% altered) -
Veins: none
Fractures: sparsely fractured
Additional comments:
NaCl around olivine crystals

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 407-3.0-2926.5')(flow contact)
Bottom (ft): (R 407-6.3-2926.8')(flow contact)
no apparent lithology change; red rubble zone at base
Unit type: aa
Phenocrysts/Clasts:
highly phric (>10%) -
olive - >10% - 1-5 mm - blocky (3:1:1) - oxidized
Olivine crystals are very oxidized and black in color.
Groundmass/Matrix: fine-grained (<1 mm) -
Color: 5R 3/4 dusky red - Structures: - Sorting: -
Vesicles: 10-30% - 5 mm - sub-rounded - equant -
Alteration: moderately (10-40% altered) -
Veins: none
Fractures: sparsely fractured
Additional comments:
<table>
<thead>
<tr>
<th>Box #: 304</th>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Date logged:</th>
<th>Checked by:</th>
<th>Check date:</th>
<th>Driller's depth:top [feet]:</th>
<th>Driller's depth:bottom [feet]:</th>
<th>Core type: NQ</th>
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<tbody>
<tr>
<td>407 408</td>
<td></td>
<td>LLW</td>
<td>12/6/93</td>
<td>MG</td>
<td>12/13/93</td>
<td>2932.6</td>
<td>2942.4</td>
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</tr>
</tbody>
</table>

**Unit # 184**

**Box Unit 1:** Highly olivine phyric basalt

- **Contacts:**
  - Top (ft): (R 407-6.3-2929.8'; flow contact)
  - Bottom (ft): (R 408-7.2-2940.2'; flow contact)
- **Contact defined by small vesicles, baked zone and slight lithologic change**
- **Unit type:** Massive
- **Phenocrysts/Clasts:**
  - Highly phyric (>10%)
  - Olivine >10% - 1-5 mm - equant to tabular - oxidation
  - 16% R 408-2.7; most olivine completely black
- **Groundmass/Matrix:** Microcrystalline
- **Color:** 5R 3/4 dusky red
- **Vesicles:** 5-10% - <1 to 10 mm - sub-rounded to sub-angular - equant - oxidation
- **Alteration:** Moderately (10-40% altered)
- **Some vesicles vertically elongate; vesicle size grades steadily from largest at R 408-0.0 getting smaller down flow**
- **Veins:** None
- **Fractures:** Rubby: R 407-6.3 to R 408-0.0; weakly otherwise: ~13/7 ft; fractures oxidized
- **Additional comments:**
  - NaCl ppt

**Unit # 185**

**Box Unit 2:** Highly olivine phyric basalt

- **Contacts:**
  - Top (ft): (R 408-7.2-2940.2'; flow contact)
  - Bottom (ft): (R-'; continuous with next box)
  - See unit 1 for top contact description
- **Unit type:** Pahoehoe
- **Phenocrysts/Clasts:**
  - Highly phyric (>10%)
  - Olivine >10% - 1-5 mm - equant to tabular - oxidation
  - 12% R 406-8.5; most olivine completely black
- **Groundmass/Matrix:** Microcrystalline
- **Color:** N 4 med. dark gray to 10R 3/4 dark reddish brown
- **Vesicles:** 10-20% - 1-3 mm - sub-rounded - equant - oxidation
- **Vesicles smallest at top of unit**
- **Alteration:** Slightly to very highly (2-95% altered)
- **Veins:** None
- **Fractures:** Highly at top of unit grading to weakly at end of box (see photo)
- **Additional comments:**
  - NaCl ppt
BOX UNIT 1: highly olivine phyric basalt

Contacts:
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R409-2.7-2945.8) (flow contact)

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine (>10% - 2 mm - equant - highly oxidized)
- visual estimate; blackened olivines

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray

Vesicles: 10-20% - 1-3 mm - sub-rounded to sub-angular
- oxidation

Alteration: slightly (2-10% altered)
- groundmass oxidation

Veins: none

Fractures: weakly; 2/4 ft - excludes small rubble zone at R409-0.8 (marked on photo); fractures heavily oxidized

Additional comments:

NaCl ppt

BOX UNIT 2: highly olivine phyric basalt

Contacts:
- Top (ft): (R409-2.7-2945.8) (flow contact)
- Bottom (ft): (R--|continuous with next box)

see unit 1 for top contact description

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine (>10% - 1.5 mm - equant - highly oxidized)
- 15% @ R409-3.8; 14% @ R409-7.4

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray to 10R3/4 dark reddish brown

Vesicles: 10-20% - 1-3 mm - sub-rounded - equant
- highly oxidized

Vesicle size is highly variable in different pieces

Alteration: moderately to highly (10-80% altered)
- groundmass oxidation

Veins: none

Fractures: moderate to highly (see photo); fracture surfaces highly oxidized

Additional comments:
**Box #:** 306

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Driller's depth:top [feet]</th>
<th>Driller's depth:bottom [feet]</th>
<th>Core type:</th>
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</thead>
<tbody>
<tr>
<td>409</td>
<td>LLW</td>
<td>2953.0</td>
<td>2971.9</td>
<td>NQ</td>
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<tr>
<td>411</td>
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</table>

**Date logged:** 12-7-93  
**Checked by:** MG  
**Check date:** 12/14/93

**Units in box:** 3

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**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R-.-)(continuous with previous box)
- Bottom (ft): (R409-8.9-2952.0)(flow contact)

Unit type: pahoehoe
- abundant sub-rounded vesicles

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine — >10% — 1-5 mm — equant to tabular — highly oxidized

**Groundmass/Matrix:** microcrystalline

**Color:** N4 medium dark gray  
**Structures:** —  
**Sorting:** —

**Vesicles:** 10-20% — 1-5 mm — sub-rounded — equant — oxidation
- vesicle size grades down to smallest near flow contact

**Alteration:**
- moderately (10-40% altered)
- groundmass oxidation; contact region most highly oxidized

**Veins:**
- Fractures: moderate: 3/0.7 ft

**Additional comments:**

---

**BOX UNIT 2:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 409-8.9-2952.0)(flow contact)
- Bottom (ft): (R411-0.0-2965.0)(flow contact)

Unit type: pahoehoe

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine — >10% — 1-5 mm — equant — iddingsite, oxidation

**Groundmass/Matrix:** microcrystalline

**Color:** N3 dark gray to 10R3/4 dark reddish brown  
**Structures:** —  
**Sorting:** —

**Vesicles:** 5% — 1-3 mm — sub-angular — equant — oxidation

**Alteration:**
- moderately to very highly (10-95% altered)
- most altered at contact

**Veins:** none

**Fractures:** highly fractured - see photo

**Additional comments:**

---

**BOX 306 CONTINUED ON NEXT PAGE**
BOX UNIT 3: highly olivine phyric basalt

Contacts: Top (ft): (R 411-0.0-2965.0)(flow contact)
Bottom (ft): (R--')(continuous with next box)
see unit 2 for description of top contact; distinct lithologic change

Unit type: massive

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine — >10% — 1-5 mm — equant — iddingsite, oxidation
- 17% @ R411-2.4; phenocrysts moderate to highly oxidized
- plagioclase — <1% — <1 mm — tabular (>3:1:1)

Groundmass/Matrix: microcrystalline
- Color: N4 med. dark gray to 5YR22 dusky brown
- Structures: — Sorting: —
- Vesicles: — Sub-rounded to sub-angular — equant — oxidation
- occasional elongate vesicles with no preferred orientation; highly vesicular zone at R411-4.1 to 4.2 marked "B" on photo
- alteration: moderately (10-40% altered) —
- groundmass oxidation

Fractures: weakly fractured; 12/5.2 ft; fractured surfaces have oxidized coatings

Additional comments:
- R411-3.2 - internal cemented rubbly zone (marked "A" on photo), possible internal flow contact??

UNIT #: 188

Box 306

Cores in box
409
410
411

Loggers: LLW
Date logged: 12-7-93
Checked by: MG
Check date: 12/14/93

Driller's depth:top [feet]: 2953.0
Driller's depth:bottom [feet]: 2971.9
Core type: NQ

Units in box: 3

Box 306
<table>
<thead>
<tr>
<th>Box #</th>
<th>Loggers</th>
<th>Date logged</th>
<th>Checked by</th>
<th>Check date</th>
<th>Cores in box</th>
<th>Driller's depth: top (feet)</th>
<th>Core type</th>
<th>Driller's depth: bottom (feet)</th>
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<tr>
<td>307</td>
<td>MBB</td>
<td>12/7/93</td>
<td>MG</td>
<td>12/14/93</td>
<td>411 412</td>
<td>2971.9</td>
<td>NQ</td>
<td>2983.8</td>
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</table>

**BOX UNIT 1: highly olivine phyric basalt**

**Contacts:**
- Top (ft): (R ++) (continuous with previous box)
- Bottom (ft): (R --) (continuous with next box)

**Unit type:** transitional

**Classification based on the presence of both sheared and equant vesicles**

**Phenocrysts/Clasts:**
- Highly phyric (>10%)
  - Olivine - 15-18% - 2-4 mm - equant to tabular -
  - 15% at R411-7.6; 18% at R412-5.8; spinel inclusions in the olivine; some bladed olivines; olivines are moderately to highly oxidized

**Groundmass/Matrix:** microcrystalline

**Color:** N3 + 5R 3/4

**Vesicles:**
- 7-10% - 1-5 mm - subrounded to subangular - equant to horizontally elongate -
- Horizontally elongate vesicles are developed below R412-4.0; basalt is oxidized within the vesicles

**Alteration:**
- Moderately (10-40% altered)
  - Extent of groundmass oxidation decreases lightly below R412-5.0.

**Veins:** none

**Fractures:**
- Weakly fractured: 97.8 ft; measurement doesn't include 2' rubble zone starting at R412-0.0; groundmass is more oxidized along fracture surfaces

**Additional comments:**
- NaCl ppt. No plagioclase!
Box #:

308

Cores in box

412
413
416

Loggers: MBB

Date logged: 12/7/93

Checked by: MG

Check date: 12/14/93

Units in box: 3

BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R-7.7 continuous with previous box)

Bottom (ft): (R413-0.0-2985.0)(flow contact)

flow contact defined by clinkery zone at the top of the bottom flow, and a decrease in vesicle size, and an increase in vesicularity in the upper flow

Unit type: transitional

Phenocrysts/Clasts:

highly phyric (>10%)

olivine - 10-16% - 2-4 mm - equant -

18% at R412-7.7; spinel inclusions in the olivine phenocrysts; olivines occur in crystal clots and sometimes have a bladed morphology (bladed olivines more abundant near the contact); olivines are slightly oxidized

Groundmass/Matrix: microcrystalline

Color: N3 + 5R 3/4 - Structures: - Sorting: -

Vesicles: 10-20% - <1-5 mm - subrounded to subangular - equant to elongate - size decreases and abundance increases toward contact

Alteration: moderately to highly (10-80% altered)

Extent of groundmass oxidation increases toward contact.

Veins: none

Fractures: weakly fractured: 3/1.2 ft; groundmass more oxidized at the fractures

Additional comments:

NaCl ppt

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 413-0.0-2985.0) (flow contact)

Bottom (ft): (R416-0.0-2995.0)(flow contact)

see unit 1 for upper contact description; poor recovery in R416 masks contact; recovered material is oxidized and clinkery

Unit type: aa classification based on the angular and elongate shape of the vesicles

Phenocrysts/Clasts:

highly phyric (>10%)

olivine - 10-16% - 2-4 mm - equant to tabular -

16% at R413-1.6; 10% at R413-5.6; rare spinel inclusions in the olivines; olivine crystal clots are present; olivines are fresh to slightly oxidized

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 3-5% - <1-5 mm - subrounded to angular - equant to elongate - Equant vesicles are generally ≤2 mm; larger vesicles are horizontally elongate.

