AGU

1986 AGU Medalists and Awardees Announced

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The recipients of the 1986 Bowie, Ewing, and Horton Medals and the Smith and Macelwane Awards have been announced by AGU. These distinctive honors recognize AGU members who make significant contributions to geophysics.

The **William Bowie Medal** is awarded to **James Dooge** of University College, Dublin, Ireland, for outstanding contributions to fundamental geophysics and for unselfish cooperation in research. The **Maurice Ewing Award** will be presented to **John Imbrie** of Brown University, Providence, R. I. This honor is awarded for significant original contributions to understanding physical, geophysical, and geological processes in the ocean and/or outstanding service to marine sciences. The medal is presented jointly by the U. S. Navy and AGU.

The **Robert E. Horton Medal** is awarded to **Abel Wolman** of the Johns Hopkins University, Baltimore, Md., for outstanding contributions to the geophysical aspects of hydrology.

The **Waldo E. Smith Award** is given to **Thomas F. Malone** of St. Joseph's College, West Hartford, Conn., for extraordinary service to geophysics.

The **James B. Macelwane Award** is given in recognition of significant contributions to the geophysical sciences by a young scientist of outstanding ability. A maximum of three awards may be made each year, and recipients must be less than 36 yr old. This year's recipients are **Bradford H. Hager** and **Edward M. Stolper** of the California Institute of Technology, Pasadena, and **Robert A. Weller** of Woods Hole Oceanographic Institution.

The Bowie and Horton Medals, as well as the Smith and one of the Macelwane Awards, will be presented at the Spring Meeting Honors Ceremony on May 21, 1986, in Baltimore, Md. The Ewing Award and the other Macelwane Awards will be presented on December 10, 1986, at the Fall Meeting Honors Ceremony in San Francisco, Calif. All AGU members are invited to attend these ceremonies.

Meetings

Meeting Report

Comparative Planetology

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Perhaps the most striking broad implication of what we have learned from the data that have been returned from planetary missions is that planetary processes are diverse and complex. Scientists are challenged to extend the dynamic range of their models and theories and are often forced to recognize that each planet or satellite is special. Nevertheless, the principles of physics are common to all these objects, and the emerging outcome of this challenge is a better understanding of how planets work and a better appreciation of the earth as a planet. The comparative approach to planets, although sometimes frustrating, is invaluable and was the focus of a meeting held at the California Institute of Technology (Caltech), Pasadena, June 5–7, 1985. This conference, entitled "Terrestrial Planets: Comparative Planetology" was sponsored by AGU, the Division of Planetary Science of the American Astronomical Society, the Geological Society of America, the Lunar and Planetary Institute (which published the abstract volume), the Planetary Society, and the Division of Geological and Planetary Sciences at Caltech. It was attended by almost 100 people, including participants from several foreign countries.

This was not a meeting for the presentation of new results (although a few were presented); rather it was, in large part, an attempt to encourage people to develop a synthesis of our knowledge in various areas. Success was only partial, but there were a number of stimulating presentations and discussions during the meeting. This report does not attempt to cover the entire range of topics but focuses on the questions that the meeting organizer (D. J. Stevenson, Caltech, author of this report) chose for discussion at the end of each of the 3 days of the meeting.

On the question "What relationship (if any) is there between meteorites and planets?", E. Anders (University of Chicago, Chicago, Ill.) and others defended the "conventional" view that appropriate combinations of meteoritic material provide a good explanation for the compositional systematics of the terrestrial planets. There can be no doubt that (primitive) meteorites provide an invaluable guide to elemental and (sometimes) isotopic abundances. However, scientists who model the physical processes of planetary formation are increasingly concerned by the possible role of planetary scale processes that do not occur on meteorite parent bodies. (A dramatic example of a "planetary scale" process that has no analog in meteorite parent bodies would be the collision of the earth with a Mars-sized body, an event that some hold responsible for the formation of the moon. This event might have dramatic chemical consequences, even for the major elements.) On the related question, "Is there a preferred explanation for the noble gas pattern among the terrestrial planets?", there was almost a consensus among the conference attendees that the answer is "No." The enormous differences in the ^{36}Ar reservoirs of the atmospheres of Venus, the earth, and Mars remain puzzling; various ideas have been suggested, but none is completely convincing.

