

MARSBUGS:

The Electronic Astrobiology Newsletter

Volume 6, Number 4, 27 February 1999.

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The purpose of this newsletter is to provide a channel of information for scientists, educators and other persons interested in exobiology and related fields. This newsletter is not intended to replace peer-reviewed journals, but to supplement them. We, the editors, envision *Marsbugs* as a medium in which people can informally present ideas for investigation, questions about exobiology, and announcements of upcoming events.

Astrobiology is still a relatively young field, and new ideas may come out of the most unexpected places. Subjects may include, but are not limited to: exobiology and astrobiology (life on other planets), the search for extraterrestrial intelligence (SETI), ecopoiesis and terraformation, Earth from space, planetary biology, primordial evolution, space physiology, biological life support systems, and human habitation of space and other planets.

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THE CONTROVERSY ON THE ANCIENT MARTIAN WATER CONTINUES

By Andrew J. LePage

When people think about water on ancient Mars, the enormous flood channels of its northern hemisphere usually come to mind. But scattered across the older highlands of Mars' southern hemisphere are a multitude of less spectacular

water-related landforms such as dendritic valley networks, small discharge channels, and apparently desiccated lake beds that formed a billion or more years earlier. Like their larger and better known relatives, these older fluvial features strongly suggest that ancient Mars was much different than it is today and that it could have been a more habitable abode for life in some distant epoch.

While most scientists agree that running water cut these various features, there is fierce disagreement on the prevailing environmental conditions on Mars when these fluvial features formed. One camp holds that ancient Mars had a warm, wet climate with precipitation and valley erosion caused by runoff and sapping of underground aquifers. Others believe that ancient Mars had a much colder climate not unlike that seen today. Adherents to this view believe that the water responsible for making Mars' ancient fluvial features was produced episodically at scattered points around the planet over billions of years as subsurface ice was melted by localized geologic events.

This debate continues unabated despite a harvest of new data from Mars and a much more detailed examination of earlier data. One recent paper in support of the "warm, wet Mars" model presents the results of an analysis performed by Randall Forsythe and Clyde Blackwelder of the University of North Carolina at Charlotte (1). In this paper the authors examined 144 craters they selected from a survey of about 21 million square kilometers of Noachian epoch highland terrain older than about 3.5 billion years. All these craters are about 40 km in diameter with floors about 1 km below the surrounding terrain. They all have inflow channels but no outflow channels and are believed to have been ancient basins where groundwater brought in by the channels would collect.

Using a finite element flow model developed by the United States Geologic Survey (USGS) called MODFLOW, Forsythe and Blackwelder simulated the groundwater flow in the area of these basins when they contained water long ago. They found that these basins could support the evaporation of 10 to 20 cm of water annually or the sublimation of a comparable thickness of ice. At that rate, the aquifer within 100 km of the basins would be drained in less than 40,000 years. Since such basins are commonly found more closely spaced than this in the regions surveyed, the authors contend that the aquifers must have been continually recharged over time. According to the models, the equivalent of 1 to 2 cm of annual precipitation (in the form of rain and/or snow) would be enough to top off the aquifers and maintain the hydrologic cycle in these basins for periods in excess of tens of thousands of years. If true, such basins would be viable habitats for Martian life billions of years ago and would prime locations to search for fossils today.

The results of a detailed analysis of ancient erosional valleys by Kenneth Tanaka and a group of scientists at the USGS came to a completely different conclusion (2). In this paper erosional valleys in the Thaumasia region of Mars were examined along with details of surrounding terrain through which they flowed. The authors found that these valleys tended to originate on volcanoes or within 50 to 100 km of rift systems dating from the Noachian to Early Hesperian epochs (*i.e.*, older than about 3 billion years) or within 100 km of craters larger than 50 km in diameter dating from the Noachian. While the types of features and the area they are found are different from those studied by Forsythe and Blackwelder, the analysis by Tanaka et al. does cover roughly the same period of Martian history.

According to Tanaka and his colleagues, the low drainage density implied by the erosional valleys studied does not require precipitation in any form. Instead the evidence is consistent with these valleys forming episodically at scattered locations and times as a result of water released by volcanic heating of subsurface ice or the disruption of aquifers by tectonic or impact events. The conclusion drawn here is that a "warm, wet Mars" model is not required to explain the origin of

these types of valley systems. A resolution to this debate will hopefully be provided with data returned by the ongoing Mars Global Surveyor mission.

