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# PSI NEWSLETTER

Summer 2002 Volume 3, No. 2

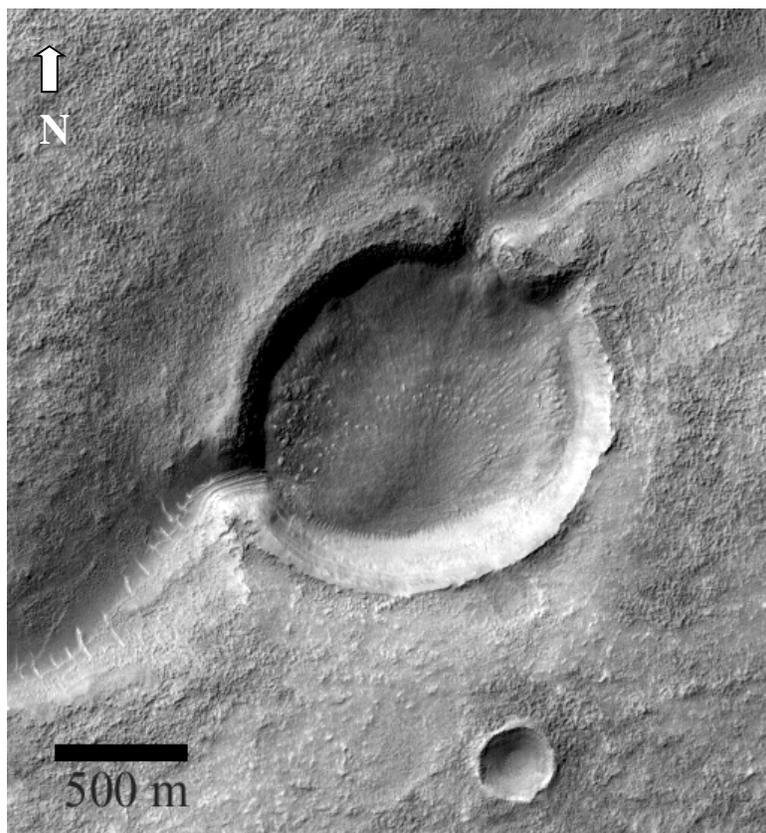
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## THIS ISSUE'S MARS MYSTERY PICTURE

by William K. Hartmann PSI Mars Group



You may have read new reports about the recent great success of NASA's Mars Odyssey mission in detecting large amounts of ice (up to 60% by volume) in the upper meters of soil at high latitudes on Mars (above 60 or 65 degrees latitude). The Odyssey ice search, headed by our colleague Bill Boynton at the University of Arizona in Tucson, has been touted as detection of the massive ground ice deposits long suspected to be the remnants of ancient seas, lakes, and rivers on Mars. However, we are still unclear about the relation of the ice in the top few meters at high latitudes to the hundreds-of-meters-deep ice deposits suspected at modest latitudes.

Evidence for massive amounts of Martian ice includes patterned ground like that seen in Arctic tundra, glacier-like features (shown in a recent issue of our newsletter), and softened terrain that may involve deformation of features by ice flow.

Here is an image from Mars Global Surveyor that dramatically exemplifies the poorly understood process of terrain softening. At the bottom of the image is a small impact crater, about 200 m across with typical sharp rim. This is what a crater "should" look like! In the middle of the image is a kilometer scale crater (comparable to Arizona's bowl-shaped "Meteor Crater" near Winslow). The floor of the crater is flat, as if filled in with sediments. The most striking thing is the crater rim structure. On the SE side the rim is sharp and well preserved, as in a normal crater. But the NW half of the crater is very strange -- the rim has "softened" or "melted" to a peculiar flat profile. Notice that the whole north or NW half of the crater lies in a depressed region with fluffy-textured soil, and a gully cuts diagonally through the crater at the boundary of that terrain. Note the sediment layers exposed where the gully cuts through the SW crater wall.

In short, it looks like the NW half of the crater lies in terrain that might have been flooded by water at one time. Possibly the soils on the NW side of the image, at a scale of 100 m depth, are ice-rich, so that the half of the crater formed in that material has "relaxed" to a flatter profile.

This image is one of the best to contrast the mysterious softening on one half of a crater with the unsoftened appearance on the other. The image is cataloged as M03-01141, in the Noachis uplands of Mars at 354W longitude and 36S latitude.