On the second day, a particularly spirited discussion was held on the question "Why are the atmospheres of the earth and Venus so different?" The conventional view of a runaway greenhouse was strongly upheld by most at this meeting, notably J. Pollack and J. Kasting (National Aeronautics and Space Administration/Ames Research Center, Moffett Field, Calif.), A. Ingersoll (Caltech), and D. Hunten (University of Arizona, Tucson). According to this view, the modest difference in insolation (essentially distance from the sun) sufficed to guarantee that the early earth could retain a water ocean and thereby (through erosion and the carbonate cycle) buffer atmospheric CO_2 to a "low" level (possibly a much higher level than the present atmospheric CO_2). The author is in the minority in believing that distance from the sun is likely to be unimportant during and immediately after planet formation. If, as seems probable, all of the earth's water was forced to enter the primordial atmosphere during accretion and could not subsequently rain out, no buffering is possible, and the "runaway greenhouse" model, as usually described, would be not merely incorrect but irrelevant. Further work is in progress on this important problem, the resolution of which may be crucial to our understanding of the earliest earth and the origin of life.

The final day's question, "What are the chemical differences between the terrestrial planets and what role do they play in tectonic and volcanic evolution?", provoked a wide range of responses, impossible to summarize adequately here. G. Wetherill (Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C.) pointed out that his numerical simulations of planetary accumulation indicate strong "mixing" in the terrestrial zone, so that (for example) much of the material that constitutes Mercury might have accumulated out near the present orbit of Mars and vice versa. If correct, this would argue against attempts to relate perceived compositional systematics (themselves controversial) to distance from the sun. D. L. Anderson (Caltech) put forward the startling (but only

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partly novel) idea that the existence of life on earth has played a crucial role in the evolution to the tectonic regime that we currently enjoy. K. Goettel (Brown University, Providence, R.I.) described his efforts to model terrestrial planet compositions, which provide partial support for the role of distance from the sun (or, more correctly, temperature in the solar nebula). It is probably fair to say that controversy will persist in this area, since we are not likely to have additional meaningful constraints on terrestrial planet composition (other than that of the earth) in the near future.

The conference ended with a public session that was moderated by B. Murray (Caltech) and was attended by several hundred people. Entitled "Dinosaurs, Greenhouses, and Ice Ages—The View from Space", it featured invited presentations by Pollack, G. Shoemaker, and H. Masursky (the latter two both of the U.S. Geological Survey, Flagstaff, Ariz.).

Limited copies of the abstract volume are available from D. J. Stevenson, California Institute of Technology, 170–25, Pasadena, CA 91125.

This report was contributed by D. J. Stevenson.

1986 Ocean Sciences Meeting Report

PAGE 163–165

The 1986 Ocean Sciences Meeting, sponsored by the American Geophysical Union (AGU) and the American Society of Limnology and Oceanography (ASLO), was held January 13–17 in New Orleans, La. There were 700 papers presented at the meeting, which had 989 registered attendees. This meeting had a 40% increase in exhibitors and an increase in the number of poster papers presented in comparison to the 1984 Ocean Sciences Meeting.

This meeting, as did the two previous Ocean Sciences Meetings, proved to be a great success. Many of the sessions held were devoted to topics that involve new technologies and new directions in oceanographic research. Highlights of the meeting included the following:

- An informal but well-attended workshop entitled "Ocean Telemetry: Resources and Needs" was held.
- There were successful sessions on marginal ice zones, estuaries, low-oxygen environments, and effects of seamounts on physical and biological processes. These multidisciplinary sessions included contributions from physical, chemical, and biological oceanographers.
- The "Global Ocean Flux" sessions addressed the extension of the understanding of the factors that control ocean production and the fate of biogenic particles on regional to global scales.

Changes to the 1986 Ocean Sciences Meeting program are printed below, along with additional, late, and revised abstracts.