Alteration: fresh to highly (<2-80% altered)

Extent of groundmass oxidation decreases away from the upper contact; core is fresh by R413-2.0.

Veins: none

Fractures: weakly fractured: 3/6 ft

Additional comments:

minor NaCl ppt
BOX UNIT 3: moderately olivine phyric

Contacts:
- Top (ft): (R 416-0.0-2995.0") (flow contact)
- Bottom (ft): (R--) (continuous with next box)
  see unit 2 for contact description

Unit type: rubble
- some of this material may be cave (size range of olivines varies dramatically among some of the pieces); most of the pieces are clinkery

Phenocrysts/Clasts:
- moderately phyric (2-10%)
  - olivine (~5-10%) - 1-3 mm - equant
    - visual estimate of mode; olivines are slightly oxidized

Groundmass/Matrix:
- microcrystalline

Vesicles:
- 5-15% - <1-4 mm - subrounded to subangular - equant to elongate

Alteration:
- moderately to very highly (10-95% altered) - groundmass oxidation

Veins: none
Fractures: rubbly
Additional comments:
BOX UNIT 1: moderately phyric olivine basalt

Contacts: Top (R: (R --')(continuous with previous box)
Bottom (R): (R--')(continuous with next box)

Unit type: aa
upper part oxidized rubble

Phenocrysts/Clasts:
moderately phyric (2-10%)
olivine - 4% - 1-5 mm - blocky (<3:1:1)
slightly more phyric in the altered zone

Groundmass/Matrix: fine-grained (<1 mm)

Color: N6 gray - Structures: - Sorting: -

Vesicles: <5% - 1 mm - sub-rounded - equant

Alteration: moderately (10-40% altered)
Zone of alteration runs from R417-0.0 to R417-4.4, after which the flow is fresh.

Veins: none
Fractures: weakly: 10/10 tt

Additional comments:
NaCl ppt

Driller's depth: top [feet]: 3001.0
Driller's depth: bottom [feet]: 3010.5
Core type: NO
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (t): (R --)(continuous with previous box)
Bottom (b): (R--)(continuous with next box)

Unit type: aa
From R418-1.4 flow is aa, but the flow previous to this is massive.

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 3-4% - 1-5 mm - blocky (<3:1:1)
- 100 pts counted @ R418-1.0 (MG)

Groundmass/Matrix: fine-grained (<1 mm)

Color: N6 gray - Structures: - Sorting: -

Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated -
flow less vesicular above R418-1.3 (<5%)

Alteration: fresh (<2% altered)

Fractures: weakly fractured: 8/10 ft

Additional comments:
NaCl ppt
BOX UNIT 1: moderately phyric olivine basalt

Contacts:
- Top (ft): (R-·-)(continuous with previous box)
- Bottom (ft): (R-·-)(continuous with next box)

Unit type: aa
Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine: 3% - 1-5 mm - blocky (<3:1:1)
- Spinel inclusions in the olivine. Some of the larger olivine crystals tend to be more tabular in shape; 100 pts counted at R419-5.0 (?).

Groundmass/Matrix: fine-grained (<1 mm)
Color: N6 gray
Vesicles: <5% - 1-3 mm - sub-rounded - horizontally elongated
Alteration: slightly (2-10% altered)
Vesicles: none
Fractures: weakly fractured: 8/10 ft
Additional comments:
- NaCl ppt. Fracture surfaces show some filamentous clay(? coatings.
BOX UNIT 1: moderately phyric olivine basalt

Contacts: Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R420-0.8-3032.4')(flow contact)

Unit type: aa

Phenocrysts/Clasts:
moderately phyric (2-10%) — olivine — 5% — 1-5 mm — blocky (<3:1:1)
Some of the larger olivine crystals tend to be tabular.

Groundmass/Matrix: fine-grained (<1 mm)

Color: 5R 2/ blackish red — Structures: — Sorting:

Vesicles: <5% — 1-5 mm — sub-rounded — horizontally elongated
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 2/1.1; lowermost 0.9' is rubbly.
Additional comments:
Minor NaCl ppt.

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 420-0.8-3032.4'Xflow contact)
Bottom (ft): (R 420-4.1-3035.7')(flow contact)
base of flow marked by glass and soil

Unit type: pahoehoe

Phenocrysts/Clasts:
aphyric (<1%) — olivine — 1-5 mm

Groundmass/Matrix: fine-grained (<1 mm)

Color: N6 gray — Structures: — Sorting:

Vesicles: 7% — 5 mm — spherical — equant
Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly fractured
Additional comments:
NaCl ppt

BOX 312 CONTINUED ON NEXT PAGE
**Box #:** 312
**Cores in box:**
- 419
- 420

**Loggers:** GFE, MBB
**Date logged:** 12/7/93
**Checked by:** MG
**Check date:** 12/14/93

**Driller's depth:**
- Top [feet]: 3029.6
- Bottom [feet]: 3038.5

**Core type:** NQ

**Units in box:** 3

---

**BOX UNIT 3: aphyric basalt**

- **Contacts:**
  - Top (ft): (R 420-4.1-3035.7') (flow contact)
  - Bottom (ft): (R 420-7.0-3038.6') (flow contact)

- **Unit type:** pahoehoe

- **Phenocrysts/Clasts:**
  - aphyric (<1%)
  - olivine - <1%

- **Groundmass/Matrix:** fine-grained (<1 mm)

- **Color:** N6 gray
- **Structures:**
- **Sorting:**

- **Vesicles:**
  - 10-20% - 3 mm - spherical - equant

- **Alteration:**
  - fresh (<2% altered)

- **Veins:** none

- **Fractures:** weakly fractured

**Additional comments:**

NaCl ppt. The top flow contact is sharp, with a baked layer of ash/soil (~3 cm thick) overlying a glassy flow top. This is followed by ~2 cm of altered pahoehoe with equant vesicles averaging 1 mm in size. Below the thin layer of pahoehoe, there is a light gray, unbaked layer of volcaniclastic soil (?) ~2 cm thick. This second layer is possibly ash that was deposited in a crack in the top of the main body of the flow. Glass, fluid-type contact at base of box.
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R 420-7.0-3038.6') (flow contact)  
Bottom (ft): (R 421-0.6-3042.2') (flow contact)  
- top flow contact defined by a highly vesicular/weathered zone at the top of the lower flow; lower contact defined by a decrease in vesicle size (no lithology change); top contact is not baked  

Unit type:  
pahoehoe  
vesicle morphology and size variation within flow  

Phenocrysts/Clasts:  
aphyric (<1%) - rare olivine microphenocrysts  

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)  
-  
-  
-  
-  
Color:  
N4 medium dark gray  
-  
-  
-  
-  
Structures: - Sorting: -  

Vesicles: 15-40% - <1-5 mm - sub-rounded to sub-angular - equant -  
- <1 mm vesicles in the region of large vesicles; these small vesicles are regions of minor oxidation. Some vesicles in the center of the flow are >10 mm in largest dimension; some horizontally elongate vesicles in center of flow  

Alteration: fresh to slightly (<2-10% altered)  
right at the top of contact the alteration/weathering is more pervasive; 2 cm thick oxidized zone at the bottom of the flow  

Veins: none  
Fractures: moderately fractured: 17/8 ft; dusting of ivory-colored material on some of the fractured surfaces  

Additional comments:  
- minor NaCl ppt; some plagioclase laths in the groundmass are observable with hand lens  

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 421-0.6-3042.2') (flow contact)  
Bottom (ft): (R 421-1.5-3043.1') (flow contact)  
see unit 1 for contact description; could be internal unit  

Unit type:  
pahoehoe  
vesicles morphology & size variation within flow units; no lithology change  

Phenocrysts/Clasts:  
aphyric (<1%) - rare olivine microphenocrysts  

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)  
-  
-  
-  
-  
Color:  
N3 dark gray  
-  
-  
-  
-  
Structures: - Sorting: -  

Vesicles: 10-50% - <1-5 mm - sub-rounded to sub-angular - equant -  
basalt within vesicles is oxidized  

Alteration: slightly (<2-10% altered)  
highly oxidized with ~1 cm of the upper & lower contact  

Veins: none  
Fractures: moderately fractured: 4/1 ft; most fractures located in the contact zone (see photo)  

Additional comments:  
- minor NaCl ppt; some plagioclase laths are observed in groundmass with hand lens  

BOX UNIT 3 CONTINUED ON NEXT PAGE
BOX UNIT 3: aphyric basalt

Contacts:
- Top (ft): (R 421-1.5-3043.1') (flow contact)
- Bottom (ft): (R - ) (continuous with next box)
  see unit 2 description

Unit type: transitional
classification based on higher fraction of elongate more angular vesicles

Phenocrysts/Clasts:
aphyric (<1%) - olivine microphenocrysts

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 10-50% - 1-3 mm - sub-rounded - equant-
narrow zones of <5% vesicles
Alteration: fresh (<2% altered)
groundmass highly oxidized right at contact
Veins: none
Fractures: weakly fractured: 9/5 ft

Additional comments:
NaCl ppt; plagioclase visible in groundmass with hand lens; "A" = regions of vesicle infillings - darker more coarsely crystalline areas with vesicle outlines.
**Box #:** 314

**Cores in box**
- 421
- 422

**Loggers:** LLW
**Date logged:** 12/8/93
**Checked by:** MG
**Check date:** 12/14/93

**Driller's depth:**
- Top (feet): 3047.8
- Bottom (feet): 3057.7

**Core type:** NQ
**Units in box:** 1

**BOX UNIT 1:** aphyric basalt

**Contacts:**
- Top (ft): (R - -)(continuous with previous box)
- Bottom (ft): (R - -)(continuous with next box)

**Unit type:** pahoehoe
- abundant sub-rounded vesicles

**Phenocrysts/Clasts:**
- aphyric (<1%)
- olivine - <1% - 1-5 mm - equant -
- Aphyric except for highly phytic zone from R421-7.8 to R421-9.0 (14% @ R421-7.9); mineral settling!