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## PSI Welcomes Dr. David Crown

David A. Crown is a new member of the PSI research staff. David affiliated with PSI last June from Pittsburgh, where he was on the faculty in the Department of Geology and Planetary Science at the University of Pittsburgh. In early March, David and his family relocated to Tucson and he physically joined PSI's Mars Group as a Senior Scientist. David's research interests are in planetary geology, physical volcanology, and remote sensing. Current research includes use of spacecraft and airborne remote sensing data for geologic analyses of planetary surface features, geologic mapping of Mars and Venus, field investigations of volcanic deposits, and development and application of models for the emplacement of geologic flows.

David received a B.S. in Geology-Physics/Mathematics in 1985 from Brown University, where he assisted Prof. Carle Pieters in research on the spectral characteristics of the lunar surface. In 1991, he received a Ph.D. in Geology from Arizona State University, where he worked with Prof. Ronald Greeley on various projects in planetary volcanology. This work included production of the first global map of Io's geology; investigation of industrial sulfur flows as analogues for potential sulfur flows on Io; geologic mapping, geomorphic analyses and eruption modeling of ancient Martian volcanoes; and remote sensing studies of pyroclastic volcanism in the Central Andes of Bolivia. In 1992 and 1993, David was a National Research Council Research Associate at the Jet Propulsion Laboratory, where he

continued work on Martian volcanism and became involved in analyses of Magellan data of the Venusian surface and corresponding studies of silicic lava domes in the western U.S. (at Long Valley Caldera and Medicine Lake Highland Volcano, both in CA).

From 1994 through early this year, David taught and conducted NASA-sponsored research at the University of Pittsburgh. This research included geologic mapping of selected regions on Mars and Venus as part of the Planetary Geologic Mapping Program, a joint NASA-U.S. Geological Survey effort to produce geologic maps and understand the evolution of planetary surfaces using techniques established in mapping the Earth. In addition to geologic mapping of parts of the ancient crater highlands of Mars, David's studies included analyses of lava flows that developed in association with major volcanic centers on Mars, the development of large outflow channels that dissect terrain adjacent to the 2000-km-diameter Hellas impact basin, and the formation of prominent debris aprons around Martian mountains that may have flowed due to incorporation of ice. David's research on Hawaiian volcanism has included detailed investigations of lava flows produced during the early phases of the ongoing Pu'u O'o eruption at Kilauea Volcano, and remote sensing and field investigations of the pahoehoe flow field produced during the 1969-1974 Mauna Ulu eruption. These studies are intended to provide critical ground truth for interpreting the morphologies and remote sensing signatures of volcanic landforms on other planets.

David's PSI research is currently supported by grants from NASA's Planetary Geology and Geophysics, Mars Data Analysis, and Mars Global Surveyor Data Analysis Programs. He continues to serve as a member of the Geological Mapping Subcommittee of NASA's Cartography and Geologic Mapping Working Group (1996-present, Chair from 1997-1999), and is currently a member of the Board of Trustees of the Adler Planetarium and Astronomy Museum (Chicago, IL). David continues to supervise a group of graduate students at the University of Pittsburgh and is the author of numerous scientific articles and abstracts, as well as U.S.G.S. geologic maps.

We are very pleased to have David join the PSI team.

***Congratulations to PSI graduate students Dr. Kunegunda Belle and Dr. Mark Huber for successfully defending their dissertations and receiving their doctorates in Physics this June from the University of Wyoming.***

***Hoorah!***



## Welcome Aboard, Dr. Pierazzo

Dr. Elisabetta Pierazzo recently joined the PSI research staff from the Lunar and Planetary Science Laboratory (LPL) of the University of Arizona, where she was a Research Associate for the past 4 years. Elisabetta's current research interests include: modeling impact cratering events on the Earth and other planetary bodies of the solar system; studying environmental and climatic effect of large impacts (in particular the Chicxulub event on the Earth), and their role in the origin/evolution of planetary biospheres; investigating how impacts affect water content of planetary and asteroidal regoliths over the age of the solar system.

