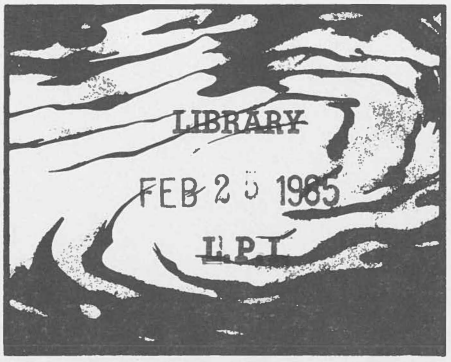


Program Scope and Participation: *The goals of the MECA program are to define the present inventory and distribution of martian volatiles and to unravel the history of their evolution so that we may understand the original volatile content of Mars as inherited from the proto-planetary nebula; the processing of the primary volatile components by the martian interior; the evolution of the martian atmosphere; the interchange between the surface and atmosphere through geologic time; and any secular or nonsecular changes in climate and the processes responsible for such changes. Any scientist whose research is relevant to the goals of MECA, but whose funding originates from outside the program, is invited to join the Study Group. Simply write to the Steering Committee through the LPI Projects Office outlining the nature of the relevant research. Your name will then be added to the mailing list.*

MECA **Newsletter** **February 1985** **Number 3**

WATER ON MARS WORKSHOP: NEW IDEAS, RESULTS, AND QUESTIONS

How much water resides in the martian crust? What forms does it take and how is it distributed? What role do the martian polar caps, atmosphere, and regolith play in the seasonal and climatic water cycles? These were just a few of the many questions considered by the eighty-three participants in the Water on Mars Workshop, held November 30th and December 1st, 1984, at the NASA Ames Research Center, Moffet Field, California. The meeting, which was sponsored by the Lunar and Planetary Institute and hosted at NASA Ames by Bob Haberle, is the first in a series of topical workshops that are planned as part of the MECA Study Project.

The opening session of the Workshop focused on one of the most debated areas of Mars volatiles research—the size of the planet's past and present bulk water content. Current estimates of the inventory of H_2O on Mars range from an equivalent layer of liquid 10–1000 meters deep averaged over the planet's surface. The most recent of these estimates, presented at the Workshop, is based on the now popular belief that the SNC-class of meteorites represent actual samples of the martian crust. From a model of planetary accretion and degassing founded on this assumption, it was determined that the present inventory of H_2O on Mars is equivalent to a global layer no more than 50 meters deep.

During the discussion generated by this estimate, several investigators expressed reservations about an H_2O inventory as small as a few tens of meters, for it appears to directly contradict the seemingly abundant morphologic evidence that Mars is (or has been) water-rich. Others, however, argued that the interpretation of much of this morphologic evidence is at best equivocal, and that the case for a "wet" Mars is far from established. The issue is further complicated by the possibility that various processes may have altered the volatile budget of the planet over the course of its geologic history. In past discussions, the most frequently cited of these processes have been cometary influx, exospheric escape, and chemical weathering. At the Workshop, a new candidate was discussed: the possibility that shock waves generated by energetic impacts may have blown off a significant fraction of the primitive atmosphere.

Interestingly, a device capable of resolving much of the controversy over the present water content of the martian crust was on display in the hallway just outside the Workshop meeting room. Penetrators have been proposed as an inexpensive means of creating a global seismometer network on Mars. Such a network, consisting of perhaps ten or more well-placed instruments, could readily determine whether the seismic propagation characteristics of the outer crust are indicative of a water-rich or water-poor planet.

The next session of the Workshop was devoted to a discussion of the seasonal water cycle. Atmospheric water vapor measurements, compiled by Earth-based telescopes and the Viking Orbiter Mars Atmospheric Water Detectors (MAWD), now span a period of over six martian years. Analysis of this data suggests that the seasonal cycle is governed by both the sublimation and condensation of H_2O at the poles and by its adsorption/desorption within the regolith. So far, efforts to simulate the seasonal vapor cycle have failed to reproduce the observed behavior. This result is not altogether surprising, since many aspects of the seasonal cycle are still poorly understood. For example, how much water is transported in the non-vapor state? What effects do the global dust storms have? Do net annual sources (or sinks) of atmospheric vapor exist within the regolith? Answers to these and similar questions will, we hope, be forthcoming following the arrival of the Mars Geoscience/Climatology Observer Mission in the fall of 1991; a primary objective of this mission is to determine the temporal and spatial distribution of atmospheric H_2O, CO_2, and dust over a complete martian year.