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- 2) Kenneth L. Tanaka et al., "Erosional Valleys in the Thaumasia Region of Mars: Hydrothermal and Seismic Origins", *Journal of Geophysical Research--Planets*, Vol. 103, No. E13, pp. 31,407-31,419, December 25, 1998

About the author

Andrew J. LePage is a physicist and freelance writer specializing in astronomy and the history of space flight. He has written extensively about bioastronomy and was a regular contributor to SETIQuest where he served as a member of its Editorial Board before it ceased publication in 1998. The author can be reached at lepage@visidyne.com

THIS WEEK ON GALILEO JPL release

15-21 February 1999

Galileo has returned to operating in a normal mode after executing two turns last week to point the spacecraft's radio antenna back to Earth. This week's activity focuses on playback of science information acquired during Galileo's January 31, 1999 flyby of Europa. Playback is interrupted once this week to perform another spacecraft turn to keep Galileo's radio antenna pointed towards Earth.

Last week's spacecraft turns were required after on-board fault protection software detected that a previous spacecraft turn, attempted on January 31, was taking too long to complete. The software correctly placed the spacecraft in safe mode to await instructions from Earth, but prevented it from achieving the desired Earth-pointed attitude. All remaining encounter commands were cancelled when Galileo entered safe mode, preventing the spacecraft from making planned distant observations of Europa, Io and Jupiter.

Investigations into the anomaly suggest that it was caused by a minimum or inflection point in the sensitivity of two sensors used to detect the sun, which was being used as a guide for the spacecraft turn. This vulnerability of the sun sensors may be partially due to exposure to radiation at Jupiter, but is not expected to have any impact on the remainder of Galileo's mission.

Cruise operations were initiated last Thursday, February 11, and included standard maintenance on the spacecraft's propulsion system, and a standard gyroscope performance test. Processing and transmission to Earth of observations taken prior to safing was also initiated last Thursday. Through this week Galileo's playback schedule includes observations obtained by the near-infrared mapping spectrometer, the photopolarimeter radiometer, the spacecraft camera, and the suite of six fields and particles instruments.

The photopolarimeter radiometer returns four observations during this period, all containing polarimetry measurements. Two of these focus on Jupiter and will allow scientists to learn more about the vertical cloud structure of Jupiter's atmosphere, including particle shape and size. The other two observations focus on Europa and will provide information on the texture and composition of Europa's surface materials.

The near-infrared mapping spectrometer returns six observations--three of a hot spot and three of a region of Jupiter's Northern Temperate Belt. Each observation will provide measurements of the composition and thermal properties of these regions of Jupiter's atmosphere.

The camera returns five observations during this week. All contain Europa and were taken during the spacecraft's close flyby of the icy moon. The first observation contains the Tegid crater region and will be used to characterize the crater's shape and determine if it has a central dome feature similar to craters seen on other Galilean satellites. The second observation contains a region of mottled or blotchy-looking terrain in an attempt to determine if there is any relationship between this type of terrain and Europa's well-known triple band features. In a regional observation, the camera captures two images. The first of these images will fill a gap in an already existing map of Europa, while the second will be used to determine whether or not Europa's rotation is synchronous. The last two observations of this week will provide information on the structure of Europa's north polar plains.

Finally, the fields and particles instruments begin the return of their observation of the plasma, dust, and magnetic and electric fields surrounding Europa. These data were recorded during the 50 minutes when Galileo was closest to Europa and will improve the understanding of the interaction between Europa and Jupiter's magnetosphere.

For more information on the Galileo spacecraft and its mission to Jupiter, please visit the Galileo home page at <http://www.jpl.nasa.gov/galileo>.

NASA BUDGET REQUEST INCLUDES NEW PROJECTS IN MARS PROGRAM

By Mark Whalen
From the *JPL Universe*

5 February 1999

NASA's requested budget for fiscal year 2000 includes funding for two new program elements in the Mars Surveyor Program. As part of the agency's request for five new initiatives in its Space Science Enterprise, NASA Administrator Daniel Goldin on February 1 announced funding for the development of the Mars Network, which would provide a comprehensive network for increased communications capability at Mars, as well as Mars Micromissions, to provide low-cost capability for delivering small payloads to Mars, including telecommunications elements of the Mars Network.

One of the first micromissions is slated to be the Mars Airplane, a fly-over mission scheduled for either 2003 or 2005. The vehicle would provide reconnaissance of sites of possible interest for future scientific exploration, including sample collection sites.

"The responsibilities of the various NASA centers' work on the Mars Airplane are still to be determined," noted Glenn Cunningham, deputy director of the Mars Exploration Directorate at JPL.

Planning for a Mars communications infrastructure has been in the works at JPL since last fall, following the conclusion of a redesign of Mars architecture strategy led by JPL Space and Earth Sciences Program Director Dr. Charles Elachi. Five teams of experts from the international scientific community helped form the new strategy; a team led by Dr. Chad Edwards, manager of the Telecommunications and Mission Operations Directorate (TMOD) Program Office, studied systems for communications, navigation and information transfer to and from Mars.

