PLANETARY SCIENCE INSTITUTE

NEWSLETTER

WINTER 2008 Vol. 9, No. 4

Est. 1972 www.psi.edu

Martian Fieldwork in Namibia

This September, PSI Research Scientist Mary Bourke and her colleague, Professor Heather Viles from the University of Oxford, returned to Namibia, Africa, to begin a new project funded by NASA's Planetary Geology and Geophysics program. Here is an interview with Mary Bourke conducted by PSI's Chris Holmberg:

Giraffe on a wildlife concession in Namibia, photographed by PSI Scientist Mary Bourke.

What are the objectives of your work?

To unfold the secrets that rocks hold. Let me explain. The surfaces of rocks have the potential to reveal their transport history. Rocks that have been subjected to sand blasting in deserts have surface features and shapes that are different to those on rocks that have been transported by rivers. Our objectives are to identify the features on rocks that are typical of certain processes (e.g., breakdown caused by the growth of salt crystals in cracks) and to explore the persistence of these features when conditions change.

Why did you choose this particular location for your fieldwork?

The Mars Exploration Rovers have shown us that some of the soils on Mars are salty. Salt, particularly when combined with moisture, is a very aggressive agent of rock breakdown. In addition, we have known since the Viking Lander missions back in the late 1970s and early 1980s that the rocks on Mars are effectively worn away by sand blasting. So we wanted a location on Earth that would give us those natural conditions for our experiments. We chose Namibia because it is dry, windy, salty and has a rock type, Etendeka basalts, similar to Martian rocks.

What are some of your experiments?

One of the purposes of the field trip was to deploy gypsum rock prototypes and simple basalt cubes into the desert for a period of two years (initially). We will monitor how they change over time. We used rock prototypes for two reasons. First ,we needed a soft material that would change in the geologically short time period we have to run these experiments, so we used one of the softest rock types, gypsum. Second, we are interested in a specific group of rock features that are similar to those we see on Mars.

We designed our rocks using computer models. On some of the rocks we have features that are typical of wind abrasion (grooves) on others we have fractures, finger projections, pits and hollows. We then printed each of these computer models using a technique know as rapid prototype printing which uses a gypsum powder and a binding agent. Once printed, we

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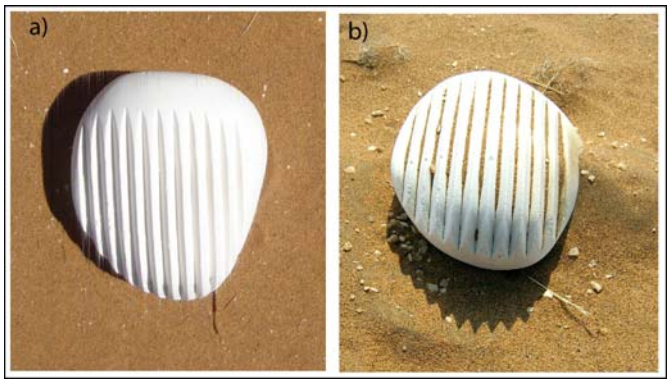
Martian Fieldwork in Namibia *(Continued)*

scanned the rocks using laser technology. This will allow us to detect change at the sub-millimeter scale. Our prototypes were printed at the University of Arizona and the models and scans were done by collaborators at Western Mapping, here in Tucson.

Where did you deploy your samples?

Our first site is at the Gobabeb research station nestled in the linear dunes of the Namib Sand Sea. Here we found abundant sand, very fast easterly winds (known as the Berg winds), and a research facility that would provide logistical assistance. As a bonus, we were able to place our samples in an old experimental plot that is protected by wire fencing. This was important because we didn't want curious wildlife—Oryx, Springbok, and even some feral donkeys—accidentally disturbing our samples. Each month, Hiskia Mbura, a senior research technician at the Gobabeb station, will visit our sample plot and take photographs so that we will have a visual record of changes to our samples. Already, there is evidence of sand and small pebbles blasting our samples (below).



Gypsum prototypes in the Namib desert. a) September 2008. b) October 2008. Note the coarse sand and small gravel located around and on top of the prototype.

