WWW.GEO.MTU.EDU WINTER 2005 - 2006

On The Faultline

Geological Hazards Peace Corps Program

New technology to tackle old problems in Central America

CENTRAL AMERICA HAS a bull's-eye on its forehead when it comes to natural disasters.

Associate Professor Gregg Bluth (GMES) counts them off. "Earthquakes, volcanoes, hurricanes . . . There's a lot of need there, and their personnel are stretched pretty thin."

Enter a new, multi-faceted Michigan Tech program made possible through a five-year, $2.3 million grant from the National Science Foundation. The funding supports an array of projects–including the new Peace Corps Master's International program in Natural Hazards, which will use remote sensing to make life better for people in Guatemala, El Salvador, Nicaragua and Ecuador.

Scientists routinely use remote sensing to monitor volcanic activity in hopes of predicting eruptions, which can be very effective in countries where there may be few trained scientists. However, this requires a long-term commitment if it is to become a part of an overall hazard mitigation strategy. "There isn't enough confidence in these methods, which take time and testing to establish for different volcanic settings," Bluth notes. He hopes that by establishing a long-term presence, remote sensing will gain more credibility.

Eruptions, while catastrophic, are rare events. That is why Bluth and his fellow researchers will use satellite images not only to analyze volcanic emissions, but also to help find water.

"By using satellite images, we can see features on the surface which represent subsurface fractures. Those are the places where groundwater may be more accessible," Bluth explains.

In a fascinating approach to incorporating undergraduate students in research, students on the ground will be using a different kind of remote sensing, seismic reflection, to study the water table.

"One of the region's persistent problems is finding good sources of drinking water," notes Bluth. "Our research is aimed at coupling satellite data with geophysical surveys to identify more productive areas for future drilling."

The first on-the-ground portion of the project will be undertaken by Associate Professor John Gierke and undergraduates in the Aqua Terra Tech Enterprise. In December the group will head to Boaco, Nicaragua—where most of the 34,000 residents are without running water but for a few hours a week.

For more on all the different GMES field trips, be sure to visitwww.geo.mtu.edu/rs4hazards.

- adapted from *Tech Topics*

Huntoon named Dean of Graduate School

DR. JACQUELINE E. HUNTOON recently completed a two-year position "on loan" to the National Science Foundation, in Washington, D.C., where she served as Program Director for Diversity and Education for the Directorate of Geosciences.

She returned to campus just in time to assume the role of Dean of the Graduate School, retaining her faculty position in GMES.

Said one friend: "In the time since you left Houghton, you've been promoted to full Professor, and appointed Dean of the Graduate School. Imagine what would happen if you stayed away any longer!"

We are proud to have the talents of our faculty recognized at the University level, and look forward to working with Dr. Huntoon in her new position.

MichiganTech

Letter from Wayne Pennington

WELCOME BACK TO *ON THE FAULTLINE*, newsletter of the Department of Geological and Mining Engineering & Sciences (GMES) at Michigan Tech. This is our first real newsletter in some time, and we have a lot to tell you.

The department is currently healthy and looking forward to a rosy future. In 2002, the Mining Engineering (MG) Department and the Geological Engineering and Sciences (GES) Department were merged, forming the new department with a name nobody can remember correctly (test yourself: what is it?). Shortly after that, the University experienced a financial shortfall; because the Mining Engineering program had graduated an average of five students per year for the past several years, its suspension was seen as a cost-saving measure that would have little impact. That program was closed and its tenured faculty dispersed across campus in support of other departments and programs.

Ted Bornhorst, who had been Chair of the GES and GMES Departments, moved to a new position, as Director of Administration for the A.E. Seaman Mineral Museum. He continues to teach the introductory course in geology, as well as petrology, with a 50% appointment in GMES. I assumed the reins as GMES Chair in the fall of 2003.

Some of you may know me, but others may not, so let me introduce myself. I am a geophysicist, working most recently in oil and gas exploration and development, with an earlier background in earthquake seismology and tectonics. My degrees are all in geology and geophysics, and I spent six years on the faculty at University of Texas at Austin, then nine years at the Colorado-based research center of Marathon Oil Company. I have been at Michigan Tech for over 11 years now, and have developed a strong research program in *seismic petrophysics* – the use of rock physics to interpret reflection seismic data in terms of rock properties for stress, fluid content, and lithology. My wife and I have recently become empty-nesters, and we moved our "nest" out to Lake Superior, on Little Traverse Bay, where our nearest neighbors are a family of bald eagles.

The Department continues to grow in strength within several key areas: Water and Society; Volcanology, Remote Sensing, and Hazards; and Oil and Gas. In spite of our small size, these programs bring in more research funding than do most other departments on campus. We are well-recognized for our friendly and welcoming environment for undergraduate majors, our strong graduate programs, our active research programs, and our innovation. Some of these new and successful efforts are highlighted elsewhere in this newsletter, so I will not bore you with them here.

Instead, let me invite you to visit the campus, and stop in and see, firsthand, how things are going here at your favorite school. You will find an active, upbeat, and successful group of students, faculty, and staff. And we would love to show you around and talk about the past, the present, and the future.

But enough from me … take a look around the rest of this newsletter and see what you think. And then let me know by e-mail at wayne@mtu.edu.