**Groundmass/Matrix:** microcrystalline

**Color:** N5 medium gray (fresh)

**Structures:**
- Sorting: -

**Vesicles:**
- 5-30% - <1-5 mm - sub-rounded - equant -
- Oxidation
- Occasional horizontally elongate vesicles, vesicle size changes throughout section, may indicate other internal flow contacts

**Alteration:**
- Fresh to highly (~2-80% altered)
- Mostly fresh; highly oxidized below internal flow contact at R422-5.1

**Veins:** none

**Fractures:**
- Weakly fractured: 15/8.5 ft - does not include highly fractured zone from R422-5.1 to R422-5.9; fractures coated with yellowish clays

**Additional comments:**
- From R421-7.2 to R421-8.1 some vesicles are partially to completely filled with a magnetic mixture of dark (hematite?) and light mineral; internal flow contact at -R422-5.1
**Box #:**

315

**Cores in box:**

422  
423

**Loggers:** GFE, MG  
**Date logged:** 12/8/93  
**Checked by:** MG  
**Check date:** 12/14/93

**Driller's depth:**

- **top [feet]:** 3057.7  
- **bottom [feet]:** 3067.1  
**Core type:** NQ

**Units in box:** 2

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**Box Unit 1:** Aphyric basalt

**Contacts:**
- Top (ft): (R --)(continuous with previous box)
- Bottom (ft): (R423-2.9-3064.9)(flow contact)
- Weathered fine-grained sandy soil ~3 cm thick

**Unit type:** Pahoehoe

**Phenocrysts/Clasts:**
- Aphyric (<1%)
- Olivine: <<1% - 1 mm - equant
- -

**Groundmass/Matrix:** Fine-grained (<1 mm)

**Color:** N4 medium dark gray  
**Vesicles:** 10-20% - 1-5 mm - spherical - equant  
**Alteration:** Fresh (<2% altered)

**Additional comments:**
- NaCl ppt

---

**Box Unit 2:** Aphyric basalt

**Contacts:**
- Top (ft): (R 423-2.9-3064.9)(flow contact)
- Bottom (ft): (R --)(continuous with next box)
- Soil/cinder at top

**Unit type:** Pahoehoe

**Phenocrysts/Clasts:**
- Aphyric (<1%)
- Olivine: <1% - 1 mm - equant
- -

**Groundmass/Matrix:** Microcrystalline

**Color:** N4 medium dark gray  
**Vesicles:** 20-30% - 2-4 mm - sub-rounded - equant  
**Alteration:** Slightly (2-10% altered)  
**Oxidation**

**Veins:** None  
**Fractures:** Weakly fractured  
**Additional comments:**
- 2/2 ft
BOX UNIT 1: aphyric basalt

Contacts:
Top (lt): (R --')(continuous with previous box)
Bottom (lt): (R --')(continuous with next box)
Internal contact at R424-2.5 defined by decreasing vesicle size and some slight alteration, but no lithology change

Unit type: pahoehoe

Phenocrysts/Clasts:
aphyric (<1%) – olivine – <1% – 1 mm – equant –

Groundmass/Matrix: fine-grained (<1 mm) –

Color: N4 medium dark gray – Structures: – Sorting: –

Vesicles: 10-20% – 1-3 mm – spherical – equant –
<5% vesicles between R423-6.0 and R423-7.7.

Alteration: fresh (<2% altered) –
There is a zone of slight alteration from 423-2.5 to R423-3.0 that is reddish-brown in color.

Veins: none

Fractures: weakly fractured: 16/10 ft (greater near base)

Additional comments:
NaCl ppt. Rubble zone from R424-1.0 to R424-1.7 that shows some sandy weathering on individual pieces.
Box #: 317  Cores in box  
424  
425

LOGS: GFE  
Date logged: 12/8/93  
Checked by: MG  
Check date: 12/14/93  

Core type: NO

Driller's depth: top [feet]: 3076.3  
Driller's depth: bottom [feet]: 3085.2

Units in box: 1

BOX UNIT 1: aphyric basalt  
Contacts: Top (t): (R--')(continuous with previous box)  
Bottom (b): (R--')(continuous with next box)  
Unit type: pahoehoe

Phenocrysts/Clasts:  
aphyric (<1%)  
olivine <1% - 1 mm - equant -  

Groundmass/Matrix: fine-grained (<1 mm) -  
Color: N5 medium gray - Structures: Sorting: -  
Vesicles: 10-20% - 1-5 mm - sub-rounded - equant- large vesicles lined with crystals (quench plagioclase?)  
Alteration: fresh (<2% altered) -  
Veins: none  
Fractures: weakly fractured  
Additional comments:  
NaCl ppt

UNIT #: 196

UNIT 196 Box 317
**Cores in box**

425 428
426 427

**Date logged:** 12/8/93
**Checked by:** MG
**Check date:** 12/14/93

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**BOX UNIT 1:** aphyric basalt

**Contacts:**
- Top (ft): (R - -) (continuous with previous box)
- Bottom (ft): (R426-2.2-3091.6") (flow contact)

R426 is missing a lot of core so actual contact not observed but contact defined by lithologic change; 80° internal glassy contact at R425-4.2 (A on photo)

**Unit type:**
- abundant rounded to sub-rounded vesicles

**Phenocrysts/Clasts:**
- aphyric (<1%)
- oliv ine - <1% - 1 mm - equant -

**Groundmass/Matrix:**
- microcrystalline/fine-grained (<1 mm)
- Color: N4 medium dark gray
- Structures: - Sorting: -

**Vesicles:**
- 10-20% - 1-5 mm - spherical to sub-rounded - equant -

**Alteration:**
- fresh (<2% altered)

**Veins:** none

**Fractures:** weakly fractured; 205/9 ft; fracture surfaces fresh

**Additional comments:**

**BOX UNIT 2:** sparsely plagioclase-olivine phryic basalt

**Contacts:**
- Top (ft): (R426-2.2-3091.6") (flow contact)
- Bottom (ft): (R- -) (continuous with next box)

See unit 1 for top contact description.

**Unit type:**
- massive

**Phenocrysts/Clasts:**
- sparsely phryic (1-2%)
- olivine - 1% - 1-2 mm - equant -
- olivines fresh
- plagioclase - <1% - -

**Groundmass/Matrix:**
- microcrystalline
- Color: N3 dark gray
- Structures: - Sorting: -

**Vesicles:**
- 5-10% - 1-2 mm - sub-angular - vertically elongated -

**Alteration:**
- fresh (<2% altered)

**Veins:** none

**Fractures:** moderately to highly fractured

**Additional comments:**
- 2 pieces at top of unit have multiple coring cuts (marked on photo)
- small (2-4 mm) microgabbroic inclusions
BOX UNIT 1: sparsely plagioclase-olivine phyric basalt

Contacts:
- Top (tt): (R 428-7.0-3109.0')(flow contact)
- Bottom (tt): (R--')(continuous with previous box)

Unit type: aa

Between R428-2.5 and R428-4.0, unit is massive.

Phenocrysts/Clasts:
- sparsely phyric (1-2%)
- olivine - 1-2% - 1-5 mm - blocky (<3:1:1)
- plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: fine-grained (<1 mm)

Color: N4 gray - Structures: - Sorting: -

Vesicles: 5-10% - 1-5 mm - sub-rounded - horizontally elongated

Alteration: fresh (<2% altered)

Veins: none

Fractures: strongly fractured in upper part along vesicles, weakly below R428-1.8 to contact

Additional comments:
- NaCl ppt; small (2-4 mm) microgabbro inclusions

BOX UNIT 2: highly phyric olivine basalt

Contacts:
- Top (tt): (R 428-7.0-3109.0')(flow contact)
- Bottom (tt): (R--')(continuous with next box)

Unit type: pahoehoe

Phenocrysts/Clasts:
- highly phyric (>10%)
- olivine - 15-30% - 5 mm - blocky (<3:1:1) - oxidized
- olivines in rubbly, altered areas are almost all black in color; visual estimate.

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 5-10% - 1-5 mm - spherical - equant

Alteration: moderately (10-40% altered)

Veins: none

Fractures: rubbly

Additional comments:
- NaCl ppt
**BOX UNIT 1:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R - -')(continuous with previous box)
- Bottom (ft): (R430-4.0-3123.0')(flow contact)

**Unit type:** aa

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - 25% - 1-3 mm - equant
- 100 pts counted at R430-1.0

**Groundmass/Matrix:** microcrystalline

**Color:** N5 medium gray

**Vesicles:** 10-20% - 1-3 mm - sub-rounded - equant

**Alteration:** slightly (2-10% altered)

**Veins:** none

**Fractures:** weakly to moderately

**Additional comments:**
NaCl ppt

**BOX UNIT 2:** highly olivine phyric basalt

**Contacts:**
- Top (ft): (R 430-4.0-3123.0')(flow contact)
- Bottom (ft): (R--')(continuous with next box)

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - >10% - 1-5 mm - tabular (>3:1)
- blackened olivines

**Groundmass/Matrix:** microcrystalline

**Color:** N4 gray

**Vesicles:** 5-10% - 1-5 mm - sub-rounded - equant

**Alteration:** moderately (10-40% altered)

**Veins:** none

**Fractures:** weakly fractured: 3/2 ft

**Additional comments:**
NaCl ppt
BOX UNIT 1: highly olivine phyric basalt

Contacts: Top (ft): (R 431-2.2-3131.2') (flow contact)
Bottom (ft): (R 431-2.2-3131.2') (flow contact)
contact defined by rubbly zone and vesicle size gradation; no lithology change

Unit type: pahoehoe

Phenocrystals/Clasts:
highly phryic (>10%) -
olivine - 15-20% - 1-5 mm - equant - oxidation
17% @ R431-4.2; some olivine very fresh, others highly altered

Groundmass/Matrix: microcrystalline-
Color: 5YR5/1 brownish gray - Structures: - Sorting: -
Vesicles: 10-20% - <1-5 mm - sub-rounded - equant - oxidized
Alteration: fresh to moderately (<2-10% altered) -
groundmass oxidation

Veins: none
Fractures: 4/0.5 ft
Additional comments:
contact may be internal

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R 431-2.2-3131.2') (flow contact)
Bottom (ft): (R 431-2.2-3131.2') (flow contact)
see unit 1 for top contact description; bottom contact defined by weathered rubbly zone; no lithology change

Unit type: pahoehoe

Phenocrystals/Clasts:
highly phryic (>10%) -
olivine - 15-20% - 1-5 mm - equant to tabular - iiddingsite
17% @ R431-4.2; some olivine very fresh, others highly altered

Groundmass/Matrix: microcrystalline-
Color: 5YR5/1 brownish gray - Structures: - Sorting: -
Vesicles: 10-20% - <1-3 mm - sub-rounded to sub-angular - equant -
occasional inclined vesicles
Alteration: fresh to moderately (<2-10% altered) -
fresh at top to ~R431-5.6 then moderate groundmass oxidation

Veins: none
Fractures: rubbly at top (R431-2.2 to R431-2.6) otherwise weakly fractured (197.5 ft; some "disking"); oxidation along fractures
Additional comments:
**Box #:** 321  
**Cores in box:** 431  
432

**Loggers:** LLW  
**Date logged:** 12-9-93  
**Checked by:** MG  
**Check date:** 12/14/93

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**BOX UNIT 3:** highly olivine phryic basalt  
**Contacts:**  
Top (ft): (R-432-0.6-3139.3' flow contact)  
Bottom (ft): (R--') (continuous with next box)  
see unit 2 for top contact description; no lithology change  
**Unit type:** massive  
**Phenocrysts/Clasts:**  
highly phryic (>10%) -  
olivine - ~10% - 1-5 mm - equant - completely oxidized  
15% @ R432-0.8

**Groundmass/Matrix:** microcrystalline -  
**Color:** 5YR3/2 grayish brown -  
**Structures:** -  
**Sorting:** -  
**Vesicles:** 5-10% - 1-3 mm - sub-rounded - equant - highly oxidized  
**Alteration:** moderately (10-40% altered) - groundmass oxidation  
**Veins:** none  
**Fractures:** rubbly top of flow; surfaces oxidized  
**Additional comments:**

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**UNIT #: 201**

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**Driller's depth:top [feet]:** 3131.0  
**Driller's depth:bottom [feet]:** 3143.0  
**Core type:** NQ

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**Units in box:** 3
BOX UNIT 1: highly olivine phyric basalt
Contacts: Top (ft): (R: -/-)(continuous with previous box)
Bottom (ft): (R433-2.4-3151.2')(flow contact)
contact defined by rubbly oxidized zone at top of unit 2; no lithology change
Unit type: pahoehoe
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - 15-20% - 1-5 mm - equant - oxidation
18% @ R433-0.4; most olivines completely oxidized

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-7 mm - sub-rounded to sub-angular - equant to inclined -
heavily oxidized
vesicle size varies throughout unit; around R432-5.2 vesicles horizontally elongate
Alteration: slightly (0-10% altered) -
Veins: none
Fractures: weakly fractured: 16/7 ft; fracture surfaces oxidized
Additional comments:
NaCl ppt; internal contacts at R432-5.4 and R433-0.0

BOX UNIT 2: highly olivine phyric basalt
Contacts: Top (ft): (R 433-2.4-3151.2')(flow contact)
Bottom (ft): (R--')(continuous with next box)
see unit 1 for top contact description
Unit type: massive
Phenocrysts/Clasts:
highly phyric (>10%)
olivine - >10% - 1-3 mm - equant - oxidation
12% @ R433-0.8; most olivines are completely oxidized

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-3 mm - sub-rounded - equant - oxidation
Alteration: highly (40-80%) altered -
highly altered at contact
Veins: none
Fractures: highly (see photo)
Additional comments:
### BOX UNIT 1: highly olivine phyric basalt

**Contacts:**
- Top (ft): (R -5(continuous with previous box)
- Bottom (ft): (R434 -2.1 -3161.0)(flow contact)

**Unit type:** transitional classification based on the presence of both sheared and equant vesicles

**Phenocrysts/Clasts:**
- highly phyric (>10%)
- olivine - 22-28% - 2-5 mm - equant
- 22% at R433-5.3; 28% at R434-1.5; spinel inclusions in the olivine phenocrysts; olivine crystal clots; olivines are slightly to highly oxidized (includes MnO coatings), with minor liddingsite.