Papers Not Presented

11B-10, E. D. Gallagher
11C-01, J. R. Schubel
11C-07, J. Zamacona Evenes
11D-02, B. Holt
11F-03, D. A. Steel
12B-11, R. L. Bernstein
12E-02, A. W. Herman
21C-01, W. S. Moore
21C-04, A. K. Masse
21D-03, S. S. Bates
21E-11, J. H. Garber
22D-04, M. E. M. Baumann
22D-06, S. B. Schnack
22F-12, B. E. Tucholke
31A-06, R. S. Keir
31C-07, J. C. J. Nihoul
31C-10, A. S. McLaren
31D-01, W. J. Kimmerer
31D-03, M. S. Evans
32C-11, J. T. Hardy
32H-06, R. P. Trocine
32H-08, R. Amundson
41B-06, M.-Y. Su
41F-09, J. Montgomery
42A-09, M. R. Hoffmann
42E-10, J. L. Spiesberger
51A-03, F. J. Sansone
51A-10, P. Sharma
51B-13, R. G. Arnold
51D-06, M. J. Fasham
51D-07, M. M. Lakich
51F-03, K. E. Heikes
51F-08, P. A. McGillivary

Late and Revised Abstracts

11D-06

A Coupled One-Dimensional Ice/Ocean Model

WARN-VARNAS, ALEX and RIEDLINGER, SHELLEY (Both of: Ocean Hydrodynamics/Thermodynamics Branch, Code 322, Naval Ocean Research and Development Activity, NSTL, MS 39529-5004

A coupled one-dimensional ice/ocean model is developed in differential form. The ice/snow system is represented by the simplified thermodynamic representation of Semtner and a dynamic representation that neglects the internal ice stresses. The ocean is represented by the Mellor level 2 turbulence mixed layer model.

The thermodynamic coupling considers a moving ice/ocean interface and a salinity flux generated by the freezing or melting of ice. The dynamic coupling occurs via the turblent stress that exists in the mixed layer beneath the ice.

Two test cases are used for model validation and scientific studies. One is the standard climatological test used by Semtner (1976) and others. The other test case is the AIDJEX data. The model is initialized from a given oceanic temperature/salinity profile and an ice/snow thickness. Then the model is forced in time by the atmospheric wind stress, latent and sensible heat flux, and long and shortwave radiation. Results are compared against previous studies and AIDJEX data.

21B-10A

Vertical Velocities, Structure and Dynamics of Gulf Stream Meanders in the South Atlantic Bight

KENRIC E. OSGOOD
JOHN M. BANE (Both at: Curriculum in Marine Sciences, University of North Carolina, Chapel Hill, NC 27514)

A triangular array of current meter moorings was deployed within the cyclonic flank of the Gulf Stream in the South Atlantic Bight from September, 1981 to April, 1982. Eulerian current velocity, temperature, and conductivity were measured at 30 minute intervals. Using the velocity and temperature data and the nondiffusive heat equation, a time series of the vertical velocity was derived. A mean vertical velocity of -.016 cm/sec and standard deviation of .108 cm/sec was obtained from the time series. The small negative mean value is consistent with the mean current flowing along the sloping bottom at the location of the instrument moorings, and the large standard deviation is an indication of the changes in the vertical velocity as Gulf Stream meanders and fluctuations pass the array. The time series of horizontal and vertical velocities and temperature were examined at times when events were passing through the array, in order to better understand the subsurface structure of Gulf Stream fluctuations. The phasing of the velocities and the temperature as typical meanders passed by showed upwelling in the trailing edge of a meander crest and the leading edge of a meander trough and associated cold core, and downwelling in the trailing edge of the cold core as another meander crest approached. This agrees with earlier conceptualized Gulf Stream meanders. Using the vertical velocity time series, the cross and along stream momentum balances were calculated. The dominant balance in the cross stream equation was found to be geostrophic, whereas in the along stream equation it was found that the Coriolis term and the acceleration terms were of equal importance. The time series of the momentum equation terms were also examined in detail, at times when events were passing through the array, in order to illustrate the dynamics of Gulf Stream fluctuations.

21B-10B

Mapping Gulf Stream Meanders: Objective Analyses from an IES Array compared with AXBT and XBT Surveys.

