orbiters. The data were selected so as to obtain a uniform distribution of periapsis longitudes over the surface of Mars, and both S- and X-band data were used where possible to eliminate charged particle effects. Inclusion of the Viking data arcs altered the Martian geoid features, as defined by previous short-arc analysis techniques of Mariner 9 data, by about 80 meters in the Southern Hemisphere, and about 140 meters in the Northern Hemisphere.
J. Geophys. Res., Red, Paper 7S0487

6530 Gross properties of the planets
LANDER LOCATIONS, MARS PHYSICAL EPHEMERIS, AND SOLAR SYSTEM PARAMETERS; DETERMINATION FROM VIKING LANDER TRACKING DATA
A. P. Mayo (NASA Langley Research Center, Mail Stop 401B, Hampton, VA 23665)
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Radio Tracking data from the Viking landers have been analyzed to determine the parameters of the Mars physical ephemeris, the radii of Mars at the landing sites, and the lander locations. The orientation of the Mars rotation axis, referred to the 1950.0 Earth mean equator, equinox, and epoch, was determined as 317.340 ± 0.003° right ascension and 52.710 ± 0.002° declination. The planet's rotation period was determined as 24 hr., 37 min. 22.663 ± 0.002 sec. Analyses indicate the determination of the motions of the Mars rotation axis will require additional tracking data. The Mars radii at the sites of landers 1 and 2 are 3389.38 ± 0.06 km and 3381.91 ± 0.08 km, respectively. The areocentric location of lander 1 is 22.272 ± 0.002° N, 47.94 ± 0.2° W. The lander 2 location is 47.670 ± 0.002° N, 225.71 ± 0.2° W. The areocentric right ascensions of the landers are determined as 227.314 ± 0.002° for lander 1 and 99.546 ± 0.002° for lander 2 at Jan. 1, 0 hr., 1977 (Julian Date 2443144.5). Possible determinations of relativity parameters, solar oblateness, asteroid mass, and variations of the universal gravitational constant, from their effects on the planetary motions, will require the additional tracking data of the Viking extended mission. (Viking, lander, Mars, rotation)
J. Geophys. Res., Red, Paper 7S0426

6545 Interiors of planets
SEISMOLOGY ON MARS
D. L. Anderson (Seismological Laboratory, Calif. Inst. of Tech., Pasadena, Ca. 91125), W. F. Miller, G. V. Latham, Y. Nakamura, M. N. Toksoz, A. M. Dainty, F. K. Duennebier, A. R. Lazarewicz, R. L. Kovach, and T. C. D. Knight.

A three-axis short period seismometer has been operating on the surface of Mars in the Utopia Planitia region since September 4, 1976. During the first five months of operation approx. 640 hours of high quality data, uncontaminated by Lander or wind noise, have been obtained. The detection threshold is estimated to be magnitude 3 to about 200 km and about 6.5 for the planet as a whole. No large events have been seen during this period indicating that Mars is less seismically active than Earth. Wind is the major source of noise during the day although the noise level was at or below the sensitivity threshold of the seismometer for most of the night during the early part of the mission. Winds, and therefore the seismic background, started to intrude into the night-time hours starting on Sol 119 (a Sol is a Martian day). The seismic background correlates well with wind velocity and is proportional to (wind velocity)^2, as appropriate for turbulent flow. The seismic envelope power spectral density is proportional to frequency to the minus 0.66 to 0.90 power during windy periods. A possible local seismic event was detected on Sol 80. No wind data was obtained at the time so a wind disturbance cannot be ruled out. However, this event has some unusual characteristics and is similar to local events recorded on Earth through a Viking seismometer system. If interpreted as a natural seismic event it has a magnitude of 3 and a distance of 110 km. Preliminary interpretation of later arrivals in the signal suggest a crustal thickness of 15 km at the Utopia Planitia Site which is within the range of crustal models derived from the gravity field. More events must be recorded before a firm interpretation can be made of seismicity of crustal structure. One firm conclusion is that the natural background noise on Mars is low and that the wind is the prime noise source. It will be possible to reduce this noise by a factor of 10^3 on future missions by removing the seismometer from the Lander, thus making it possible to operate an extremely sensitive seismometer on the surface. (Mars seismicity, Mars crust, Mars winds, Viking Seismology)
J. Geophys. Res., Red, Paper 7S0408