**Groundmass/Matrix:** microcrystalline

**Color:** N4 + 5R 3/4

**Vesicles:**
- >30% - <1-4 mm - rounded to subrounded - equant

**Alteration:**
- highly to very highly (40-95% altered)
- groundmass oxidation

**Veins:** none

**Fractures:**
- moderately fractured: >16/2 ft; core is close to being highly fractured at the top of the flow

**Additional comments:**
- NaCl ppt

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### BOX UNIT 2: aphyric basalt

**Contacts:**
- Top (ft): (R 434 -2.1 -3161.0)(flow contact)
- Bottom (ft): (R -5(continuous with next box)

**Unit type:** pahoehoe classification based on the high abundance and the morphology of the vesicles

**Phenocrysts/Clasts:**
- aphyric (<1%)
- olivine - <1% - ≤1 mm - equant

**Groundmass/Matrix:** microcrystalline

**Color:** 10R 4/2 + 5R 3/4

**Vesicles:**
- >30% - <1-4 mm - rounded to subrounded - equant

**Alteration:**
- highly to very highly (40-95% altered)
- groundmass oxidation

**Veins:** none

**Fractures:** moderately fractured: >16/2 ft; core is close to being highly fractured at the top of the flow

**Additional comments:**
- NaCl ppt; glassy flow surface at R434-2.6
BOX UNIT 1: aphyric basalt

Contacts:
- Top (ft): (R -·')(continuous with previous box)
- Bottom (ft): (R -·')(continuous with next box)

Unit type: pahoehoe
abundant rounded to sub-rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%) - aphyric except for ~5% olivine zone at R434-9.0 to R435-1.0
olivine - <1% - 1-2 mm - equant -
olivine more abundant between R434-6.5 to R435-2.5 (MG)

Groundmass/Matrix: microcrystalline
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 10-20% - 1-5 mm - spherical to sub-rounded - equant -
vessel size and abundance variable, both generally decreasing down section

Alteration: fresh (<2% altered) -
Veins: none
Fractures: weakly fractured: 20/9.6 ft

Additional comments:
NaCl ppt
**Box #:** 325

**Cores in box**

- 435
- 436

**Loggers:** GFE, MG

**Date logged:** 12/9/93

**Checked by:** MG

**Check date:** 12/14/93

**Driller's depth:**
- Top [feet]: 3172.6
- Bottom [feet]: 3181.8

**Core type:** NQ

**Units in box:** 1

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**BOX UNIT 1:** aphyric to moderately olivine phryic basalt

**Contacts:**
- Top (ft): (R-1)(continuous with previous box)
- Bottom (ft): (R-1)(continuous with next box)

**Flow contains at least 2 internal contacts.**

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- aphyric to moderately phryic (<1-10%)
- olivine -<1-3% - 1-2 mm - blocky (<3:1:1)

**Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)

**Vesicles:** 10-20% - 1-5 mm - spherical - equant

**Alteration:** fresh (<2% altered)

Core becomes more altered near internal contacts.

**Veins:** none

**Fractures:** weakly fractured

**Additional comments:**
- NaCl ppt
Box #: 326

Cores in box:
436
437

Loggers: GFE, MG
Date logged: 12/9/93
Checked by: MG
Check date: 12/14/93

Driller's depth: top [feet]: 3181.8
Driller's depth: bottom [feet]: 3191.9
Core type: NQ

Units in box: 2

BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R-4.3169.8) (continuous with previous box)
Bottom (ft): (R-4.3169.8) (flow contact)
Internal contacts @ R436-3.0, 4.2, 8.1, and 8.9 defined by decreasing vesicle size toward the contact, but no distinct lithologic change.

Unit type: pahoehoe

Phenocrysts/Clasts:
aphyric (<1%) - olivine - 1-2% - 1 mm - blocky (<3:1:1) -

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N5 gray - Structures: - Sorting:

Vesicles: 10-20% - 1-5 mm - spherical - equant

Alteration: slightly (2-10% altered)

Flow becomes more altered near internal and flow contacts.

Veins: none

Fractures: weakly fractured

Additional comments:

NaCl ppt

BOX UNIT 2: sparsely phyric olivine basalt

Contacts: Top (ft): (R437-0.4-3189.8) (flow contact)
Bottom (ft): (R-4.3189.8) (continuous with next box)

Unit type: pahoehoe

Phenocrysts/Clasts:
sparsely phyric (1-2%) - olivine - 1-2% - 2 mm - blocky (<3:1:1) - iddingsite

Groundmass/Matrix: fine-grained (<1 mm)

Color: N5 gray - Structures: - Sorting:

Vesicles: 10-20% - 1-5 mm - spherical - equant

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured

Additional comments:

NaCl ppt; open textured microgabbro inclusions
**Box #:** 327  
**Cores in box:**  
437  
438

**Loggers:** GFE, MG  
**Date logged:** 12/9/93  
**Checked by:** MG  
**Check date:** 12/14/93  
**Driller's depth: top [feet]:** 3191.9  
**Driller's depth: bottom [feet]:** 3199.0  
**Core type:** NQ  
**Units in box:** 2

**BOX UNIT 1:** sparsely olivine phyric basalt  
**Contacts:**  
- Top (ft): (R --)(continuous with previous box)  
- Bottom (ft): (R 437 -4.0-3193.4')(flow contact)

**Unit type:** pahoehoe  
**Phenocrysts/Clasts:**  
- sparsely phyric (1-2%)  
- olivine - 1% - 2 mm -  

**Groundmass/Matrix:** fine-grained (<1 mm) to microcrystalline  
**Color:** N5 gray  
**Structures:**  
**Sorting:**  
**Vesicles:** 5-10% - 1-5 mm - sub-rounded - equant-  
**Alteration:** fresh (<2% altered)  
**Veins:** none  
**Fractures:** weakly fractured  
**Additional comments:** NaCl ppt

**BOX UNIT 2:** highly olivine phyric basalt  
**Contacts:**  
- Top (ft): (R 437-4.0-3193.4')(flow contact)  
- Bottom (ft): (R --)(continuous with next box)

**Unit type:** massive  
**Phenocrysts/Clasts:**  
- highly phyric (>10%)  
- olivine - 10-12% - 1-5 mm - tabular (>3:1:1) -  
- 100 pts counted at R437-6.2; olivines near contacts are very altered and almost all black in color. Also, spinel inclusions appear inside of some of the olivine phenocrysts.

**Groundmass/Matrix:** microcrystalline  
**Color:** N4 gray  
**Structures:**  
**Sorting:**  
**Vesicles:** 5-10% - 1-5 mm - sub-rounded - equant-  
**Variable, some zones >30%**  
**Alteration:** slightly (2-10% altered)  
- Core becomes more altered near contact.  
**Veins:** none  
**Fractures:** rubbly  
**Additional comments:** NaCl ppt
| Box #: | 
|---|---|
| 328 | 
| BOX UNIT 1: highly olivine phyric basalt |
| Contacts: | Top (ft): (R 438-0.9-3207.9') (continuous with previous box) Bottom (ft): (R 439-0.9-3207.9') (flow contact) |
| Unit type: | massive |
| Phenocrysts/Clasts: | moderately phyric (2-10%) - olivine - 10-15% - 3mm - blocky (<3:1:1) - Spinel inclusions appear within the olivine phenocrysts. 100 pts counted at R438-4.0. |
| Groundmass/Matrix: | fine-grained (<1 mm) to microcrystalline - Color: N5 gray - Structures: - Sorting: - Vesicles: <5% - 1-5 mm - sub-rounded - horizontally elongated - Alteration: fresh (<2% altered) - Veins: none - Fractures: weakly fractured - Additional comments: NaCl ppt |

| BOX UNIT 2: moderately olivine phyric basalt |
| Contacts: | Top (ft): (R 438-0.9-3207.9') (flow contact) Bottom (ft): (R 439-0.9-3207.9') (continuous with next box) Internal flow contact at R440-0.0 |
| Unit type: | pahoehoe |
| Phenocrysts/Clasts: | moderately phyric (2-10%) - olivine - 6% - - blocky (<3:1:1) - |
| Groundmass/Matrix: | fine-grained (<1 mm) to microcrystalline - Color: 5YR 3/4 reddish-brown - Structures: - Sorting: - Vesicles: 10-20% - 1-5 mm - sub-rounded - equant - Alteration: moderately (10-40% altered) - Veins: none - Fractures: weakly fractured - Additional comments: NaCl ppt |

| UNIT #: 205 |
|---|---|
| Box: | 328 |
| Driller's depth: top [feet]: | 3199.0 |
| Date logged: | 12/9/93 |
| Checked by: | MG |
| Check date: | 12/14/93 |
| Core type: | NQ |
| Units in box: | 2 |

| UNIT #: 206 |
|---|---|
| Box: | 328 |
| Driller's depth: bottom [feet]: | 3213.7 |
| Core type: | NQ |
BOX UNIT 1: moderately olivine phyric basalt

Contacts: Top (ft): (R --' (continuous with previous box)
Bottom (ft): (R440-5.1-3216.1') (flow contact)
contact defined by vesicle size gradation and lithology change

Unit type: pahoehoe
Phenocrysts/Clasts:
- moderately phyric (2-10%) - olivine - 2-10% - 1-5 mm - equant - oxidation
- 5% @ R440-2.9; 9% @ R440-4.7

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting:
Vesicles: 5-10% - 1-5 mm - sub-rounded to angular - equant - oxidation
Alteration: moderately (10-40% altered)
Veins: none
Fractures: weakly to moderately fractured: 8/2.4 ft; fracture surfaces oxidized
Additional comments:
NaCI ppt; internal flow contact at R440-3.2

BOX UNIT 2: highly olivine phyric basalt

Contacts: Top (ft): (R440-5.1-3216.1') (flow contact)
Bottom (ft): (R441-4.1-3223.1') (flow contact)
See unit 1 for top contact description; bottom contact defined by weathered rubbly zone; no distinct lithology change.