Our second site is riskier. We selected a location near the coast that has very salty soils. The samples are not protected from wildlife or the locals. My collaborator, Heather, has lost some samples due to vandalism in the past so we have our fingers crossed that we placed our samples in a location that few people will discover.

Did you encounter any difficulties during the fieldwork?

My baggage was lost. I was less concerned about my personal luggage than the loss of the samples we were to deploy. It was a worrisome three days. Eventually they turned up, but they were damaged by the TSA during the security check. TSA had opened the protective Pelican case that contained our well-packed prototypes, but failed to repack them as carefully. However, fieldwork is always logistically challenging and after a couple of decades you develop strategies to deal with whatever you encounter.

Another challenge we had was the unreliable fuel supply. Although we had a long-range tank, we ran into two situations: In Terrace Bay, on the northern Namibian coast, we found that the petrol station fuel pump was broken so they couldn't dispense fuel (they fixed it the next day). At another site, they had run out of unleaded fuel, but we used leaded on the advice of the 4WD rental company. These places are so remote that if you are unwise or unlucky you can get into a whole lot of trouble very quickly.

Did you have any encounters with dangerous animals?

Luckily no, we did not cross paths with any wild cats or poisonous snakes. If we did see any we were usually in our vehicle.

Perhaps the most dangerous animals we came across in Namibia were the tourist drivers. As we crossed the Gammsberg Pass, a very beautiful yet treacherously sinuous dirt road, we came upon someone who had driven their vehicle off the road, apparently the steering had seized. He was walking to the top of the range (no hat, no water) to get a cell phone signal. Once we had ascertained that he had no injuries (and no need for water!) we took him back to the highest part of the pass and we all tried to contact the outside world. Neither his cell phone nor our satellite phone got a signal (hmmm)! Eventually, he succeeded. Later as we drove past his vehicle, still listing in a deep culvert on the mountain-side of the pass, we remarked on how lucky he was: one bend before or after his landing spot and he would have plunged several hundred meters to a certain death. I drove at a snail's pace for the remainder of that day.

What were the highlights of the expedition?

From a nerdy geomorphologist's perspective, one highlight was just how dramatic desert landscapes can be. Many think of deserts as places where things happen slowly. But in Namibia, there are locations where things have a dramatic way of changing. One example is a location where the rivers are dammed by migrating sand dunes that block their flow. Eventually the flows become so high that the rivers catastrophically burst through the sand dunes, scouring new channels and destroying the dunes in their path. These events are infrequent because the Namib Desert is hyperarid with infrequent rain. One process that is more active is the migration of sand dunes themselves. These can be a road hazard in many locations. We did some work at a major, if remote, intersection—the only route west out of the Skeleton Coast National Park—where I was able to determine that the dune had moved 55 meters since June 2003 – a rate of 10 meters per year.

And, being a woman from Ireland, each encounter with wildlife was a highlight. Once, as we were driving through the wildlife concession to one of our field sites, we came across three giraffes having lunch. So as not to startle them, we parked the 4WD and had our lunch. On a second memorable occasion, I looked up from taking measurements of basalt rocks in the Uniab River to see two zebras looking at me from the opposite hillside. I am used to kangaroos and dingos from my fieldwork in Australia, but this was very different. Finally, during our stay at the Palmweg Lodge, an elephant wandered through one night, to munch on the plants in the courtyard. We watched from a safe distance as he ripped up the long grasses and scratched his rear end on the surrounding thatched hut roofs.

Did the trip give you any ideas for future research projects?

Lots! That's what is so interesting about Namibia. It is an ancient landscape with a lot of the same processes operating there as we see on Mars. We saw at least three great student projects and have begun thinking about the next major phase of our research collaboration.

What were the people of Namibia like?

Absolutely wonderful. They were very interested in our project and were amazed at the pictures of rocks on Mars and remarked

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Cyrena Goodrich is Latest PSI Newcomer

Cyrena Goodrich joined PSI as a Senior Scientist in October, 2008, and is an off-site employee working from her home on 12 acres of beautiful woodland in Chester, Vermont.