6560 Meteoritics
CORRELATED O AND Mg ISOTOPIC ANOMALIES IN ALLENDE INCLUSIONS: II. MAGNETISM
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T. Lee and D. A. Papanastassiou

Mg in two Allende Ca-Al rich inclusions shows large isotopic, mass-dependent fractionation which enriched the heavier isotopes. After normalization, Mg in these inclusions shows negative $\delta^{26}Mg$ which appears to require the presence of nuclear effects in Mg distinct from ^{26}Al decay. The Mg mass fractionation is correlated with distinct but smaller fractionation effects for O reported by Clayton and Mayeda for the same inclusions (see companion paper). The observation of distinctive but uniform Mg isotopic composition in different phases within single Allende inclusions indicates that nuclear effects in O and Mg are not due to the entrapment of interstellar carrier grains as discrete entities, which are preserved as remnants, but are instead due to a homogenized mixture of components of extraordinary isotopic composition mixed with a component of ordinary solar system material and subjected to isotopic fractionation. The distinct O isotopic composition of different phases within a single inclusion is believed to be due to incomplete back-reaction of the higher temperature condensates with a cooler solar nebula of "normal" composition. The processes responsible for the O and Mg nuclear effects and the astrophysical site of their occurrence remain undefined.
Geophys. Res. Lett., Paper 7L0406

6560 Meteoritics
CORRELATED OXYGEN AND MAGNESIUM ISOTOPE ANOMALIES IN ALLENDE INCLUSIONS,I: OXYGEN
Robert N. Clayton and Toshiko K. Mayeda (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637)

Two Ca-Al-rich inclusions from the Allende meteorite have been found to have undergone large mass-fractionation of oxygen isotopes subsequent to incorporation of the nucleosynthetic ^{16}O-anomaly found in other Allende inclusions. The magnitude of the oxygen isotope fractionations is in constant ratio to the magnesium isotope fractionations found in the same inclusions by Wasserburg, Lee and Papanastassiou. The observations support earlier theories of the addition of supernova ejecta into the solar nebula just prior to collapse and condensation. (Meteorites, oxygen isotopes, solar nebula, supernova).
Geophys. Res. Lett., Paper 7L0407

6575 Surface of planets
IPL PROCESSING OF THE VIKING ORBITER IMAGES OF MARS
See 6590 Instruments and techniques

6575 Surfaces of planets
VIKING RADIO OCCULTATION MEASUREMENTS OF THE MARTIAN ATMOSPHERE AND TOPOGRAPHY; PRIMARY MISSION COVERAGE
See 6510 Atmosphere of planets

6575 Surface of planets
PROCESSING THE VIKING LANDER CAMERA DATA
See 6590 Instruments and techniques

6575 Surfaces of Planets
MARS: WATER VAPOR OBSERVATIONS FROM THE VIKING ORBITERS
See 6510 Atmospheres of Planets

6575 Surface of planets
THE VIKING BIOLOGICAL INVESTIGATION: GENERAL ASPECTS
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The Viking biological investigation has tested four different hypotheses regarding the possible nature of Martian organisms. While significant results were obtained for each of these, tests of three of the hypotheses appear to indicate the absence of biology in the samples used, while the fourth is consistent with a biological interpretation. The original assumptions for each experiment and the experimental procedures that were utilized to test these assumptions are reviewed.
J. Geophys. Res., Red, Paper 7S0439

6575 Surface of planets
PECULIARITIES OF THE GEOLOGICAL STRUCTURE OF THE MARS' SECTOR PHOTOGRAPHED BY AUTOMATIC STATIONS
"MARS" (9 pp.)
A. L. Sukhanov
Geotect., No. 1, 1977