D. RANDOLPH WATTS (Graduate School of Oceanography, Univ. Rhode Island, Narragansett, RI 02882), and
JOHN M. BANE, JR. (Marine Sciences Program, Univ. North Carolina, Chapel Hill, NC 27514)

An array of 20 inverted echo sounders (IES) was maintained from Sept. 1983 to May 1985 on a grid with six lines across the mean path of the Gulf Stream 150-550 km northeast of Cape Hatteras. Each record was calibrated to determine the 12°C isotherm depth (Z12). Coinciding data come from 6 AXBT and 5 XBT surveys.

We have adapted objective analysis (OA) techniques to map the Gulf Stream Z12 field. OA applies to fields with homogeneous statistics, and may not seem appropriate for frontal regions. However, we have overcome this difficulty by subtracting the mean Z12 field and nomalizing the variance of the remaining perturbation field before performing the OA (these are restored later). The IES array spacing (65km) is sparse but gives excellent temporal resolution. We have produced daily maps of the Gulf Stream Z12 field for the entire deployment period. The individual AXBT/XBT surveys give excellent spatial resolution, and AXBT surveys are completed within 5 hrs.

The IES OA field accuracy is verified as follows: (1) Varying the choice of "mean field" has minimal effect upon the output Z12 fields, so the method is robust. (2) The input measurements and the output mapped fields evaluated at the input sites differ by only 12m r.m.s., so the method is internally consistent. (3) Intercomparisons between the IES OA maps and from AXBT/XBT surveys show r.m.s. differences of 44m and 35m, respectively. These differences come mainly from uncertainties in the Z12s determined by IESs (25m) and AXBT/XBTs (15m), and systematic navigation offsets between aircraft and ship (2km cross-stream). Since these differences are small compared to the overall change in Z12 (700m) across the Gulf Stream, the IES OA maps agree well with surveys by other methods.

21C-04

Dynamics of a Surface Buoyant Jet

JORG IMBERGER (Centre for Water Research, University of Western Australia, Nedlands 6009, Western Australia)

The tidal outflow from Leschenault Inlet into Koombana Bay forms a buoyant surface jet which spreads across the ocean water in a near radial fashion. The tidal entrance is a shallow rectangular channel. The spreading jet was fully documented with in-situ instrumentation, with drogue markers with C-T-D sections using the vessel Djinnang II and with new vertically rising microstructure equipment. The volume flux was found the rise almost linearly as the ebb tide commenced to flow through the channel leading to a peak internal Froude number of around 6. The front propagated linearly with a self similar streamline pattern, however, a definite frontal instability was observed which caused sub-fronts to form and propagate from the lee into the main front. The microstructure data indicated that the very active roller region with the turbulence collapsing in the lee of the front. However, appreciable turbulence remained being sustained by the shear of the overflowing water. These field data will be discussed in detail and the discussion will range from the jet channel exit to the roller region.

21F-15A

Surface Layer Turbulence Response to the Passage of a High Pressure Front

R.G. LUECK (Ocean Turbulence Laboratory, Naval Postgraduate School, Monterey, Ca. 93943)

Eighty-five profiles of velocity and temperature microstructure were made between the 7th and 9th of November 1983 at the MILDEX site during the passage of an atmospheric front. The depth of mixing and the depth of the mixed (or homogeneous) layer were comparable at the leading edge of the storm. Air-Sea temperature differences were as large as -2.5 C, producing an oceanic mixing layer driven by both surface stress and a downward buoyancy flux. On the trailing edge of the storm, the air-sea temperature difference was negligible and the depth of mixing was much less than the mixed layer depth, even though wind speeds were comparable on the sides of the front. Differences in mixing and mixed layer depth can be explained by buoyancy flux variations as measured by Davidson. Even when the mixing layer depth is less than half the mixed layer depth, there is entrainment of seasonal thermocline water into the mixed layer. The entrainment process is then independent of local surface forcing and must be driven by internal wave shear at the top of the thermocline. Mixed layer models that assume that turbulence is present over the entire surface homogeneous layer may thus, at times, underestimate turbulence intensity in the surface layer and also misjudge entrainment out of the top of the thermocline.