Unit type: aa
Phenocrysts/Clasts:
- highly phyric (>10%) - olivine - 15-20% - 1-5 mm - equant to tabular - iddingsite
- 8% @ R440-2.9; 10% @ R440-4.7

Groundmass/Matrix: microcrystalline
Color: N3 dark gray - Structures: - Sorting:
Vesicles: 20-30% - 1-5 mm - sub-rounded to angular - equant - oxidation
Alteration: moderately (10-40% altered)
Veins: none
Fractures: weakly to moderately fractured: 8/2.4 ft; fracture surfaces oxidized
Additional comments:
NaCI ppt; internal flow contact at R440-3.2
**Box #: 329**

<table>
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<th>Cores in box</th>
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<tbody>
<tr>
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<td>MG</td>
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<tr>
<td>Check date:</td>
<td>12/14/93</td>
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</tbody>
</table>

**Unit #: 208**

**BOX UNIT 3: highly olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R 441-4.1-3223.1') (flow contact)
  - Bottom (ft): (R--') (continuous with next box)
  - see unit 2 for top contact description; no lithology change

- **Unit type:** aa

- **Phenocrysts/Clasts:**
  - highly phyric (>10%)
  - olivine - >10% - 1-5 mm - equant - iddingsite, oxidation
  - 16% @ R442-1.5; some olivines are fresh

- **Groundmass/Matrix:** microcrystalline
- **Color:** N3 dark gray
- **Structures:**
- **Sorting:**
- **Vesicles:** 10-20% - 1-3 mm - sub-angular to angular - equant to vertically elongated - oxidation
- **Alteration:** slightly (2-10% altered)
- **Veins:** none

- **Fractures:** Rubbly from R441-4.1 to R442-0.8, then unfractured to end of box; rubble is oxidized on surfaces.

- **Additional comments:**

**Cores in box:**

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<thead>
<tr>
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<tr>
<td>440</td>
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<td>442</td>
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</table>

**Logger:** MBB, LLW

**Date logged:** 12-10-93

**Checked by:** MG

**Check date:** 12/14/93

**Driller's depth:**
- **Top [feet]:** 3213.7
- **Bottom [feet]:** 3230.0

**Core type:** NQ

**Units in box:** 3
**BOX UNIT 1: highly olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R ---) (continuous with previous box)
  - Bottom (ft): (R443-1.0-3235.8') (flow contact)
  - Contact determined by rubby weathered zone at top of unit 2 and lithology change

- **Unit type:** massive

- **Phenocrysts/Clasts:**
  - highly phyric (10-15%) -
  - olivine - 10-15 - 1-5 mm - equant to rounded - iddingsite
  - 12% @ R442-7.5; spinel inclusions observed

- **Groundmass/Matrix:** microcrystalline

- **Color:** N4 medium dark gray

- **Vesicles:** 5-10% - <1-7 mm - sub-rounded - equant - oxidation

- **Alteration:** moderately (10-40% altered) - moderate groundmass oxidation

- **Veins:** none

- **Fractures:** weakly fractured: 11/8.1 ft; oxidation on fracture surfaces

**Additional comments:** NaCl ppt

**BOX UNIT 2: aphyric basalt**

- **Contacts:**
  - Top (ft): (R 443-1.0-3235.8') (flow contact)
  - Bottom (ft): (R ---) (continuous with next box)
  - See unit 1 for top contact description.

- **Unit type:** pahoehoe

- **Phenocrysts/Clasts:**
  - aphyric (<1%)

- **Groundmass/Matrix:** microcrystalline

- **Color:** 10R3/4 dark reddish brown

- **Vesicles:** 20-30% - 1-2 mm - sub-rounded - equant - oxidation

- **Alteration:** highly (40-80% altered) - groundmass oxidation/palagonitization at top

- **Veins:** none

- **Fractures:** moderately (see photo)

- **Additional comments:** tiny bit of glass at contact, mostly palagonitized
** BOX UNIT 1: aphric basalt **

Contacts:
- Top (ft): (R-)(continuous with previous box)
- Bottom (ft): (R-)(continuous with next box)
- Internal flow contacts at R444-3.6, 6.2

Unit type: pahoehoe
- Equant, abundant vesicles

Phenocrysts/Clasts:
- Aphric (<1%) - rare olivine microphenocrysts (<1%)

Groundmass/Matrix: microcrystalline
- Color: grayish black
- Structures: Sorting:
- Vesicles: 20-30% - 1-3 mm - subrounded to angular - equant
  - Oxide coatings in rubble zones; other yellow coatings at R444-8.8

Alteration:
- Fresh to moderately (<2-40% altered) - groundmass oxidation
  - Fresh except: R444-0.0 to 0.5, moderately altered; R444-6.1 to 9.2, slightly altered

Veins: none

Fractures: Weakly fractured: 9/6.7, excluding 4 rubble zones marked A on photo

Additional comments:
- NaCl ppt

** UNIT #209 **

UNIT #: 209

Driller's depth: top [feet]: 3241.5
Driller's depth: bottom [feet]: 3250.9
Core type: NQ

Units in box: 1

LOGGERS: TJ
DATE LOGGED: 12/10/93
CHECKED BY: MG
CHECK DATE: 12/14/93

Box #:
- 331
  - Cores in box:
    - 443
    - 444

Driller's depth: top [feet]: 3241.5
Driller's depth: bottom [feet]: 3250.9
Core type: NQ

Units in box: 1
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R --') (continuous with previous box)
Bottom (ft): (R444-9.6-3251.1') (flow contact)
1' red weathered zone below bottom contact, glassy base

Unit type: pahoehoe
abundant rounded vesicles

Phenocryst/Clasts:
aphyric (<1%) - 10% olivine microphenocrysts

Groundmass/Matrix: microcrystalline -
Color: dark gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-5 mm - rounded to sub-rounded - equant -
Alteration: fresh to slightly (<2-10% altered) - groundmass oxidation
Top 2' and bottom 2' slightly altered, otherwise fresh.
Veins: none
Fractures: weakly fractured: 167.0 ft
Additional comments: NaCl ppt; internal contact at R445-4.3'

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R444-9.6-3251.1') (flow contact)
Bottom (ft): (R445-6.7-3258.2') (flow contact)
See unit 1 for top contact. Bottom contact: Vesicle size decreases, 1' orange soil below

Unit type: pahoehoe
abundant rounded vesicles

Phenocryst/Clasts:
aphyric (<1%) - 10% olivine microphenocrysts

Groundmass/Matrix: microcrystalline -
Color: grayish black - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - spherical - equant -
Alteration: fresh to moderately (<2-40% altered) - groundmass oxidation
altered only in bottom 1'
Veins: none
Fractures: weakly fractured: 167.0 ft
Additional comments: NaCl ppt; internal contact at R445-4.3'

BOX 332 CONTINUED ON NEXT PAGE
BOX UNIT 3: moderately phyric olivine basalt

Contacts:
- Top (ft): (R 445-6.7 - 3258.2') (flow contact)
- Bottom (ft): (R - - ) (continuous with next box)
Top has "weathered zone, marked B on photo, overlain by next flow.

Unit type: transitional/aa
- angular vesicles, sparse in center of flow

Phenocrysts/Clasts:
- moderately phyric (2-10%)
- olivine - 6-10% - 1 mm - equant

Groundmass/Matrix: microcrystalline

Color: dark gray
- Structures: - Sorting:
- Vesicles: 10-20% - 1-5 mm - sub-rounded to angular - equant to elongate
- Alteration: fresh to highly (<2-60% altered) - clay, oxides
  - Oxide coatings on vesicle surfaces above R445-8.0. Soil: R445-6.7 to 7.7.
- Veins: none
- Fractures: entire length is rubble in this box

Additional comments:
- NaCl ppt. "weathered zone at top (R445-6.7 to 7.7); orange soil with chunks of intact lava."
BOX UNIT 1: moderately to highly olivine phyric basalt

Contacts:
- Top (ft): (R 446.7-9-3268.9') (flow contact)
  - Continues with previous box
- Bottom (ft): (R 446.7-9.0-3268.9') (flow contact)
  - Continues with previous box
- Flow contact defined by lithologic changes (more to less olivine phyric) and the appearance of plagioclase in the lower unit; no other really distinct contact features

Unit type: transitional/aa

Classification based on vesicle morphology; the top of the flow has more equant vesicles than are generally observed at the tops of aa flows.

Phenocrysts/Clasts:
- Moderately to highly phyric (2-10%) - olivine - 9-16% - 2.5 mm - equant
  - 9% at R446-0.7; 16% at R446-2.6; 15% at R446-7.3; no obvious spinel inclusions in olivines; olivine phenocrystals are fresh to slightly oxidized
- Plagioclase - 1% - 1-2 mm - laths - 1% at R446-8.4; plagioclase appears highly altered, milky white in color (sericite?)

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles: 5-20% - <1-5 mm - rounded to subangular - equant to horizontally elongate -
  - Zone of highly sheared vesicle trains in the interval R446-5.0 to R446-6.7

Alteration: fresh to slightly (2-10% altered) - groundmass oxidation

Veins: none

Fractures: weakly fractured; 197.9; some fractures have a dusting of soft yellow/orange material (clay?)

Additional comments:

BOX UNIT 2: moderately plagioclase-olivine phyric basalt

Contacts:
- Top (ft): (R 446-7.9-3268.9') (flow contact)
  - Continues with previous box
- Bottom (ft): (R 446-7.9-3268.9') (flow contact)
  - Continues with next box

Unit type: pahoehoe

Classification based on vesicle morphology

Phenocrysts/Clasts:
- Moderately phyric (2-10%) - olivine - 1-2% - 1-2 mm - equant - highly oxidized
  - 2% at R446-8.4
- Plagioclase - 1% - 1 mm - laths
  - 1% at R446-8.4; plagioclase appears highly altered, milky white in color (sericite?)

Groundmass/Matrix: microcrystalline

Color: 10R 4/2 grayish red - Structures: - Sorting: -

Vesicles: 10-15% - 1-10 mm - rounded to subrounded - equant to sub-horizontally elongate -
  - Extent of groundmass oxidation decreases away from contact; yellowish clay on fractures.

Veins: none

Fractures: moderately fractured; 5/1.4 ft

Additional comments:
- Small (2-4 mm) microgabbroic inclusions
**Box #:** 334

<table>
<thead>
<tr>
<th>Cores in box</th>
<th>Loggers:</th>
<th>Date logged:</th>
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<td>448</td>
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</table>

**BOX UNIT 1:** moderately plagioclase-olivine phryic basalt

**Contacts:**
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R 447 -3.8-3274.9') (flow contact)

**Unit type:**
- Some zones have abundant rounded vesicles and some are more massive-aa like zones.

**Phenocrysts/Clasts:**
- moderately plagioclase (2-10%)
- olivine - 1-2% - 1-2 mm - equant to tabular
- 2% @ R447-0.8
- plagioclase - <1% - <1 mm - tabular (>3:1:1)

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Vesicles:**
- 10-20% - <1-5 mm - sub-rounded to sub-angular - equant

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Vesicles:**
- 10-20% - <1-5 mm - sub-rounded to sub-angular - equant

**Alteration:**
- fresh (≤2% altered)

**Veins:**
- none

**Fractures:**
- weakly fractured: -12/4.3 ft; fractures at top of box coated with yellow-orange clay (?), visible in photo

**Additional comments:**
- NaCl ppt

**BOX UNIT 2:** sparsely olivine phryic basalt

**Contacts:**
- Top (ft): (R 447 -3.8-3274.9') (flow contact)
- Bottom (ft): (R --) (continuous with next box)

**Unit type:**
- pahoehoe

**Phenocrysts/Clasts:**
- sparsely olivine (1-2%)
- olivine - 1-2% - 1-3 mm - equant
- 1% @ R447-6.6
- plagioclase - <1% - 1 mm - tabular (>3:1:1)

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Vesicles:**
- 10-20% - <1-5 mm - sub-rounded to sub-angular - equant