Cyrena and her niece Lexi; one of her 11 nieces and nephews.

Cyrena is a meteoriticist/ cosmochemist, working primarily on igneous (achondritic) meteorites. She brings with her a grant from the NASA Cosmochemistry program to study ureilites, the second largest group of achondrites ("Thermal Evolution, Aqueous Alteration and Differentiation of the Ureilite Parent Body"). She also works on Martian meteorites, and is hoping to break into the Mars Fundamental Research Program (soliciting the advice of other PSI "martians").

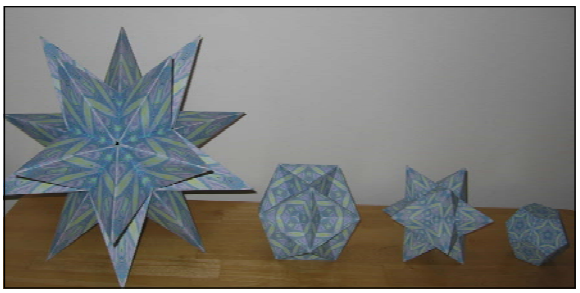
Cyrena grew up in Chester, and left to attend Cornell University. In 1977, she received her B.A. in Russian Language and Literature (after a brief flirtation with a possible major in Foreign Relations), and then went to work in Ithaca, as a bicycle mechanic. A year later, she decided to go to graduate school in Geology (it's an implausible story, really). Her interests quickly settled on igneous petrology/mineralogy, and she wrote her dissertation, under the direction of Dr. John (Jack) Bird, on the petrogenesis of native iron-carbon alloys from Disko Island, Greenland (yes, she went to Greenland and it is one of the most beautiful places on Earth). Thus, beginning her obsession with "weird" rocks.

Cyrena's enviable view, in Vermont.

The Disko island basalts (associated with opening of the Davis Strait between Greenland and Baffin Island) erupted through a thick sequence of carbonaceous shales, and assimilated large amounts of carbon. The carbon resulted in chemical reduction and formation of not only metallic iron (similar to steel and white cast iron), but also a suite of unusual minerals very similar to those found in lunar basalts. Thus, in 1983 she received her Ph.D. from the Cornell Department of Geology knowing next to nothing about normal earth rocks. This certainly helped in getting her first postdoctoral appointment, at the Institute of Meteoritics in Albuquerque, NM, where she was promptly put to work on lunar meteorites. In 1984, she met the second Jack B. in her life, Dr. John Berkley, and was introduced to ureilites, which are certainly the weirdest carbon-bearing igneous rocks off the Earth. She's been working on them ever since.

From Albuquerque she moved to Tucson and worked for almost eight years as a postdoc for Dr. Michael Drake at the Lunar and Planetary Laboratory, University of Arizona, spending about half of that time in the Department of Geosciences doing Sm-Nd and Rb-Sr isotopic dating of ureilites in the laboratory of Dr. Jonathan Patchett. Subsequent research positions took her to Scripps Institution of Oceanography, Max Planck Institute für Chemie (Mainz), and Hawaii Institute of Geophysics and Planetology. Since 2003 she has been an Assistant Professor at City University of New York, in Brooklyn, finally landing relatively close to home. She is still transitioning from Brooklyn, and looks forward to next June when the commuting (and noise) will end.

Cyrena is an Associate Editor for the journal Meteoritics and Planetary Science, and Asteroid 6762 was named in her honor. When not working on meteorites, she enjoys gardening, home maintenance, walking in the woods, and a variety of arts and crafts hobbies. In particular, check out some of her mathematical origami constructions (below).



Cyrena's mathematical origami showing scaled stellations of the dodecahdron. She designs the paper to highlight the symmetry of each object.

Cyrena will be visiting Tucson several times a year to touch base with PSI scientists and to use the electron microprobe facilities at the Lunar and Planetary Laboratory. She is looking forward to meeting all of her new colleagues, and hopes to find ways to collaborate.

We are delighted to welcome Cyrena to PSI!