Following the seasonal discussion, attention at the Workshop turned to the martian climate, where the topic that appeared to generate the most interest was the origin of the valley networks. The networks appear to have been formed by a variety of fluvial and non-fluvial processes; yet their almost exclusive occurrence in the

ancient heavily cratered terrain suggests that, whatever processes were responsible for their formation, they ceased to operate early in martian history. The central question is: Why?

One analysis suggests that the impact that created the Argyre basin may have played a critical role. The basis for this supposition is the observation that channel drainage densities appear to have undergone a dramatic decline in terrains that post-date the Argyre event. An alternative hypothesis proposes a climatic link with the formation of the Tharsis volcanic complex. In this scenario, the high obliquities that are thought to have characterized pre-Tharsis Mars, may have periodically resulted in the sublimation of large quantities of ice from the poles and its preferential deposition as snow at equatorial latitudes. Sunlight, absorbed within the snowpack, may have then led to significant melting, thus providing the necessary liquid water to carve the channels.

Another aspect of the martian climate discussed at the Workshop was the long-term redistribution of H_2O within the regolith. Detailed studies of the thermodynamic stability of ground ice on Mars suggest that there should be a net transfer of regolith H_2O from the warmer equatorial latitudes to the colder poles. Indeed, examination of high resolution Viking Orbiter imagery has revealed that the distribution of certain terrain features, whose origins have been attributed to the presence of interstitial ice, appears restricted to the latitudes poleward of 30 degrees. The absence of these features at more equatorial latitudes supports the conclusion that much of the near-surface regolith in this region may be ice-free.

The final session of the Workshop was devoted to the question of H_2O sources and sinks. Recently acquired spectroscopic evidence and theoretical arguments suggest that water has played an important role in the mineralogical development of the present martian surface. So, too, various investigators have shown that the mineralogy of the surface may exert a strong influence on the exchange and storage of regolith H_2O. Clays are of particular importance, for their relative abundance, particle size, and specific surface area will determine both the regolith's adsorptive capacity and diffusive properties. Interestingly, an examination of Viking Orbiter imagery now indicates that the thick mantles of clay-size eolian material that were once thought to blanket temperate and polar latitudes, are far less extensive than previously suggested. This discovery implies a sizable reduction in the estimated volatile storage potential of the polar regolith.

If further emphasis were needed, the questions raised during the closing talks of the Workshop highlighted the uncertainty that underlies much of our current knowledge of water on Mars. For example, did large ice-covered lakes once fill the bottoms of the great equatorial canyons? Have the permanent polar caps always been in their present geographic locations, or have changes in the planet's moment of inertia led to polar wandering? What role, if any, does groundwater play in the martian hydrologic cycle? For the time being, these and many of the other intriguing questions raised at the Workshop remain unanswered; however, the ideas and cooperative efforts stimulated by their open discussion will inevitably provide us with new insights, and thus new questions, regarding the nature of water on Mars.

Summaries of the major results of the Water on Mars Workshop were presented by Heinrich Wänke, Bruce Jakosky, Jim Pollack, and Mike Carr at a special session of the Fall Meeting of the American Geophysical Union, held in San Francisco on December 3rd. The high level of interest displayed by the participants at both the Ames Workshop and the special session at AGU, bodes well for future MECA workshops.

MARS GEOSCIENCE/CLIMATOLOGY OBSERVER (MGCO) STATUS

by Frank Don Palluconi

After receiving administrative and congressional approval, the Mars Geoscience/Climatology Observer Mission began as a Flight Project at the start of the fiscal year in October, 1984. Experiments and instruments will be selected through an Announcement of Opportunity (AO) process, with release of the AO on April 1, 1985. Completed proposals will be due on August 1, 1985 and tentative selections will be announced in February, 1986. The spacecraft will be a modified version of an existing commercial design and will be selected in parallel with the instruments.