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Vesicles:**
- 10-20% - <1-5 mm - sub-rounded to sub-angular - equant

**Alteration:**
- fresh (≤2% altered)

**Veins:**
- none

**Fractures:**
- moderate; yellowish clays (?) on some fracture surfaces

**Additional comments:**
- NaCl ppt
Box #: 335

Cores in box:
448
449

Logs:
EMS

Date logged:
12/11/93

Checked by:
MG

Check date:
12/14/93

Driller's depth:
Top [feet]: 3281.1
Bottom [feet]: 3290.6
Core type: NG

Units in box: 4

BOX UNIT 1: sparsely olivine phyric basalt

Contacts: Top (tt): (R 449-2.3-3280.3') (flow contact) glass at contact
Bottom (tt): (R 448-2.3-3280.3') (flow contact) glass at contact

Unit type: pahoehoe

Phenocrysts/Clasts:
sparsely phyric (1-2%) - olivine - 1-2% - 1-5 mm - equant-rounded - plagioclase - <1% - 1 mm - tabular (>3:1:1) -

Groundmass/Matrix: glassy to microcrystalline -

Color: 5YR 6/1 light brownish gray to 5YR 4/1 brownish - Structures: - Sorting:

Vesicles: 10-20% - <1 mm - sub-rounded to sub-angular - equant -

Alteration: moderately (10-40% altered) -

Veins: none

Fractures: rubble

Additional comments:
glass fragments along bottom contact; NaCl ppt; microgabbro inclusions

BOX UNIT 2: moderately olivine phyric basalt

Contacts: Top (tt): (R 448-2.3-3280.3') (flow contact) lithology change and red rubble zone at contact
Bottom (tt): (R 448-5.2-3283.2') (flow contact) glass at contact

Unit type: pahoehoe

Phenocrysts/Clasts:
moderately phyric (2-10%) - olivine - 3-6% - 1-5 mm - equant-rounded - 100 pts counted at R448-4.5

Groundmass/Matrix: microcrystalline -

Color: N5-N6 medium to medium light gray - Structures: - Sorting:

Vesicles: 20-30% - highly variable (<1 to >10 mm) - sub-rounded - horizontally elongated -

Alteration: fresh (<2% altered) -

Veins: none

Fractures: whitish/yellow mineral coating fracture (F)

Additional comments:

The top of this unit has been sub-divided as follows (keyed to photo): (A) brown-olivine-red dirt or solid, containing rock (up to 2 cm) and mineral fragments down to fine sandy material; (B) below the soil is a fragment of lava that looks like the solid lava that makes up the bulk of this unit (from R448-3.0), but it looks like it has a flow boundary at its bottom, possibly with glass fragments - could this be a very thin internal flow unit? (C) dirt or broken up, highly oxidized material that is reddish brown and crumbly, but it is more coherent in the archive box - is this more soil or just very decrepitated basalt?
BOX UNIT 3: moderately plagioclase-olivine phyric basalt

Contacts: Top (ft): (R 449.2-3283.2') (flow contact)
Bottom (ft): (R 449.1-3287.2') (flow contact)
Top is defined by a red, baked, altered fragment 0.1' long (D in photo), changes in vesicle content and structure, and changes in phenocryst abundance.

Unit type: pahoehoe

Phenocrysts/Clasts:
- moderately phric (2-10%) - highly variable, from an occasional phenocrystal in some pieces, to up to -10% in others
- olivine - <2% - 1-5 mm - equant
- plagioclase - <1% - 1 mm - laths - seen on the cut and cored surfaces of fragment E

Groundmass/Matrix: microcrystalline (possible glass, see cut face of fragment E)

Color: N5 medium gray, but variable to reds and browns - Structures - Sorting:

Vesicles: 20-30% - <2 mm - spherical - equant
Fe-oxides/hydroxide coatings on vesicle linings - generally evenly distributed

Alteration: moderately (10-40% altered) - red/brownish in places

Veins: none
Fractures: rubble

Additional comments:
NaCl ppt

BOX UNIT 4: moderately olivine phyric basalt

Contacts: Top (ft): (R 449.1-3287.2') (flow contact)
Bottom (ft): (R --') (continuous with next box) - rubbly top, red/brown fragments

Unit type: transitional/pahoehoe

Phenocrysts/Clasts:
- moderately phric (2-10%) - plagioclase microphenocrysts (<0.5 mm)
- olivine - <2% - 1-5 mm - equant/rounded
- plagioclase - <1% - 1 mm - tabular (>3:1:1)

Groundmass/Matrix: fine-grained (<1 mm)

Color: N4 medium gray - Structures - Sorting:
Vesicles: 20-30% - <2 mm - sub-rounded to sub-angular - 1:1 to 7:1

(1) In addition to the large vesicles, there is a population of much smaller (<1 mm) vesicles between them. (2) The larger vesicle population is partially filled with brown microcrystalline material, variably altered to Fe-oxide/hydroxides - formed from liquid from groundmass?

Alteration: slightly (2-10% altered)
Veins: none
Fractures: weakly to moderately

Additional comments: 
**Box #:** 336

<table>
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<th>Cores in box</th>
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**Date logged:** 12/10/93

**Checked by:** MG

**Check date:** 12/14/93

**Driller's depth:**
- Top: 3290.6 feet
- Bottom: 3301.3 feet

**Core type:** NQ

**Units in box:** 2

---

**BOX UNIT 1:** moderately olivine phyric basalt

**Contacts:**
- Top (ft): (R-[]): continuous with previous box
- Bottom (ft): (R 450-0.5-3293.5') (flow contact)

**Unit type:** transitional - pahoehoe

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 2-5% - 1-5 mm - blocky (<3:1:1) - iddingsite
- Groundmass/Matrix: microcrystalline
- Color: dark gray
- Vesicles: 20-30% - 1-5 mm - equant - Sorting:
- Alteration: fresh to slightly altered - groundmass oxidation
- Veins: none
- Fractures: highly fractured: 22/2.2 ft

**Additional comments:**
- NaCl ppt
- Abrupt changes in vesicle size and shape (internal flow contacts) at several points, labeled A on photo.

---

**BOX UNIT 2:** moderately plagioclase-olivine phyric basalt

**Contacts:**
- Top (ft): (R 450-0.5-3293.5') (flow)
- Bottom (ft): (R-[]): continuous with next box

**Unit type:** transitional

**Phenocrysts/Clasts:**
- moderately phyric (2-10%)
- olivine - 3% - 1-5 mm - equant - olivines oxidized to black
- plagiooclase - <1% - 1 mm - tabular (>3:1:1)
- Groundmass/Matrix: microcrystalline
- Color: blackish red
- Vesicles: 15-40% - 1-5 mm - equant - Sorting:
- Alteration: moderately altered - groundmass oxidation - pervasive oxidation throughout
- Veins: none
- Fractures: highly fractured: 22/2.2 ft

**Additional comments:**
- NaCl ppt
- Abrupt changes in vesicle size and shape (internal flow contacts) at several points, labeled A on photo.
BOX UNIT 1: sparsely plagioclase-olivine phryic basalt

Contacts: Top (ft): (R 451-3.0 to R 451-9.0) (continuous with previous box)
Bottom (ft): (R 451-10.4 to R 451-7.1) (flow contact)

Unit type: massive
Core has pahoehoe characteristics between R451-3.0 and R451-9.0; below R451-9.0, unit appears to be aa.

Phenocrysts/Clasts:
- Sparsely phryic (1-2%) -
- Olivine - 1% - 1-2 mm - equant -
- 1% at R451-5.4; 1% at R452-1.6; no obvious spinel inclusions in the olivine phenocrysts; olivines are completely to highly oxidized, some iddingsite.
- Plagioclase - <1% - 1-2 mm - tabular (>3:1:1) -
- Groundmass/Matrix: microcrystalline -

Color: N4 medium dark gray - freshest piece - Structures: - Sorting:
- Vesicles: 5-30% - <1-5 mm - rounded to angular - equant to elongate -
- Rounded to subrounded above R451-9.0; subangular to angular below; in the least oxidized portions, the oxidation is localized around the vesicle surfaces.

Alteration: slightly to completely (2-100% altered) - groundmass oxidation
Core is also weakly oxidized throughout the interval R451-9.0 to R452-1.0.

Veins: none
Fractures: weakly fractured: 15/9.7 ft, groundmass is more oxidized along fractures

Additional comments:
- NaCl ppt; olivine microphenocrysts, rare plagioclase microphenocrysts

BOX UNIT 2: aphyric basalt

Contacts: Top (ft): (R 451-10.4 to R 451-7.1) (flow contact)
Bottom (ft): (R 451-10.4 to R 451-7.1) (continuous with next flow)

Unit type: aa

Phenocrysts/Clasts:
- Aphyric (<1%) -
- Olivine - <1% - 1-3 mm - equant -

Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting:
- Vesicles: 10-20% - 1-3 mm - sub-angular - irregular -

Alteration: slightly (2-10% altered) -
Veins: none
Fractures: weakly: 1/2 ft

Additional comments:
- NaCl ppt
Box #: 338
Cores in box: 452

Loggers: LLW
Date logged: 12/11/93
Checked by: MG
Check date: 12/14/93

Driller's depth: top [feet]: 3310.6
Driller's depth: bottom [feet]: 3319.4
Core type: NQ

BOX UNIT 1: aphyric to sparsely olivine phyric basalt

Contacts:
Top (ft): (R --)(continuous with previous box)
Bottom (ft): (R --)(continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric to sparsely phyric (<1-2%)
olivine - <1% to 1% - 1-3 mm - equant - iddingsite, oxidation
phenocrysts rare

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: <5% - 1 mm - sub-angular to angular - horizontally to vertically elongated -
oxidation
vesicularity variable throughout unit
Alteration: fresh (<2% altered)
Veins: none
Fractures: weakly fractured: 10/9 ft; does not include small rubbly zone from R452-7.0 to R452.5-0.0; some fracture surfaces oxidized
Additional comments:
NaCl ppt; fine-grained dunite clast @ R452-6.25 on back of core (marked "A" on photo)

UNIT #:218

UNIT 218
Box 338
BOX UNIT 1: aphyric to sparsely olivine phryic basalt

Contacts:
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R --')(continuous with next box)
  - rubbly from R452.5-8.4 to R453-0.0 but no evidence for a time break

Unit type: massive

Phenocrysts/Clasts:
- aphyric to sparsely phryic (<1-2%)
- olivine: <1% to 1% - 1-5 mm - equant to tabular - iddingsite
  - phenocrysts rare

Groundmass/Matrix: microcrystalline

Color: N4 medium dark gray - Structures: - Sorting: -

Vesicles:
- 5% - <1-10 mm - sub-rounded to angular - equant to elongate - oxidation
- Larger vesicles are subrounded; smaller vesicles are sub-angular to angular; elongate vesicles range from horizontal to vertical, two generations of vesicles.

Alteration: fresh (<2% altered)

Veins: none

Fractures: weakly fractured: 14/6.6 ft; excludes rubbly zone from R452.5-8.4 to R453-0.0

Additional comments:
- minor NaCl ppt
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**Box UNIT 1: moderately olivine phyric basalt**

- **Contacts:**
  - Top (ft): (R - - ) (continuous with previous box)
  - Bottom (ft): (R 453 -3.7 -3329.9') (flow contact)

- **Unit type:** aa
  - Relatively few vesicles with horizontal elongation

- **Phenocrysts/Clasts:**
  - Moderately phyric (2-10%)
  - Olivine - 2% - 1-3 mm - anhedral - Mn oxides
  - 5-10% olivine microphenocrysts

- **Groundmass/Matrix:** microcrystalline
- **Color:** medium dark gray
- **Structures:** - Sorting:
- **Vesicles:** 5-10% - 0.5 mm - angular - equant
- **Alteration:** Slight to moderately (2-10%) altered - groundmass oxidation

- **Veins:** none
- **Fractures:** Moderately fractured: 8'1.6 ft

**Additional comments:**
NaCl ppt

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**Box UNIT 2: aphyric basalt**

- **Contacts:**
  - Top (ft): (R 453 -3.7 -3329.9') (flow)
  - Bottom (ft): (R - - ) (continuous with next box)

- **Unit type:** pahoehoe
  - Abundant, rounded vesicles.