Elisabetta received a Physics degree (Laurea, a degree in between a B.S and M.S.) at the University of Padua, Italy, in 1988. She spent most of 1989 in the United States through an Italian fellowship, working first in the Accelerator Mass Spectrometry group led by Prof. Roy Middleton at the University of Pennsylvania, and later with Prof. Charles Sonnett at LPL, University of Arizona. In 1990 she held a fellowship from the Italian National Council for Research, working under the supervision of Dr. Andrea Bergamasco, in association with the POEM (Physical Oceanography for the Eastern Mediterranean) international program, in Venice. That same year, she started her graduate career at the Department of Planetary Sciences, University of Arizona, Tucson, where she carried out several impact cratering projects under the supervision of Prof. H. Jay Melosh. She received her Ph.D. in 1997, the same year she received the University of Arizona Gerard P.



Kuiper Memorial Award, given yearly to a graduate student from the Department of Planetary Science in recognition of outstanding research and scholastic capability. She remained at LPL as a research associate, under the supervision of Prof. Melosh from 1998 until February 2002.

Elisabetta's PSI research is currently supported by grants from NASA's Planetary Geology and Geophysics, Exobiology and Origins programs, and from the SETI Institute. She served on the PG&G panel review in 2000 and 2001, and is currently a co-convenor of a workshop on impact modeling to be held in February 2003 at the Lunar and Planetary Institute in Houston. Elisabetta is the author of numerous scientific articles and abstracts, and has been an invited speaker at several international meetings and workshops.

We are very happy to welcome Elisabetta to the research staff at PSI.

## Director's Notes June 2002

Home ownership is the American dream. PSI has long dreamed of having a facility that it can call its own. We have been housed in six different locations in Tucson over the thirty-plus years of our existence, all of which have been leased buildings. Ah, if we had just purchased a building when PSI was founded, we would likely own it free and clear now, thus freeing up thousands of dollars that we currently pay in rent to further the science and educational goals of the Institute. However, ownership was not an option as long as PSI was a division of Science Applications International Inc. — they simply did not allow small field offices to acquire property. Renting was the only option. When PSI merged with SJI, we became masters of our own destiny and could consider acquiring a facility. With the growth in staff in Tucson over the past year, we have been forced to consider a larger facility for the Institute — things have gotten entirely too cozy at 620 N. Sixth Avenue.

Our first choice would be a facility within the historic neighborhood where we are currently located; many buildings are quite attractive and proximate to the University of Arizona. The downside is that properties are expensive and

only infrequently appropriate for PSI. We have attempted to make offers on two occasions for the one building that is both suitable and affordable; unfortunately, more nimble parties with deeper pockets beat us.

Another option is to partner with the International Dark-Sky Association to purchase a 10,000 square-foot building about two miles from our current location. The dream here would be to turn this property into a home for 3-4 compatible non-profit organizations which have different missions but overlapping interests and shared values. This option looks to be financially viable and offers the prospect of owning the building free and clear after 5-7 years. It also allows the option of further growth of PSI if we are successful in attracting new staff to Tucson.

The final decision on a home for PSI has not been made at the time of this writing, but we are traveling a path that offers long-term benefits and a permanent home for the Institute. Hopefully, we can report on successful action in this area in the next newsletter.

Ah, home, sweet home.

Donald R. Davis,  
Director

## Europa Has Right Stuff

From the SETI press release May 21, 2002

Compelling evidence for a liquid water ocean beneath its icy crust makes Jupiter's moon Europa an attractive target for scientists seeking life in distant regions of our solar system. Recent work (Icarus 156, p.120-127, 2002) by Dr. Elisabetta Pierazzo, currently at the Planetary Science Institute, and Dr. Christopher Chyba of the SETI Institute, sheds light on the question of whether enough "biogenic elements," the raw ingredients for life, including carbon, nitrogen, sulfur and phosphorus, could be present to support European life. Because Europa's formation conditions are uncertain, scientists do not know the exact composition of the moon's ocean and overlying ice. Some models suggest a Europa depleted of life-essential carbon and other important biogenic chemicals at birth. Pierazzo and Chyba explored comets as an alternate source for biogenic materials, applying complex modeling methods to set the lower limits for a European inventory. In the May edition of the journal Icarus, Pierazzo and Chyba present a paper that concludes the European inventory to be "substantial."

In their model, Pierazzo and Chyba used typical cometary sizes, densities, and impact velocities throughout Solar System history to calculate how much biogenic material would remain on the moon's surface after impact events. Unlike the more massive Earth, which has a much higher escape velocity and can therefore retain a higher percentage of cometary impact material, Europa has a very low escape velocity, thus losing a significant portion of material from any projectile that hits its surface.

