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# PSI NEWSLETTER

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## We've Got 12 Wheels on Martian Dirt! *by Catherine Weitz*

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January was the most amazing month of my life! Both Spirit and Opportunity rovers successfully landed on Mars and are now making scientific measurements of the surface. I was with the science team in the science operations room at the Jet Propulsion

Laboratory in Pasadena during the Spirit landing on January 3. What a thrill ride it was! After hearing the initial tones at 8:35p.m. indicating that Spirit was safely on the surface of Mars, the room erupted

in applause and hugs; we certainly had *our* spirits lifted by this historic landing of Spirit.

Later, I was in the Mission Support Area (MSA) to see the first images come down from Spirit only a few hours after landing. We all cheered as we saw those initial images showing many small rocks around the lander and evidence for dark bounce marks in the nearby soil. Since the landing, we have driven the rover off the lander, studied the soil with several instruments, and are now doing detailed analyses of a rock. Although we have experienced some recent difficulties with Spirit due to memory problems, Spirit is now on the mend and has begun to conduct more scientific studies.

On January 24, Opportunity made her successful landing at Meridiani Planum. This time, I watched the landing from the mission operations area where all the engineers were monitoring the entry, descent, and landing. It was thrilling to be in the same room with all the engineers who had made the landings so successful. Right after the landing, Governor Schwarzenegger and former Vice President Al Gore came into the room to congratulate the engineers.

The first images took a few hours longer to be sent back from Opportunity than from Spirit, but when they arrived we were overjoyed with what we saw—the first bedrock ever seen on Mars! It also turns out that we hit a hole-in-one and managed to

land in one of the few impact craters at Meridiani Planum. Beat that, Tiger Woods! We just got Opportunity off the lander and will soon strike out towards the outcrop to do some detailed analyses to understand if the layering we see in the outcrop could have formed by water, volcanism,

wind, or some other process. Stay tuned because we have some exciting weeks ahead of us!

*Dr. Weitz is the Mars Exploration Rover Scientist at NASA Headquarters and is working there courtesy of a Cooperative Agreement between PSI and NASA.*



*NASA scored a hole-in-one, landing the Opportunity rover in this impact crater at Meridiani Planum. This serene photo shows a Martian outcrop of layered bedding which will be key to exploring the water history on Mars.*

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## This Issue's Mars Photo: Lavas, Craters and Aging