The AO will be similar to previous planetary announcements, modified to reflect the specifics of the Mars Mission and the modest-cost nature of the Observer Series. Proposers who submit "Letters of Intent" will be sent an extensive information package describing the mission. Proposals will be accepted for Principal Investigator (PI)-led experiments, Team Member (TM) positions with any one of three potential facility experiments (Radio Science, Gamma-Ray Spectroscopy or Visual and Infrared Mapping Spectroscopy), and for a small number of Interdisciplinary Scientists (IDS) positions.

By the time tentative experiment selections are announced in February, 1986, the spacecraft will also have been chosen. The seven months from February to September, 1986 will be used as a confirmation period to insure compatibility between experiments, spacecraft, and mission. Delivery of flight hardware is required in May, 1989 for integration with the spacecraft. Launch will occur in August/September, 1990 with arrival at Mars in August, 1991. After achieving the sun-synchronous near-polar and circular mapping orbit the mission objectives will be met using observations made over the course of one martian year (687 days).

WORKSHOPS

THE NEXT MECA WORKSHOP: "Evolution of the Martian Climate"

The next MECA workshop, entitled: "Evolution of the Martian Climate", will be held in conjunction with the IAMAP/IAPSO Joint Assembly (International Association of Meteorology and Atmospheric Physics/International Association for the Physical Sciences of the Ocean) in Honolulu, August 9-10, 1985. Conveners of the meeting are Michael Carr, Conway Leovy, and Robert Pepin.

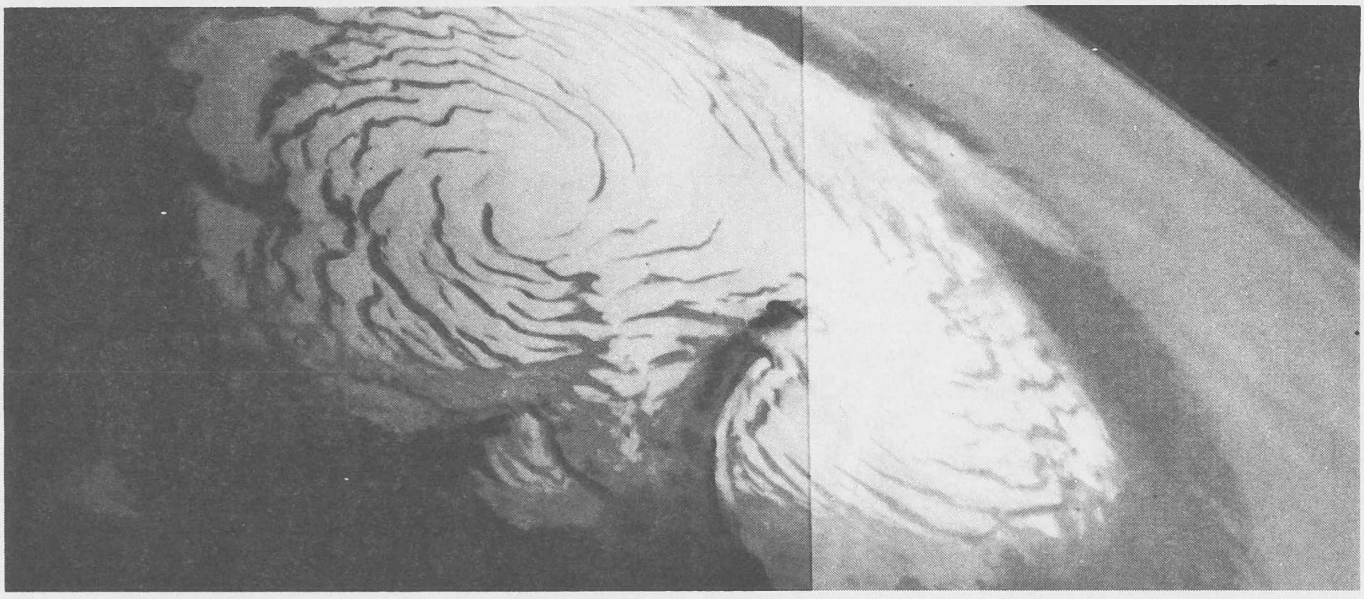
Major results presented at the workshop will be summarized by several representatives at a special Joint Assembly symposium entitled "Comparative Climatology of the Terrestrial Planets" that will be held August 13-14. The abstract deadline for the IAMAP/IAPSO Joint Assembly is March 15, 1985. Guidelines for abstract preparation follow those of other AGU meetings. Dimensions must not exceed 11.8 × 18 cm (the text should begin at least 4 cm below the top edge of the paper, and as close to the left edge as possible). The title should be typed in upper and lower case letters, and underscored. After skipping a line, type the names (in upper case) and affiliations of all authors; underscore the name of the author presenting the paper. Skip a line after the author block, and begin the text of the abstract by indenting two spaces. To the right of the "abstract box", the following submittal information should appear:

1. title of meeting (IAMAP/IAPSO Joint Assembly)
2. corresponding author's address (include telephone number)
3. symposium code (M-9 for Comparative Climatology of the Terrestrial Planets).

The original abstract plus two copies should be mailed to: Joint Assembly Meeting, American Geophysical Union, 2000 Florida Ave. NW., Washington, DC 20009. It should be noted that these instructions apply only to abstracts submitted to the Joint Symposium and do not represent guidelines for submittal to the MECA workshop. More detailed information about the workshop will be contained in the next issue of the Newsletter.

"MARS: WHERE DO WE STAND AND WHERE DO WE GO FROM HERE?" The First Annual LPI/GSA Planetary Workshop

On the weekend of October 26-27, 1985, the Lunar and Planetary Institute and the Planetary Geology Division of the Geological Society of America will cosponsor "Mars: Where do we stand and where do we go from here?", the first in a series of topical planetary workshops that will be held in association with the annual meeting of the GSA. This year's workshop, which will be held in Orlando, Florida, is being organized to address specifically some of the outstanding geologic questions left in the wake of the Viking mission. Areas that will be considered for discussion include issues related to martian tectonics, volcanism, cratering, and volatiles. Members of the MECA Study Group and the planetary community at large are encouraged to offer their suggestions for the workshop program and format. Suggestions and comments should be directed to one of the three workshop conveners: Don Wise, Baerbel Lucchitta, or Stephen Clifford. Additional information will appear in the next issue of this Newsletter.



VIEWPOINT

". . . we have been careful to indulge in no speculation . . . "

If you, like myself, are often prone to over-interpreting your data or stating your conclusions more forcefully than perhaps they deserve, consider the carefully measured words of one of our predecessors:

"In our exposition of what we have gleaned about Mars, we have been careful to indulge in no speculation. The laws of physics and the present knowledge of geology and biology, affected by what astronomy has to say of the former subject, have conducted us, starting from the observations, to the recognition of other intelligent life. We have carefully considered the circumstantial evidence in the case, and we have found that it points to intelligence acting on that other globe, and is incompatible with anything else. We have, then, searched for motive and have lighted on one which thoroughly explains the evidence that observation offers. We are justified, therefore, in believing that we have unearthed the cause and our conclusion is this: that we have in these strange features, which the telescope reveals to us, witness that life, and life of no mean order, at present inhabits the planet." (From Percival Lowell's Mars as the Abode of Life).

Since posting this quotation above my desk, I've noticed the tendency to overstate the implications of my research has diminished precipitously . . . (SC)

VIEWPOINT *is a regular feature whose purpose is to provide individual participants in the MECA Study Project with the opportunity to communicate ideas, suggestions, and criticisms, between themselves and the Study Group at large. Potential topics for discussion include suggestions for areas of new or cooperative research; changes in MG/CO or follow-on mission objectives, experiments, and procedures; or practical tests of various assumptions, theoretical models, and morphologic interpretations. Where significant differences of opinion exist, opposing points of view will be actively solicited. All submissions should follow the guidelines outlined in NEWSLETTER CONTRIBUTIONS.*

LPI GEOPHYSICAL DATA FACILITY

by Kinpong Leung and Roger Phillips

The LPI Geophysical Data Facility (GDF) provides a set of research tools to analyze geophysical datasets such as gravity and magnetic data on a regional/global basis, to compare datasets of different geophysical phenomena over the same geographical area, and to utilize iterative as well as image processing techniques for analysis and modelling of these datasets.