Nevertheless, cometary impacts would provide billions of tons of carbon, and somewhat less nitrogen, sulfur and phosphorus to the surface of Europa. These amounts are significant, and correspond to about 1% of the biomass of prokaryotic life (cells lacking nuclei and believed to be representative of early life) in today's Earth oceans. Knowing that, at a minimum, Europa has enough of the elements needed to sustain a biosphere offers further reason for scientists to feel hopeful about the search for extraterrestrial life within our own solar system.

Note: Articles based on this press release were published in several newspapers including Moscow's Izvestia, The San Francisco Chronicle and in New Scientist.



### YOUR DONATIONS ARE APPRECIATED!

The California Science Education Field Trip Program is in need of a Tesla coil. The students really enjoy the demonstrations in which it is used. If you would like to help, please mail your tax deductible donation directly to:

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THANK YOU!

## Thank You, California Field Trip Volunteers

by Pam Byrd

As the school year comes to a close and we wind down for school's summer break, I want to take a moment to thank the many volunteers and others who have helped to keep this program alive and flourishing. It has been another wonderful year and we are very grateful for all their help. In the next newsletter, we will be hearing from a few of our volunteers and their thoughts on the "Journey through the Solar System" Science Education Field Trip Program. Special thanks go to Dick Kenealy, who is the heart and soul of the program. Without him, we would not be able to provide this much needed avenue for elementary school children to become exposed to the wonders of science. Also, many thanks to both Muriel Gustin and Connie Christensen who volunteer regularly at the Tuesday and Thursday field trips and bring positive energy with them each day. Last, but not least, particular thanks to B.J. Scott, Director of the Camino Real Playhouse, who graciously allows us to rent the facility where the program is held. It is much appreciated and we are looking forward to continuing our program next year at the Playhouse as well.

These field trips provide an excellent opportunity for elementary school children to experience science in a friendly and fun environment and also provide teachers with the knowledge that many grade-appropriate science content standards are being met. Retired teachers, and others, are encouraged to apply for volunteer positions. If interested, please give us a call. Be sure to visit our web site at [www.psi.edu](http://www.psi.edu) and click on the "Education Program" link for more information about the program. Additionally, we are now accepting reservations for the 2002-2003 school year. To reserve a field trip date, please email us at [educator@psi.edu](mailto:educator@psi.edu) or call (949) 582-2727.

*Press Release  
April 23, 2002*

## **PSI Astronomer Honored With European Medal**

William K. Hartmann, of Tucson's Planetary Science Institute, is being honored this week with a medal from a European scientific society, for his work on planetary evolution. The European Geophysical Society is giving its Runcorn-Florensky Medal jointly to Hartmann and a German researcher, Gerhard Neukum, for their work on the impact cratering of planets by asteroids and meteorites. This is the third award of the medal. "I'm especially pleased at the internationalism of it," said Hartmann. "It's a medal named for a Brit and a Russian, awarded by a European society to an American and a German. In a year when the world seems to be flying apart, it's great to point out the benefits on international colleagues working together."

The medal particularly recognizes recent work by Hartmann and Neukum that uses numbers of accumulated impact craters on Martian lava flows and volcanoes to estimate their age. The result shows that some lava flows on Mars are probably less than 50 million years old. "This sounds like a long time to most people," Hartmann said, "but geologically it is very young. That's exciting, because it means volcanism has been active on Mars in the last one percent of the planet's history, which in turn means there may be heat sources on modern Mars, and geothermal areas, and maybe a chance to find habitats where we can find out if Martian microbes exist. It all ties into NASA's exploration strategy."

Hartmann also remarked that the award shows that Tucson continues to be an international leader in astronomical research.

Hartmann obtained his M.S. and Ph.D. degrees in geology and astronomy, respectively, from the University of Arizona and has been a resident of Tucson since the 1960s. He and Planetary Science Institute director, Donald R. Davis, pioneered the modern theory of the origin of the moon. Hartmann was honored last year with election as a Fellow of the American Association for the Advancement of Science, and has an asteroid named after him. He is also a writer, and his second novel, *Cities of Gold*, about the history of the Southwest, is due for publication this fall.



*Medal from European Geophysical Society awarded Dr. William Hartmann in Nice, France*

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### *Shibboleth*

To candidates hoping for Ph.D.s:

Better brush up on irregularities.

To get your degree,

You must spell "syzygy"

And correctly pronounce "ephemerides".

Anne Raugh, 2002

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