"The eye-opening thing that emerged from that study was that there are low-cost opportunities to fundamentally change the link between Earth and Mars," Edwards said, "in terms of increasing bandwidth and increasing connectivity."

Current technology allows only a few hours or less each day for communications between a Mars lander and Earth, which would prove constraining for the operations of sample-return missions planned for 2003 and 2005. The amount of data and imagery that could be brought back to Earth is also severely limited, Edwards added.

Enhanced telecommunications capability at Mars could include the development of a constellation of low-cost microsatellites, the first of which would be developed for a 2003 mission. These would provide much more frequent contact and data return as well as navigation determination, much like the Global Positioning System (GPS) satellites do on Earth. The microsatellites would "piggyback" on a commercial Ariane V launch vehicle for a ride into Earth orbit before heading for Mars. The mass of the entire spacecraft at launch, including propellant, would be limited to about 200 kilograms (440 pounds). Edwards said two of these satellites might be launched at every Mars opportunity (about 26 months), with a lifetime of five to six years for each satellite.

Another idea under consideration for the 2005 timeframe and beyond is a further enhanced capability called the Mars Areostationary Relay Satellite (MARSAT), which would provide near-continuous communications between a Mars surface site and Earth. This satellite would orbit over a landing site or other interesting area and would provide video capability back to Earth, Edwards said.

"This quantum leap in communications capability would change the way we do science at Mars, and create new opportunities for how NASA can engage the public in the adventure of Mars exploration," he said.

A "phase A" study--led by Shel Rosell of TMOD's Technology Program Office and sponsored by Johnson Space Center's Space Operations Management Office--is currently under way to refine technical and cost issues.

Rosell said JPL is working with five companies on feasibility studies on the aforementioned low-cost microsatellites, with a request for proposal for their development to follow.

In addition, Rosell said, "We are trying to develop a common spacecraft bus with the Mars Exploration Directorate that would satisfy three requirements: the telecommunications/navigation orbiter, a science orbiter, and a science probe carrier." JPL and industry teams have been working on a common design for the spacecraft, which he said would eventually be beneficial for lower-cost Discovery missions and Earth missions.

Complete details on NASA's fiscal year 2000 budget request are available online at http://www.nasa.gov/budget/budget_index.html.

37TH GODDARD MEMORIAL SYMPOSIUM, "INSPIRATION, ECONOMICS, AND EXPLORATION OF SPACE"
From the AAS home page

March 17-18, 1999
Greenbelt Marriott Hotel, Greenbelt, Maryland

We are in the midst of revolutionary change in our understanding of the universe and utilization of space for development of the human enterprise. In the last few years, discoveries made through the use of advanced space-based telescopes have caused us to reconsider our fundamental understanding of how planets, stars, and galaxies form, and how they're distributed throughout the universe. We are reaching ever deeper into the early stages of the universe and resolving galaxies and planetary systems with higher and higher resolution. This improved understanding is expected to continue to accelerate as we place more instruments with different spectral bands into space and as we plan the next generation of telescopes and instruments.

The impact of Earth-observing programs on society has been just as dramatic. Up-to-the-minute reporting of weather conditions have saved many lives and billions of dollars in emergency services due to early warning of hurricanes, hailstorms, and tornadoes. We are beginning the long-term storage and monitoring of a large array of global environment conditions with the Earth Observing System and its complex of spacecraft and data management systems. Commercial applications are opening up in a wide range of applications, including navigation, agriculture, resource mapping and monitoring. This is due both to the development of improved spacecraft instrumentation and to customization of the processed data in a commercially-influenced marketplace.

The goals of Earth and space sciences intersect across other planetary phenomena, such as better understanding of the conditions for the genesis of sustenance of life and stable atmospheric composition. These advances should help us to validate models of global climate change.

The 37th Goddard Memorial Symposium presents a summary of recent discoveries in the Earth and space sciences, and an overview of current and future program plans. It will provide the participants with an understanding of the goals of the science enterprises and the impact of these enterprises on society. It will examine upcoming areas for improved instrumentation and spacecraft systems. This conference will examine the synergy between the Earth and space sciences, the tools used to improve the science, and commercial application of the science and technology of space systems. This conference presents an excellent opportunity to hear from specialists in the various fields of space sciences and to share ideas with participants who have utilized the technology and science for commercial applications.

For more information, see the American Astronautical Society home page at <http://www.astronautical.org/> or contact AAS.
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SPACELAB ACCOMPLISHMENTS FORUM

By John Emond
NASA release

26 February 1999

Registrations are still being taken for the NASA Office of Life and Microgravity Sciences and Applications (OLMSA) Spacelab Accomplishments Forum to be held at the National Academy of Sciences, 2100 C Street NW (off Constitution Avenue), Washington, DC on March 10 and 11, 1999.