6575 Surface of planets
GEOCHEMICAL AND MINERALOGICAL INTERPRETATION OF THE VIKING INORGANIC CHEMICAL RESULTS
P. Toulmin, III (U.S. Geological Survey, 959 National Center, Reston, VA 22092)
A.K. Baird, B.C. Clark, K. Keil, H.J. Rose, Jr., R.P. Christian, P.H. Evans and W.C. Kelliher

The elemental analyses whose basis is described in the preceding two papers represent the composition of samples of Martian fines; the only undetermined major constituents thought to be present are H_2O, CO_2, Na_2O, and possibly NO_x. The samples are principally silicate particles, with some admixture of oxide and probably carbonate minerals; the fines appear to have been indurated to a variable degree by a sulfate-rich intergranular cement. The overall elemental composition is dissimilar to any single known mineral or rock type, and apparently represents a mixture of materials. Close chemical similarity among samples at each site, and between the two sites, indicates effective homogenization of the fines, presumably by planetary windstorms, and further suggests that the samples analyzed represent the fine, mobilizable materials over a large part of the planet's surface. Low trace-element, alkali, and alumina contents suggest that the great preponderance of the materials in the mixture is of mafic derivation; highly differentiated, salic igneous rocks or their weathering products are insignificant components of the samples. Normative calculations, comparisons with reference libraries of analytical data, and mathematical mixture modeling have led to a qualitative mineralogical model in which the fines consist largely of iron-rich smectites (or their degradation products), carbonates, iron oxides, probably in part maghemite, and sulfate minerals concentrated in a surface duricrust. The original smectites may have formed by interaction of mafic magma and subsurface ice, and the sulfates (and carbonates?) may have been concentrated in the surface crust by subsurface leaching, upward transport, and evaporation of intergranular moisture films. Testing and refinement of this and competing models will accompany continuing acquisition of samples and data, and refinement of the analyses, particularly with respect to the critical light elements Mg, A, and Si. (Mars, chemical composition, mineralogy, weathering)
J. Geophys. Res., Red, Paper 7S0464

6575 Surface of Planets
MARTIAN IMPACT CRATERS AND EMPLACEMENT OF EJECTA BY SURFACE FLOS
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L.A. Crumpler, J.A. Cutts, R. Greeley, J.E. Guest and H. Masursky

Several types of martian impact craters have been recognized. The most common type, the rampart crater, is distinctively different from lunar and mercurian craters. It is typically surrounded by several layers of ejecta, each with a low ridge or escarpment at its outer edge. Outward flow of ejecta along the ground after ballistic deposition is suggested by flow lines around obstacles, the absence of ejecta on top and on the lee side of obstacles, and the large radial distance to which continuous ejecta is found. The peculiar flow characteristics of the ejecta around these craters are tentatively attributed to entrained gases or to contained water, either liquid or vapor, in the ejecta as a result of impact melting of ground ice. Ejecta of other craters lack flow features but have a marked radial pattern; still others have ejecta patterns that resemble those around lunar and mercurian craters. The internal features of martian craters, in general, resemble their lunar and mercurian counterparts except that the transition from bowl-shaped to flat-floored takes place at about 5 km diameter, a smaller size than for Mercury of the Moon.
J. Geophys. Res., Red, Paper 7S0488

6575 Surface of planets
COMMENTS ON: "CHARACTERISTICS OF FRESH MARTIAN CRATERS AS A FUNCTION OF DIAMETER: COMPARISON WITH THE MOON AND MERCURY" BY M. J. CINTALA ET AL.
C. P. Florensky, A. T. Basilevsky, and V. P. Polosukhin (Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR)

Cintala et al. attempt to determine: (1) at what diameters fresh martian craters begin to develop features such as central peaks, flat bottoms, terraces, etc. and (2) what determines the threshold diameters for various features. We argue that the results of Cintala et al. are biased by the way in which they collect and organize data.
Geophys. Res. Lett., Paper 7L0122