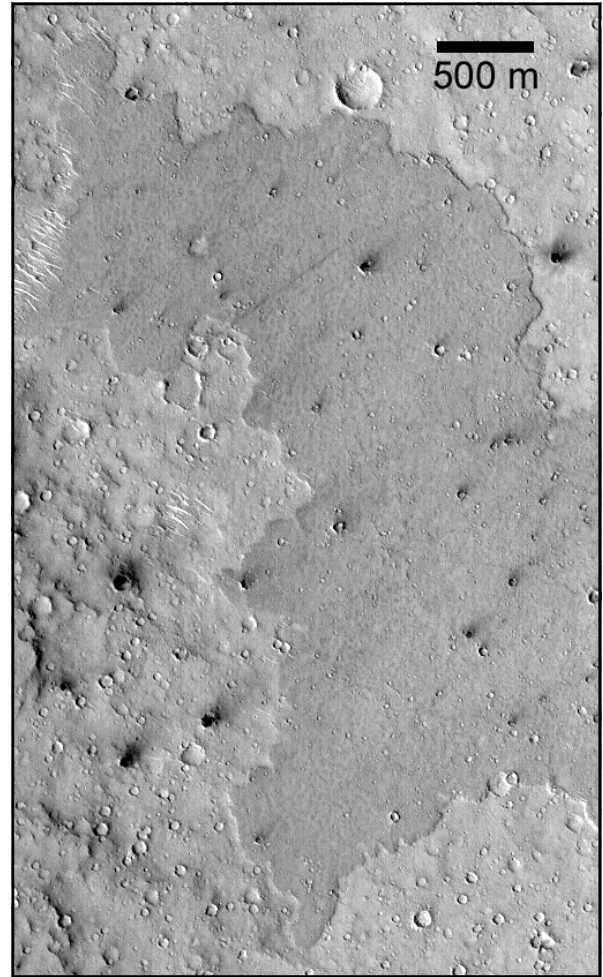
by William K. Hartmann

This image from Mars Global Surveyor shows a beautiful example of a young lava flow on an older cratered background, and at the same time gives a dramatic example of how aging processes affect craters on Mars. The image shows part of the volcanic plain of Elysium Planitia, where PSI Research Associate Dan Berman and I have dated very young lava flows with virtually no superimposed impact craters. Such flows have ages probably less than 20 million years. In this image, we see a great example of superposition of features representing different ages and timescales. First, there was an old background surface with many impact craters. Second, a smooth young lava flow, slightly darker in color, crossed the central area like a spill of molasses. Because the flow has distinctly fewer craters than the background, we know it is considerably younger than the background. Third, the area was peppered with small, sharp craters that are very dark in color, like little ink spots on the image. These were probably ordinary impacts, but the craters are black because they expose dark, fresh lava inside each crater-pit.

The relationship between the lava and the black craters illuminates a geological process of modification and aging among the craters. You can faintly see that prevailing winds have blown dark dust out of these craters, producing diffuse "wind tails" toward the NE, and this shows that fresh, dark, loose lava dust can be lifted out of the crater bowls by the wind. (A dark SW-NE streak in the upper center is the track of a dust devil that also moved to the NE, as we can infer from other Martian images.) However, we also see that the black craters have different degrees of blackness. They fade, because the fresh black material gradually gets covered by the all-pervading, light-toned Martian dust, which blows around in the atmosphere and settles out on all surfaces. Thus, a fresh black impact site gradually gets mantled and fades into the background.

This image allows us to address the timescales of fading. On the old surfaces black craters are only a few percent of the total crater population, meaning that the time needed to blanket the black craters is only a few percent of the age of that surface. In the same way, the black craters are perhaps half of the population on the lava flow, meaning that the duration of the aging process is about half the age of that flow.

More quantitative studies of such images will give us an idea of the actual timescales for these processes, measured in years, which in turn will give us quantitative estimates of the rate of dust transport and deposition on Mars.



*Mars Global Surveyor telephoto image shows a molasses-like lava flow on the Martian plain of Elysium Planitia. Latitude 14N, longitude 200W, MGS image M07-01051. (North is at the top of the image.)*

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### Fair Warning

The occasion does seem to demand it,  
 So I'll be, if I may, rather candid:  
 That bouncing you heard  
 Was a robotic nerd.  
 Look out, Mars,  
 the Earthlings have landed!

Anne Raugh, 2004

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## PSI Lures Dr. Bourke from Oxford

Dr. Mary Bourke has recently joined us from the University of Oxford, England, where she lectured in the School of Geography and the Environment.



She is a geomorphologist with specialist experience in desert regions on Earth.

Following the completion of her undergraduate and masters degrees, at University College Dublin (UCD), Mary shared

her time between mapping drumlins (glacial landforms) on the west coast of her native Ireland for the Geological Survey, and lecturing at night to Geography candidates at UCD. Drumlin (meaning "little hill") is one of the Gaelic terms (also esker) that Irish geomorphologists have contributed to international geological nomenclature.