- **Phenocrysts/Clasts:**
  - Aphyric (<1%) - Sparse, anhedral olivine phenocrysts and microphenocrysts
  - Olivine - <1% - 1-2 mm - equant

- **Groundmass/Matrix:** microcrystalline to fine-grained (<1 mm)
- **Color:** medium dark gray
- **Structures:** - Sorting:
- **Vesicles:** 20-30% - 1-5 mm - Sub-rounded - equant
- **Alteration:** Slightly (2-10%) altered - groundmass oxidation

- **Veins:** none
- **Fractures:** Highly fractured/rubblly except weakly fractured from R454-0.9 to R455-1.4

**Additional comments:**
NaCl ppt. Possible caved material at top of Run 454 (0.0-0.4) and top of Run 455 (0.0-0.3). Vesicular oxidized rubble in these zones, marked B on photo.
Box #: 341
Cores in box:
455
456

Loggers: LLW
Date logged: 12/11/93
Checked by: MG
Check date: 12/14/93

Driller's depth: top [feet]: 3338.5
Driller's depth: bottom [feet]: 3347.1
Core type: NQ

Units in box: 1

BOX UNIT 1: aphyric basalt
Contacts: Top (t): (R- -)(continuous with previous box)
Bottom (t): (R--')(continuous with next box)
Unit type: pahoehoe
abundant rounded to sub-rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1-2 mm - equant -

Groundmass/Matrix: fine-grained (<1 mm)

Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 20-30% - 1-5 mm - spherical to sub-rounded - equant - oxidation
occasional horizontally elongate vesicles
Alteration: fresh (<2% altered)
Veins: none
Fractures: moderately fractured - R455-3.0 to R455-6.4; weakly fractured - R455-6.4 to R456-1.3; fracture surfaces oxidized and occasionally coated with yellow-orange clay

Additional comments:
NaCl ppt

UNIT #: 219

UNIT: aphyric basalt
Contacts: Top (t): (R- -')(continuous with previous box)
Bottom (t): (R--')(continuous with next box)

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - 1-2 mm - equant -

Groundmass/Matrix: fine-grained (<1 mm)

Color: N4 medium dark gray - Structures: - Sorting:
Vesicles: 20-30% - 1-5 mm - spherical to sub-rounded - equant - oxidation
occasional horizontally elongate vesicles
Alteration: fresh (<2% altered)
Veins: none
Fractures: moderately fractured - R455-3.0 to R455-6.4; weakly fractured - R455-6.4 to R456-1.3; fracture surfaces oxidized and occasionally coated with yellow-orange clay

Additional comments:
NaCl ppt
BOX UNIT 1: aphyric basalt
Contacts: Top (ft): (R 456.9-3356.5') (flow contact)
         Bottom (ft): (R--) (continuous with previous box)
Unit type: pahoehoe
          abundant rounded vesicles
Phenocrysts/Clasts:
          aphyric (<1%) - 8% olivine microphenocrysts
          olivine - <1% - 1-2 mm - equant
          - - - -
          Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
          Color: grayish black - Structures: - Sorting: -
          Vesicles: 20-30% - 0.2-2 mm - spherical to subrounded - equant-
          Alteration: fresh (<2% altered)
          - oxide coatings in vesicles, bottom 2" of unit
Veins: none
Fractures: weakly fractured: 10/8.0 ft
Additional comments:
NaCl ppt

BOX UNIT 2: aphyric basalt
Contacts: Top (ft): (R 456.9-3356.5') (flow contact)
         Bottom (ft): (R--) (continuous with next box)
1" of friable soil at top
Unit type: pahoehoe
          abundant large rounded vesicles
Phenocrysts/Clasts:
          aphyric (<1%) - 5% olivine microphenocrysts
          - - - -
          Groundmass/Matrix: microcrystalline
          Color: 5YR 2/2 dusky brown - Structures: - Sorting: -
          Vesicles: 10-20% - 5-7 mm - spherical - horizontally elongated-
          Alteration: moderately (10-40% altered) - groundmass oxidation
          pervasive oxidation
Veins: none
Fractures: moderately fractured: 11/1.8 ft
Additional comments:
NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts: Top (fl); (R--')(continuous with previous box)
Bottom (fl): (R--')(continuous with next box)

Unit type: massive
core with large, rounded vesicles (pahoehoe-type) which grades into massive material by R457-4.0

Phenocrysts/Clasts:
aphyric (<1%)
olivine - <1% - <1 mm - equant -
Visual estimate of mode; olivine phenocrysts are fresh.

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Vesicles: 10-15% - <1-8 mm - rounded to angular - equant to elongate -
Vesicle size decreases from top of box (R457-0.5) to R457-4.0 where a majority of the vesicles are <1 mm; below R457-7.3, vesicles are all <1 mm; zone between R457-7.3 and R457-8.3 has ~5% of <1 mm sized vesicles. Horizontal vesicle trains in the interval R457-3.0 to R457-5.0.

Alteration: fresh to moderately (<2-40% altered) - groundmass oxidation
Core is essentially fresh by R457-3.0.

Veins: possible segregation veins - labeled "A" on the photo; these veins are more coarsely grained and vesicular than the surrounding groundmass

Fractures: weakly fractured: 10/9.5 ft

Additional comments:
NaCl ppt

Box #: 343
Cores in box 457

Loggers: MBB
Date logged: 12/11/93
Checked by: MG
Check date: 12/14/93

Driller's depth: top [feet]: 3356.3
Driller's depth: bottom [feet]: 3365.6
Core type: NQ

Units in box: 1
**BOX UNIT 1: aphyric basalt**

**Contacts:**
- Top (ft): (R --) (continuous with previous box)
- Bottom (ft): (R:458-2.4-3369.9") (flow contact)

**Unit type:** massive

**Phenocrysts/Clasts:**
- aphyric (<1%)
- --
- --
- --
- --
- --
- --
- --

**Groundmass/Matrix:**
- fine-grained (<1 mm)

**Color:**
- N3 dark gray

**Vesicles:**
- 5-10% --<1.3 mm -- rounded to sub-rounded -- equant--

**Alteration:**
- fresh (<2% altered)

**Veins:**
- some microcrystalline segregation veins of basalt at R458-0.0, R458-0.85, R458-1.25, R458-1.45

**Fractures:**
- weakly fractured: 4/2.7 ft

**Additional comments:**
- NaCl ppt

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**UNIT #: 220**

**BOX UNIT 2: aphyric basalt**

**Contacts:**
- Top (ft): (R 458-2.4-3369.9") (flow contact)
- Bottom (ft): (R --) (continuous with previous box)

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- aphyric (<1%)
- --
- --
- --
- --
- --
- --
- --

**Groundmass/Matrix:**
- microcrystalline

**Color:**
- N4 medium dark gray

**Vesicles:**
- 10-20% -- 1-7 mm -- sub-rounded -- equant--

**Alteration:**
- slightly (2-10% altered) --

**Veins:**
- none

**Fractures:**
- weakly fractured: 9/5.5 ft; excludes rubble zones from R458-2.4 to R458-3.3 and R458-6.9 to R458-7.3

**Additional comments:**
- NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts:
Top (ft): (R -~ -continuous with previous box)
Bottom (ft): (R 459.7-1.3-3385.0') (flow contact)
Bottom contact: vesicles change size abruptly; unit below has oxidized vesicle surfaces; fluid-like glassy surface at base; no lithologic change.

Unit type: transitional
Variable vesicle morphology; large rounded to fine, angular, elongated.

Phenocrysts/Clasts:
aphyric (<1%) - 1-3% olivine microphenocrysts

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: medium dark gray - Structures: - Sorting:
Vesicles: 10-20% - 0.2-5 mm - sub-rounded to angular - equant to horizontally elongated -
Alteration: fresh (<2% altered) - oxide alteration on vesicle surfaces in bottom 1”
Veins:
Fractures: weakly fractured: 5/8.2 ft
Additional comments:
NaCl ppt

BOX UNIT 2: aphyric basalt

Contacts:
Top (ft): (R 459.7-1.3-3385.0’) (flow)
Bottom (ft): (R -~ -continuous with next box)
See unit 1 for contact info. (possibly part of unit 1)

Unit type: pahoehoe
abundant rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%) - sparse olivine microphenocrysts

Groundmass/Matrix: microcrystalline
Color: dark gray - Structures: - Sorting:
Vesicles: >30% - 1-5 mm - spherical to sub-angular - equant -
Alteration: fresh to slightly (<2-10% altered) - oxides on vesicle surfaces
Veins: none
Fractures: moderately fractured: 5/1.0 ft, excluding rubble zone in last 6” of box.
Additional comments:
NaCl ppt
**BOX UNIT 1** aphyric basalt

**Contacts:**
- Top (ft): (R - -continuous with previous box)
- Bottom (ft): (R460-4.0-3392.3')(flow contact)

flow contact not well defined; oxidation increases in the rubbly material (upper flow) going down towards the contact; rare "glassy" spines on the piece labeled "A" at the top of the bottom flow; no lithologic change, but matrix is coarser

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- aphyric (<1%) - no phenocrysts observed; olivine microphenocrysts are present in the unit

**Groundmass/Matrix:** fine-grained (<1 mm)

**Color:** 5YR 3/2 grayish brown

**Vesicles:** 15-30% - <1-3 mm - rounded to subrounded - equant

Vesicle size increases with distance away from the contact.

**Alteration:** fresh to moderately (<2-40% altered) - groundmass oxidation

Groundmass oxidation decreases below R460-3.0 (to the contact); from R459-8.6 (top of box) to R460-0.5, groundmass oxidation is localized to the <1 mm vesicles.

**Veins:** none

**Fractures:** weakly fractured: 16/5.5 ft; fracture surfaces are zones of increased groundmass oxidation

**Additional comments:**
- NaCl ppt

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**UNIT #223**

**Contacts:**
- Top (ft): (R460-4.0-3392.3')(flow contact)
- Bottom (ft): (R- -continuous with next box)

see unit 1 for contact description

**Unit type:** pahoehoe

**Phenocrysts/Clasts:**
- aphyric (<1%) - no phenocrysts observed

**Groundmass/Matrix:** fine-grained (<1 mm)

**Color:** 5YR 3/2 grayish brown

**Vesicles:** 15-30% - <1-3 mm - rounded to subrounded - equant

Vesicle size increases with distance away from the contact.

**Alteration:** moderately to completely (10-100% altered) - groundmass oxidation

Extent of groundmass oxidation decreases away from the contact (see photo).