PSI Scientists Attend DPS

In October, four PSI scientists, l-r, Dave O'Brien (AZ), Jeff Morgenthaler (ME), Beatrice Mueller (AZ) and Nalin Samarasinha (AZ) attending the 40th annual meeting of the Division for Planetary Sciences of the American Astronomical Society in Ithaca, NY, got together for dinner at the famous Moosewood Restaurant.

Hurricane Ike Affects PSI Off-site Scientist

by Paul Abell

On September 11, as Hurricane Ike headed toward the Houston/ Galveston area, offsite PSI Research Scientist Paul Abell and his wife Amy left their Houston home when a mandatory evacuation notice was issued for their zip code. Here is his report:

After boarding up our house, we left in two cars, merging onto the jammed roads for a brutal ten-hour trip to North Richmond Hills, a drive that normally takes only four and a half hours. Fortunately, we have some very good friends who allowed us (again) to bring all seven (!) of our cats. This evacuation was less stressful than the one for Hurricane Rita (September 2005) during the drive up, but more stressful waiting and watching the news. Unlike Rita, which veered off and missed the Houston area, we knew that Ike was going to hit us.

The initial reports were pretty grim. We watched Galveston start to flood and burn well before the storm even hit. With projected storm surges of 22 feet, we knew that much of Houston and Galveston could be devastated. Luckily, the storm surge was less than predicted, only 13 feet, but the wind damage was significant. Many areas lost power. Galveston and the Bolivar peninsula took the brunt of the storm, with two small communities, Gilchrist and Crystal Beach, getting wiped off the map.

Many trees were downed by the hurricane.

From our neighbors who had not evacuated we learned that our house was fine, but that there was no power. This was a great relief as we had heard of other homes that had significant damage; in fact, some people lost everything. Also, in the Houston area, gasoline was almost impossible to find and curfews had been put in place to discourage looting. We stayed with our friends until September 17th, and headed back to Houston when the power had been restored.

At home, we removed the boards and surveyed the damage, finding only minimal harm to the house. We did lose all of our fence and a few shingles from the roof, but no significant water came into the house. And while we did get lots of debris in the yard, we did not lose any of our trees. However, in our subdivision and the Houston area many, many trees were lost. But we are all home and okay, and the cats are still wondering what all the fuss was about as they catch sunbeams and watch squirrels.

Debris from Hurricane Ike in Paul Abell's neighborhood .

Three months later.

Although many people are still homeless in Hurricane Ike's aftermath, Paul reports that his neighborhood is okay — power is fully restored, 95% of the debris has been removed, and they are in the repair-and-rebuild phase.

Hartmann on NPR's *Science Friday* Radio Broadcast *by Ed Stiles*

PSI Senior Scientist Bill Hartmann was one of three panelists talking with National Public Radio host Ira Flatow on NPR's *Talk of the Nation® Science Friday*, September 17, 2008. The program focused on Mars exploration and was broadcast live from the University of Arizona's Phoenix Science Operations Center, in Tucson.

On the "Science Friday" panel, from left, Bill Hartmann, Alfred McEwen and Peter Smith; host/moderator Ira Flatow is at far right.

UA Professors Peter Smith, Principal Investigator for NASA's Phoenix Lander Mission, and Alfred McEwen, Principal Investigator for the HiRISE camera that is flying aboard NASA's Mars Reconnaissance Orbiter spacecraft, joined Hartmann in fielding questions from callers regarding current exploration efforts on and around the Red Planet. Steven Squyres, Cornell University, was also on the panel via phone.

Bill Hartmann is an internationally known scientist, writer, and painter. His research involves cratering studies on Mars and other bodies in our solar system as well as research on the origin and evolution of planets and planetary surfaces. He has written several textbooks, popular nonfiction books and novels, including the science fiction novel *Mars Underground*.

In September, Ira Flatow, host of NPR's science call-in program, broadcast the show from Tucson.

His paintings of astronomical themes have appeared in books, magazines, and exhibits, and he has twice had paintings commissioned by the NASA Fine Arts Program.

This episode of *Science Friday* gave listeners around the world a chance to learn more about the Mars missions that are making headlines and an opportunity to have their questions answered by researchers who are directly involved in Mars exploration.