Tempted by the antipodes, Mary accepted the Australian-European Fellowship and headed for Australia, to the University at Wollongong (80 km south of Sydney). During that year, she was exposed to a very different type of geomorphology. She assisted in an excavation of a 30,000-year-old aboriginal archaeological sites (which included mouse spiders — similar to tarantulas), tasted the acrid and bitter yangona drink while respectfully crouched on a floor in a chief's hut in Fiji, and discovered the difficulty of extracting fine-grained sediment from

## A Not-So-Merry Christmas

by Frank Chuang

In the early morning of December 22, 2003, the home phone of PSI office manager Elaine Owens rang with unpleasant news: the Young Alarm company called to report that the motion detector in our new building had been triggered and police were already on their way to investigate. The break-in occurred at 4:45 am, and, when police arrived, they found the glass door to our Planetary Geosciences Laboratory shattered. Thieves had broken the glass door by throwing a rock and stolen two of our newly-purchased Mars lab computers. Yet, it could have been worse; probably due to the alarm system the thieves did not steal any additional computers—there were free-standing laptops sitting untouched in people's offices—or a very nice Polaroid slide scanner. Of course, I am not trying to make light of this incident; it was serious, and it prompted a wake-up call for our institute to take greater security measures. However, all of us realized that the thieves could have taken much more and that we were quite fortunate.

Even though the mood was somber that morning, work carried on as usual (after a lengthy clean-up.) The glass in the door was replaced that very day (albeit at a very high cost!) and PSI's

the ears following sandstorms in the Simpson Desert, Australia. She also spent time investigating the concept of braided river floodplains in New Zealand. Following these experiences, Mary signed up for a Ph.D. at the Australian National University where she investigated the sedimentology of desert rivers and the timing and geomorphology of catastrophic floods that occurred 15,000 years ago. The research was interrupted by laboratory fires and, ironically, modern desert floods, but was completed in 1998. Following this, she made the not-so-large leap from Australian research to Martian research, during her post-doctorate fellowship at the Centre of Earth and Planetary Studies at the Smithsonian Institution, Washington, DC.

Mary has been funded by NASA to investigate the attributes of catastrophic flood channels on Mars. Another NASA project tasks her to assess how rivers, once abandoned by water and sculpted by wind, may appear today on Mars. She has recently heard the good news that a proposal on Martian sand dunes has been funded for the next three years. She has published articles on fluvial landforms, debris flows, and sand dunes. While at PSI, Mary will continue to work with colleagues at the Smithsonian and at Oxford where she currently holds a Senior Research Associate position. She will continue to develop research projects on fluvial and aeolian systems on Mars in collaboration with scientists here at PSI and at the Lunar and Planetary Lab, University of Arizona, Tucson. She is initiating two new research directions: rock breakdown processes on Mars and instrument development for landers and rovers. She intends to continue ongoing field research in Australia, Namibia and Washington, DC and will initiate new field studies in Antarctica, Iceland and Chile.

PSI welcomes Dr. Bourke and looks forward to a long and interesting association with her.

insurance company assessed our losses and processed our claim. We have purchased two new computers and both machines are in the lab again. Now, at least the physical parts are restored. However, I took the biggest blow as a few months worth of my data were stolen with the computers. The bad news was that the data were not backed up; the good news was that none of the data were irrecoverable, I just needed to regenerate what was lost. So, what I really lost was time. Ironically, I had ordered a backup disk the week before the break-in occurred and it arrived a week after the break-in. Bad timing indeed. But, I am happy to report that about 80% of my data has been restored, as of this writing. Full restoration should occur in the next few weeks.

Because of our incident, and a few smaller incidents in our complex, the property owners have installed floodlights in the rear parking lot, adding security patrols on nights and weekends, and are planning to add security cameras around the complex. At PSI, we have increased our own security by upgrading our in-house backup system, implementing a set schedule for backing up and taking copies of our backed-up data off-site on a regular basis, making individual offices less visible from the outside, safely storing important documents, and considering replacement of the glass doors with solid doors. We have all learned a lesson and we hope that 2004 will be a peaceful one!

## Director's Notes: In with the New, Out with the Old.

"Talent and perseverance cannot be denied" – PSI motto, circa mid-1970s.