This forum will recognize the history and achievements of the Spacelab series of Shuttle missions from 1981 to 1998 and their role in advancing a broad range of space-based research objectives. In addition to substantial space science and earth science research efforts, Spacelab-based life and microgravity research resulted in over 1,000 refereed articles and over 750 investigations. The Spacelab forum will also celebrate Spacelab's role in the evolution of space-based research towards a permanent presence in space.

The forum will begin March 10 with registration from 7:30 am. The opening address will take place at 9:00 AM. The forum will conclude at approximately 4:00 PM March 11. There will be a reception at the National Academy of Sciences the evening of March 10.

Forum topics will include:

- Building and Operating Spacelab
- Earth Observations
- Space Science
- Life Science
- Microgravity Science
- International Research
- Commercial Research

Hotels in close proximity to the forum are as follows; attendees to make own arrangements:

- Holiday Inn Capitol, 550 C Street SW, refer to Spacelab forum, phone: 202-479-4000.
- State Plaza Hotel, 2117 E Street NW, refer to group #4609, phone: 800-424-2859.

Reservations are accepted at both hotels at the discount rate through Saturday, February 27. After that date, State Plaza Hotel indicates it will accept reservations at the discount rate if rooms remain available.

Forum participants may also make other hotel reservations of their choosing in the Washington area.

The registration fee for the forum is \$25, which includes the Administrator's Reception the evening of March 10 in the Great Hall of the National Academy of Sciences. The registration date has been extended. Please register by close of business Thursday, March 4, 1999. Registrations will still be accepted after that date, but you are highly encouraged to register by March 4. Registration information is provided below.

For more information regarding the forum, please refer to the Spacelab web site at <http://www.hq.nasa.gov/office/olmsa>. You can also contact Mr. John Emond at 202-358-1686 or e-mail at john.emond@hq.nasa.gov.

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(Separate and mail to address below, or make reservations by phone)

REGISTRATION FORM

NAME :

ADDRESS :

ORGANIZATION :

Phone/e-mail

Registration fee of \$25 made payable to WESTOVER CONSULTANTS, INC.

Detach this information and send to:

Antoine Holley

Westover Consultants, Inc.

7833 Walker Drive

Greenbelt, MD 20770

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Payment can also be made by credit card. Include name as it appears on the card, card number and expiration date. A fax number to use is 301-345-4659; confirm by phone first prior to sending fax in order to ensure it is received and acknowledged.

Mr. Holley can be reached at 301-345-3211 and by e-mail at aholley@westover-gb.com

RESEARCH OPPORTUNITIES IN SPACE SCIENCE - 1999
OSS Electronic Notification Service

This NASA Research Announcement (NRA) is a broad agency announcement as specified in FAR 6.102 (d) (2). NRA 99-OSS-NN, entitled "Research Opportunities in Space Science - 1999," will be available on or about January 19, 1999, by opening "Research Opportunities" from the menu on the NASA Office of Space Science (OSS) homepage at www.hq.nasa.gov/office/oss/ on the World Wide Web. This NRA solicits proposals for supporting research, analysis, and technology across a broad range of different space science program elements relevant to the four defined OSS science themes, entitled Astronomical Search for Origins, Solar System Exploration, Structure and Evolution of the Universe, and The Sun-Earth Connection. Proposal due dates are staggered from April 19, through December 30, 1999. An electronically submitted Notice of Intent to propose is requested for all program elements. Participation through this NRA is open to all categories of U.S. and non-U.S. organizations, including educational institutions, industry,

nonprofit institutions, NASA Centers, and other Government agencies. Further information about specific program elements may be obtained from the individual OSS Discipline Scientists listed in this NRA, while questions concerning general NRA policy issues may be directed to Dr. J. David Bohlin, Code SR, Office of Space Science, NASA Headquarters, Washington, DC 20546-0001; E-mail: david.bohlin@hq.nasa.gov; phone: 202/358-0880.

NASA LIFE SCIENCES TASK BOOK
By Jennie Moehlmann
NASA release

24 February 1999

The NASA Life Sciences Program Tasks and Bibliography for FY 1998 (Task Book) is now available online at http://peer1.idi.usra.edu/peer_review/taskbook/taskbook.html

Unlike past years, hard copies of the Task Book will not be available. However, we are currently planning on developing a CD-ROM that will include both the Microgravity and Life Sciences 1998 Task Books scheduled for release later in the year. If you have any further questions, please don't hesitate to contact me.

Jennie Moehlmann (jmoehlma@hq.nasa.gov)

End *Marsbugs* Vol. 6, No. 4