Talk of the Nation® Science Friday reaches over 3 million listeners a week on more than 200 NPR member stations.

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on how similar they seemed to many of the rocks in Namibia. Most of the people we met had come from remote tribes: Topnaar Hottentots, Herero, and Himba. They seemed to love their jobs but missed their families. They were always on the verge of a shy smile, which invariably appeared with very little prompting.

How long did it take to get there?

Too long! From Tucson, I flew to Atlanta and from there caught the flight to Johannesburg, South Africa. Although the plane stopped for fuel and supplies in Dakar, we didn't disembark, making the total flight time 19 hours – the longest I have been on a plane in one go. I then had to overnight in Johannesburg to catch a 6:00 a.m. flight to Windhoek, Namibia. A long, long trip but definitely worth it. □

PSI Meets Jim Head's Twin Boys

PSI Affiliate Scientist Jim Head (left) holds his infant twin son, Alan Albert, while Director Mark Sykes bonds with the other twin boy, Macy Norman. They were born May 27, 2008. Congratulations on your adorable boys, Jim and Molly!

Bicycling 252 Miles or Why I decided to do this to myself, again? *by Dave O'Brien*

The Cochise County Cycling Classic 252 is a bike race in southeastern AZ, starting and ending in Douglas, AZ, on the US-Mexico border; this year it took place on October 11. The route is 252 miles long and actually extends a bit into New Mexico (see map below). I rode in it last year, and after swearing that I would never, *ever* do it again, I somehow decided that it was a good idea to give it another try, partly because I wanted to prove I could do it twice and also partly because I forgot how bad it was last year. As if to punish me for my decision, Hurricane Norbert made landfall in Baja California the weekend of the race, bringing strong winds and some rain.

Throughout the race, in addition to rain, I rode in early morning darkness for four hours, fixed two flat tires, and fought a severe, 20 mph headwind for over 60 miles (much worse than last year).

Finally, I arrived in Douglas at 7:08 p.m. — total time: 17 hours, 8 minutes — placing 7th out of 12 finishers. About 24 people started the race. My time was 13 minutes longer than last year, due to the much stronger headwind on the way back. My time for the first 170 miles was over 15 minutes faster than last year. Damn Hurricane Norbert...

Director's Note: Approaching a Crossroads

We are entering a new and disturbing era in solar system exploration. The financial crisis in the U.S., coupled with huge bailouts by the government to stem its effects, will result in huge pressure to shrink the discretionary part of the federal budget which funds NASA. Added to this is the recent decision by NASA Administrator Griffin to delay the launch of the Mars Science Laboratory (MSL) mission to 2011 at the additional cost of $400 million, increasing to $2.3 billion the price of a mission originally proposed at $650 million. Mars exploration in particular and solar system exploration in general have been put between a hammer and an anvil. MSL is not the only large NASA project growing out of control. On the Astrophysics side there is the ever-looming James Webb Space Telescope. Former Associate Administrator Alan Stern made a valiant effort to stop MSL's budgetary explosion, only to be shut down by the administrator, resulting in Stern's resignation.

In an era of severely limited resources, our space exploration efforts are going to be seriously scaled back. As a nation, we need to take a hard look at what is required to get past these times to resume a robust exploration program. The answer is in a survey conducted two years ago, to which an amazing half of the U.S.-based planetary community responded. In times of no growth or shrinking budgets, 87% said our first priority was NASA's Research and Analysis programs and small, competed missions (e.g., Discovery, Mars Scout). 91% said that R&A funds should be stable and never reduced to fund missions. Keeping research programs and small missions strong in times of adversity preserves the core competencies we need to pursue larger, more ambitious missions when resources allow.

We can only hope that the new administration will bring new leadership to an agency that desperately needs fiscal discipline and a clear understanding of how taxpayers benefit from their investment in science missions (hint: it involves actually doing science before and after...). In the meantime, it will be up to individuals to advocate for a rational path that protects this country's future in solar system exploration.

Mark V. Sykes
December 2008

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