"We can't believe that we are still here", a wag comments on the attitude of PSI staff at our 25<sup>th</sup> anniversary party in 1997.

PSI welcomes a new Director, Dr. Mark Sykes, who will take over 1 May 2004. This event is a pivotal one for the Institute, reflecting a new generation of leadership to direct the new generation of scientists who have joined PSI in recent years. As Hartmann and Davis — the last two of the original five scientists who founded PSI in 1972 — move into emeritus status in 2004, it is worthwhile to reflect on the history of PSI and the principles upon which it was built.

PSI was founded as an organization devoted to fostering an environment in which creative scientists could pursue excellence in their chosen field with a minimum of bureaucratic distraction; in short, an institute run by scientists for the benefit of scientists. Consensus was the operative management principle and transparency of operations and decision-making were key tenets of the organization.

PSI has operated under a variety of corporate umbrellas. It was founded as part of a large, non-profit research organization, the Illinois Institute of Technology, then migrated to a for-profit company, Science Applications International Corporation (SAIC), for 25 years, and finally into its current status as an independent, non-profit research and education institute. Throughout all of these corporate changes, though, PSI has retained its founding principles; in fact, the main reason for leaving SAIC was that we could no longer function as a basic research institute under that

increasingly demanding corporate umbrella. Frightening though it seemed at the time, the staff agreed that leaving was the only real option if we wished to maintain the goals and environment of PSI.

The first few years after leaving SAIC were tough ones. Funding was exceedingly tight, staff departed, and the future of the organization was in jeopardy. However, PSI staff and the Board of Trustees worked hard to attract new scientists. Also, PSI adopted a business model which encouraged off-site scientists to join us. We have always been a distributed organization, so it was a natural extension to be able to add scientists to our staff who were, for one reason or another, geographically constrained. Over the past five years we have grown to the point where we have staff members all across the U.S., from Boston and Washington, DC to Arizona, California and Washington state.

PSI is looking to 2004 to be our best year ever. We have 17 Principal Investigator level scientists on our staff. We are looking at revenues of approximately \$3M this year. We are finalizing the purchase of our office complex in Tucson, the first real property the Institute has acquired in its history. And, we have a talented and motivated scientific staff, many of whom are young or mid-career scientists, who can continue the growth of the Institute under its new leadership in the coming years.

I would like to express my deepest appreciation to the many colleagues and co-workers who have contributed to building the PSI of today. Through good times and bad, the steadfast support of the people of PSI have been a constant source of strength and motivation. I will miss you.

Don Davis  
Director of PSI, 1978-2004

## New Printing of PSI Mars Book

PSI's Mars book, **A TRAVELER'S GUIDE TO MARS**, by Bill Hartmann, was done partly as an experiment to raise some funds for our non-profit institute. As noted in the book, 25% of royalties will go to PSI and will probably be used to support our building purchase. The progress report is gratifying: The first printing of 30,000 copies sold out last summer when Mars was close.

A first contribution to PSI came out of the advance money and was used to support staff assistants who helped with much of the image processing. The amount of the advance was calculated on the sale of the first printing, so new money should start to appear if additional copies are sold.

The good news is that a second printing of 11,000 was done — and is now nearly gone — and a third printing of 7500 copies has been ordered. That means 48,500 copies are in print, and we hope for an additional contribution of several thousand dollars to PSI from royalties, as well as positive exposure for our Institute and our work.

Contact PSI if you would like a personalized copy of Dr. Hartmann's **A TRAVELER'S GUIDE TO MARS** (\$18.95), a beautiful book with hundreds of colorful photos, and a great way to support PSI!