**Veins:** none

**Fractures:** moderately fractured: 12/3 ft; measurement doesn't include highly fractured zone labeled "B" in the photo

**Additional comments:**
- NaCl ppt; plagioclase and olivine microphenocrysts
- see photo: "C" = remnant of slickensides
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R--')(continuous with previous box)
Bottom (ft): (R--')(continuous with next box)
internal contacts (glassy rinds, oxidized groundmass) at R461-2.1, R461-4.7, and R461-7.0 (see photo)

Unit type: pahoehoe
abundant rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%)
Groundmass/Matrix:
Color: grayish black
Structures: Sorting:
Vesicles: >30% - 1-5 mm - rounded to sub-rounded - equant
Vesicles smaller near internal contacts.
Alteration: slightly (2-10% altered) - groundmass oxidation
Alteration moderate (reddish color) near internal contacts.
Veins: none
Fractures: weakly fractured: 13/6.5 ft, excluding rubble near internal contacts

Additional comments:
NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts:
Top (ft): (R- - ) (continuous with previous box)
Bottom (ft): (R 461-10.4-3407.7") (flow contact)
decrease in vesicle size, glassy rind above oxidized rubble zone (no soil); no lithologic change

Unit type: pahoehoe
abundant rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%)

Groundmass/Matrix:
microcrystalline to fine-grained (<1 mm)
Color: medium dark gray
Vesicles: 20-30% - 1-7 mm - sub-rounded to angular - equant
Alteration: fresh to slightly (<2-10% altered)

Additional comments:
NaCl ppt

BOX UNIT 2: aphyric basalt

Contacts:
Top (ft): (R 461-10.4-3407.7") (flow contact)
Bottom (ft): (R- - ) (continuous with next box)
Internal contact at R462-6.4; this unit could be part of unit 1

Unit type: transitional
abundant vesicles, rounded, except R462-4.0 to 5.5, angular, horizontally elongated

Phenocrysts/Clasts:
aphyric (<1%)

Groundmass/Matrix:
microcrystalline to fine-grained (<1 mm)
Color: medium dark gray
Vesicles: >30% - 1-5 mm - rounded to sub-rounded - equant
Alteration: fresh to slightly (<2-10% altered - groundmass oxidation
moderately altered (groundmass oxidation) in bottom 4"

Veins: none
Fractures: weakly fractured: 10/3.2 ft

Additional comments:
NaCl ppt
Box #: 349

Cores in box
462
463

Loggers: MBB
Date logged: 12/12/93
Checked by: MG
Check date: 12/14/93

Driller's depth: top [feet]: 3413.2
Driller's depth: bottom [feet]: 3422.2
Core type: NQ

Units in box: 1

BOX UNIT 1: aphyric basalt

Contacts:
- Top (ft): (R --')(continuous with previous box)
- Bottom (ft): (R --')(continuous with next box)

Unit type: pahoehoe/transitional
Classification based on the presence of equant, rounded vesicles as well as some sheared vesicle trains in the interval R462-9.7 to R463-5.0

Phenocrysts/Clasts:
- aphyric (<1%) - no phenocrysts observed, but abundant olivine microphenocrysts present
- 
- 
- 

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: N4 medium dark gray

Vesicles: 5-20% <1-10 mm - rounded to subrounded - equant to horizontally elongate
- Vesicle size increases and vesicle abundance decreases down section; angular <1 mm vesicles are present below R462-8.5 and they are the only vesicles present below R463-4.6; some large >1 cm sized vesicles/vugs also present (see photo).

Alteration: fresh to slightly (<2-10% altered) - groundmass oxidation
- Core is fresh below R462-8.0; below this level the groundmass oxidation is associated with the <1 mm vesicles.

Veins: none

Fractures: weakly fractured: 14/9.3; doesn't include highly fractured zone labeled "A" in the photo; some fractures are surfaces of slightly greater groundmass oxidation

Additional comments:
- NaCl ppt
BOX UNIT 1: aphyric basalt

Contacts:
Top (ft): (R --')(continuous with previous box)
Bottom (ft): (R463-9.7-3427.9')(flow contact)
bottom has finer vesicles and oxidized groundmass; overlies pahoehoe flow; no lithology change

Unit type:
aa
relatively few vesicles, small and angular, often horizontally elongated

Phenocrysts/Clasts:
aphyric (<1%) - common olivine microphenocrysts

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N5 medium gray - Structures: - Sorting: -
Vesicles: 10-20% - 0.2-5 mm - angular to sub-rounded - horizontally elongated to equant-in bottom 6", vesicles become large, rounded, and grade toward finer size near contact
Alteration: fresh to slightly (<2-10% altered) - groundmass oxidation
moderately altered in bottom 3"
Veins: none
Fractures: weakly fractured: 6/2.2 ft
Additional comments:
NaCl ppt

BOX UNIT 2: aphyric basalt

Contacts:
Top (ft): (R463-9.7-3427.9')(flow contact)
Bottom (ft): (R--')(continuous with next box)
Top: see unit 1 (may be part of unit 1); internal flow contact at R464-4.2: thin glassy layer over highly altered zone

Unit type:
pahoehoe
abundant rounded vesicles

Phenocrysts/Clasts:
aphyric (<1%) - common olivine microphenocrysts

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - rounded to sub-angular - equant-
Alteration: slightly to moderately (2-40% altered) - groundmass oxidation alteraiton increases downward
Veins: none
Fractures: weakly fractured: 15/4.9 ft
Additional comments:
NaCl ppt
**Box #: 351**

**Cores in box**
- 464
- 465

**Loggers:** LLW  
**Date logged:** 12/12/93  
**Checked by:** MG  
**Check date:** 12/14/93  
**Driller's depth:top [feet]:** 3432.5  
**Driller's depth:bottom [feet]:** 3442.5  
**Core type:** NQ  
**Units in box:** 2

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**BOX UNIT 1: Aphyric Basalt**

**Contacts:**
- Top (ft): (R-')(continuous with previous box)
- Bottom (ft): (R465-5.0-3442.9')(flow contact)

**Unit type:** Pahoehoe

**Phenocrysts/Clasts:**
- Aphyric (<1%) - common olivine microphenocrysts

**Groundmass/Matrix:** Fine-grained (<1 mm)

**Color:** N4 medium dark gray  
**Structures:**  
**Sorting:**
- Vesicles: 5-25% - 1-10 mm - sub-rounded - equant - near R464-7.7 vesicles are horizontally elongate; vesicle size and abundance variable
- Alteration: Fresh to slightly (<2-10% altered)
- Slightly oxidized from R464-5.0 to R464-7.0; otherwise fresh
- Veins: None
- Fractures: Rubbly from R464-5.0 to R464-6.6; otherwise weakly fractured (12/7.4 ft)

**Additional comments:**
- NaCl ppt

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**UNIT #: 225**

**BOX UNIT 2: Aphyric Basalt**

**Contacts:**
- Top (ft): (R 465-5.0-3442.9')(flow contact)
- Bottom (ft): (R-')(continuous with next box)

**Unit type:** Pahoehoe

**Phenocrysts/Clasts:**
- Aphyric (<1%) - olivine - <1% - 1-3 mm - equant - iddingsite

**Groundmass/Matrix:** Microcrystalline

**Color:** N4 medium dark gray  
**Structures:**  
**Sorting:**
- Vesicles: 20% - 1-3 mm - sub-rounded - equant - oxidation
- Alteration: Moderately (10-40% altered)
- Moderate groundmass oxidation
- Veins: None
- Fractures: Moderate (see photo)

**Additional comments:**
- Only have top 0.5 ft of this unit in this box so descriptions are difficult
BOX UNIT 1: aphyric basalt
Contacts: Top (ft): (R 465-0.3-3448.2)(flow contact) Bottom (ft): (R 465-0.3-3448.2)(flow contact) contact defined by vesicle size gradation, small glassy rind, and blue clay in vesicles of lower flow; internal contacts (glassy surface) at R465-7.7 and 9.0
Unit type: pahoehoe abundant sub-rounded vesicles
Phenocrysts/Clasts: aphyric (<1%) - olivine - <1% - <1-3 mm - equant - iddingsite <1% @ R465-6.8; olivine microphenocrysts observed - - - - -
Groundmass/Matrix: microcrystalline -
Color: N3 dark gray - Structures: - Sorting: -
Vesicles: 20-30% - 1-3 mm - sub-rounded - equant - slight oxidation
some vesicles slightly vertically elongated; vesicle size grades from larger to smaller towards contact Alteration: slightly (2-10% altered) - slight groundmass oxidation
Veins: none
Fractures: moderately fractured from R465-9.0 to R466-0.7; weakly fractured from R466-0.7 to R466-4.6 (6/3.9 ft); fracture surfaces and vesicles coated with yellowish clay (?) and blue clay
Additional comments: NaCl ppt

BOX UNIT 2: aphyric basalt
Contacts: Top (ft): (R 466-0.3-3448.2)(flow contact) Bottom (ft): (R 466-0.3-3448.2)(continuous with next box)
See unit 1 for top contact description.
Unit type: pahoehoe
Phenocrysts/Clasts: aphyric (<1%) - common olivine microphenocrysts
Groundmass/Matrix: microcrystalline -
Color: N4 medium dark gray - Structures: - Sorting: -
Vesicles: 25-10% - 1-10 mm - rounded to sub-rounded - equant - slight oxidation
Groundmass/Matrix oxidation slight; some vesicles slightly vertically elongated; vesicle size grades from larger to smaller towards contact Alteration: fresh (<2% altered) - slight groundmass oxidation
Veins: none
Fractures: moderately fractured from R465-9.0 to R466-0.7; weakly fractured from R466-0.7 to R466-4.6 (6/3.9 ft); fracture surfaces and vesicles coated with yellowish clay (?) and blue clay
Additional comments: NaCl ppt
3 types of vesicle fillings observed: (A) colorless needles of zeolite; (B) blue to blue-green clay as vesicle coatings and fillings; (C) gray mud vesicle fillings (may be drillers' mud) - examples of each are circled on photo
BOX UNIT 1: aphyric basalt

Contacts: Top (ft): (R--) (continuous with previous box)
Bottom (ft): (R--) (continuous with next box)

Unit type: massive

Phenocrysts/Clasts:
aphyric (<1%) - sparse olivine microphenocrysts

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)

Color: medium gray - Structures: - Sorting:

Vesicles: 5-10% - 0.5-1 mm - angular - equant -

bluish mineral (zeolite?)

Alteration: fresh (<2% altered) -
yellow and orange coatings on fractures, R467-3.0 to 4.7; bluish coatings, R466-4.7 to R467-1.1

Veins: none

Fractures: Weakly fractured: 18/8 ft, first 8' of box. Moderately fractured, last 2'.

Additional comments:
minor NaCl ppt
vertical segregation vein, R467-1.2 to 2.1, marked "A" on photo; horizontal segregation vesicles common
Box #: 354  Cores in box  467

Loggers: MBB  Date logged: 12/12/93  Checked by: MG
Driller's depth: top [feet]: 3462.9  Core type: NQ
Driller's depth: bottom [feet]: 3464.0  Check date: 12/14/93

Units in box: 1

BOX UNIT 1: aphyric basalt

Contacts:
- Top (ft): (R -- ') (continuous with previous box)
- Bottom (ft): (R -- ') (end of core; T.D.)

Unit type: pahoehoe/transitional
unit displays both rounded, equant vesicles and horizontal vesicle trains

Phenocrysts/Clasts:
- aphyric (<1%) -
- olivine - <1% - 1-2 mm - equant -
- <1% at R467-5.3; olivine microphenocrysts, both equant and bladed morphologies; olivines are slightly oxidized

Groundmass/Matrix: microcrystalline to fine-grained (<1 mm)
- Color: N4 medium dark gray
- Structures: -
- Vesicles: 20-30% - <1-5 mm - rounded to subrounded - equant to horizontally elongate - vesicles vary in morphology and volume%, see photo
- Alteration: fresh (<2% altered) -
- Veins: none

Additional comments:
- NaCl ppt; plagioclase in groundmass (seen with hand lens)