The GDF dataset collections include Earth topography, SEASAT, and MAGSAT information; Venus topography and line-of-sight (LOS) gravity; Mars topography, LOS gravity, thermal inertia, and albedo; and the Lunar Consortium datasets. Most datasets are of quarter-degree resolution in latitude and longitude except for LOS gravity data which can be gridded to quarter-degree resolution for a given area of interest.

A user-oriented package has been developed to allow users to select a planet, have the global coverage of the desired dataset displayed graphically, and compile a dataset of a region of interest. Profiles and 3-D perspectives of the area of interest can then be displayed. Comprehensive software is available to compare the observed data with the data predicted by physical models.

An Analogic AP 500 32 bit floating point array processor with 2 megabytes of memory is used in conjunction with a DEC VAX 11/80 for fast complex calculation. An important feature of GDF is the capability for users with a DEC VT125 compatible graphics terminal to dial in through 1200 baud modems to analyze the datasets on a remote access basis. The terminal must be able to use either DEC REGIS graphics software or Tektronics PLOT 10 software. It is possible to select color image output from the GDF program, but the image will be physically produced at the

LPI. This can be pre-arranged by phone call, and the images will be mailed to you.

The LPI computer is free (to you), so your expense is going to be phone time. At present you may access the GDF by whatever long distance phone service is available to you. Simply follow the computer log-on procedure outlined in *NEWSLETTER CONTRIBUTIONS*. The appropriate username is "GDFLPI", while the password is "GDF". You will then be in the GDF program. It is menu driven and self-explanatory. You should be able to use it without any external help. However, deep down inside, we don't believe this is totally true, and are working on a user's manual. If you become a serious user of GDF, you will be given your own account on the LPI VAX, and you will be able to access the GDF program through this account. For human help with GDF, call Brian Fessler at 713-486-2184.

MARS PREPRINTS/REPRINTS AVAILABLE THROUGH THE LPI

A new preprint/reprint distribution service is being initiated at the LPI. Any paper whose scope is encompassed by the research objectives of the MECA Study Project, and whose authorship includes at least one member of the Study Group, is a candidate for the distribution service. Preprints (one unstapled copy) should be submitted in their final accepted form. All duplication will then be provided by the LPI. Reprints should be supplied in quantity by the author. As new papers are received for distribution, their titles will be added to a list of available publications printed as part of each Newsletter. Requests for copies of these papers may be made through the LPI Projects Office.

Current Holdings: (R) - reprint, (P) - preprint.

Clifford and Hillel (1983) The stability of ground ice in the equatorial region of Mars, *JGR 88*, 2456-2474. (R)

Fanale and Jakosky (1982) Regolith-atmosphere exchange of water and carbon dioxide on Mars: Effects on atmospheric history and climate change, *Planet. Space Sci. 30*, 819-831. (R)

NEWSLETTER CONTRIBUTIONS

In an effort to keep the Study Group informed about the latest meetings, activities, and other news relevant to MECA's goals and Mars in general, contributions to the MECA Newsletter are cordially invited. Contributions should be brief and written in Newsletter style. Submissions may be either typewritten or transmitted as standard ASCII text files over the phone. To send contributions via electronic mail, your modem should be set to either 300 or 1200 baud; to reach the LPI VAX dial (713)-486-8214 or 486-2183. The username is "MAILBOX", the password is "LPI" (after each entry hit RETURN). When the prompt "$" appears on your screen, type "MAIL". All contributions should be addressed to "CLIFFORD". When you complete your message hit CTRL Z and then type "EXIT" in response to the prompt ">". When the symbol "$" returns to your screen, type "LOG" and then hang up. For electronic mail, any PC or terminal will theoretically work; however, best compatibility is achieved by using or emulating a DEC terminal.

Newsletter 4 Contribution Deadline: 4/12/85

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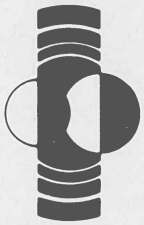

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