## Photo Gallery: PSI's Anniversary Party



*At our 33rd Annual Anniversary party, PSI Board members Carolyn Shoemaker (left) and David Levy (center) chat with David Kring from LPL (right). In the rear are PSI Board members Brent Archinal and John Mason.*

*Our Director Don Davis (left) and Mike Drake, Director of the University of Arizona's Lunar and Planetary Lab, enjoy the PSI anniversary party in February.*



*Bill Hartmann (left) shows Floyd Herbert, from LPL, the art gallery at PSI.*

## PSI Welcomes Rose Early...



In October, Rose Early joined PSI as a research assistant to Dr. Mark Sykes, our new Associate Director (see profile of Dr. Sykes in last issue). Rose graduated from the University of Arizona in May 2003 with a Bachelor of Science degree in Computer Science.

During college, she worked as a research assistant for the Milster Research Group in the Optical Sciences Department, maintain-

ing and expanding an optical system simulation program, written in Matlab (a mathematical tool), called Optiscan. She presented a talk on Optiscan at the Opto-Southwest conference in Tucson.

Rose's current project is creating a tool that will allow astronomers to clean up their FITS images (Flexible Image Transport System: a file format that stores images with a table of information describing them) in preparation for archiving in NASA's Planetary Data System (PDS). The tool includes an Oracle Database, a Java application, and a web application written in Java Server Pages (JSP). After the FITS tool is complete she and David Tarico will work on developing an interface to the Small Bodies Data Base, a new and improved version of the old Steward Observatory Asteroid Relational Database (SOARD). The new interface will allow users to make complicated queries of the data in the PDS Small Bodies Node.

Welcome aboard, Rose!

## Friends of PSI

The *Friends of PSI* are people like you — folks interested in the excitement and knowledge brought about by astronomy and planetary science. The scientists at the Planetary Science Institute pursue fundamental research in planetary science, geology, and astronomy. PSI is also involved in many educational activities including school field trip programs, popular articles and lectures, research internships for undergraduates, and training and mentoring young researchers at the graduate and postdoctoral levels.

*Friends* receive a quarterly newsletter detailing the activities of PSI's science and education programs. Additionally, the newsletter contains new scientific discoveries at PSI, as well as features on PSI scientists and their activities.

So join us today with your yearly membership contribution, or become a supporting or sustaining member by joining at one of the tax-deductible categories listed below.

## ...and David Tarico

David Tarico also joined PSI as a research assistant to Dr. Mark Sykes in October 2003. Although he grew up in Phoenix, he wisely decided to move to Tucson to attend college and recently graduated from the University of Arizona (May 2003) with a Bachelor of Science degree in computer science. While David is in the process of making the transition from the University of Arizona to PSI along with Mark, he is currently an employee of both institutions.

David has been working for a year and a half on the On-Line Archiving Facility (OLAF); first, part-time as a student and then, full-time after graduation. OLAF is a website that aids astronomers in submitting their data to the Planetary Data System. It has been in development for the last three years and is nearly finished. Besides



Mark, he works closely with Rose Early and will be part of an upcoming database project for the Small Bodies Node that will be hosted at PSI in May, 2004.

Welcome to PSI, David!

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- **Asteroid Member** (\$200): All of the above plus your choice of one of the following: A multicolor print of a W. K. Hartmann original painting, or a signed copy of *A Traveler's Guide to Mars*, Bill Hartmann's beautiful and fascinating overview of modern Mars research, illustrated by detailed photographs from the Mars Global Surveyor mission.
- **Planet Member** (\$750): All of the above plus an exclusive invitation to an annual private dinner and highlights of astronomy talk with Institute scientists.
- **Star Member** (\$5,000): All of the above plus an invitation to a night of observing at the Skywatcher's Inn, hosted by PSI scientists. This outing includes naked eye and telescopic viewing of the night sky, at a prime dark-sky observatory near Benson, AZ.
- Or you can become a **Supporting Member** (\$10,000 or more) or a **Sustaining Member** (\$20,000 or more) and receive all of the above as well as provide additional funds to be used by PSI scientists in research and educational activities.

To make a tax-deductible donation, please complete the form on page 6 and send to the Tucson office.

*Thank you!*

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