The status of mining at Michigan Tech

The undergraduate ABET-accredited program in Mining Engineering is officially suspended. The Board of Control stated that all current undergraduates will have until summer 2006 to complete their degrees. Almost all students have already graduated, and the others are on track to complete in time. ABET accreditation for the program ends shortly afterward.

The graduate MS and PhD programs in Mining Engineering continue, and currently a few students are making good progress toward their degrees. We cannot offer a comprehensive graduate program, but have retained excellence in several niche areas.

The undergraduate Minor in Mining is going strong, with mining-specific courses supported through a Mining Lectureship endowment with the Michigan Tech Fund. Scholarships endowed for support of mining and the minerals industry are supporting students in GMES who are pursuing careers in resource development, including exploration and the business and environmental aspects of such development.

The undergraduate Mining Engineering degree program has been suspended; this means that it can be brought back by action of the Board of Control, at any time. But it would have to be a good program before Michigan Tech would consider proposing it. And, even though careers for its graduates are plentiful, it still takes resources and commitment to establish a core of faculty to maintain the program and facilities. If you are interested in voicing an opinion, or helping determine the future, please let me know.

More detailed information on any of the programs, research centers, field trips, and other activities, whether or not they are discussed in this issue of *ON THE FAULTLINE*, can be found through the GMES website www.geo.mtu.edu, which we invite you to visit.

- Wayne Pennington

Did you know?

Dr. Lloyal Bacon
celebrates his 90th birthday
on December 10

Field Trips – where it all makes sense

The GMES Department (and its predecessors) have always stressed hands-on training and experience. We teach two required field courses in the summer, but also provide plenty of opportunities for students to see classic and novel field sites. What follows is a short description of just one of those trips. See www.geo.mtu.edu for more info and photos.

BACK IN MAY 2005, a group of science and engineering students and faculty from four universities in the U.S. and Canada embarked on a one-week field course in the Rio Lerma-Chapala Basin in central Mexico, one of the most intensively developed watersheds in the world.

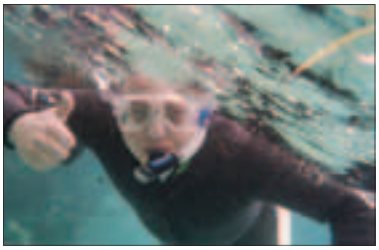
The basin covers a total area of more than 54,000 km2 and is home to 9.35 million inhabitants. It also contains 6,400 industries, which generate one-third of the GNP and 20 percent of all national commerce in Mexico.

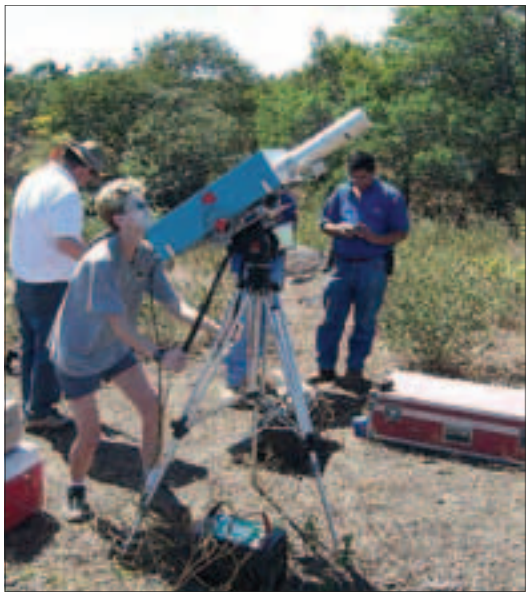
The field course was hosted by the University of Guadalajara and led by Salvador Peniche Camps, a well-known environmental economist who has studied the Rio Lerma and Lake Chapala for several decades. It all began at the birthplace of the Rio Lerma, near the lagoons located outside the city of Almoloya, and ended at the river's terminus in Lake Chapala.

At each stop along the way, specialists briefed the 24 participants. Topics discussed included difficulties of managing the basin under intensive pressures from growing municipal populations and an expanding agro-industry, manipulation of flows in the river and sources of water quality problems in the basin, and the social and political tensions of the diverse stakeholders. Specialists included university scientists, government officials, farmers, environmental activists, and indigenous peoples.

But the field course wasn't all about science. Participants enjoyed live performances of indigenous dances and music, took part in an indigenous cleansing ceremony, viewed archaeological remains, and toured colonial architecture.

This trip was sponsored by the "ExCit" Consortium: the University of Sonora and University of Guadalajara in Mexico; Michigan Technological University; and the University of Cincinnati in the United States; and the University of British Columbia and Laval University in Canada. Its goal is to train students to be aware of water resources issues in all three countries.





The pictures on this page show students working on field trips and research projects in Guatemala, Mexico, the Florida Keys, Labrador, and Michigan.

Richard Edward Gertsch February 21, 1945 - August 30, 2005

DR. RICHARD GERTSCH died of natural causes Tuesday, August 30, 2005 while working in Minnesota on a research project for the United States Department of Energy.

He will be greatly missed.

Dr. Gertsch came to Michigan Tech in the late 1990's, and initially shared a single faculty position with his wife, Leslie Gertsch.

He taught core mining engineering courses, including Introductory Mining, Mine Cost Engineering, Surface and Underground Mine Design, and Mining Methods. He conducted research in rock fragmentation and construction in rock, and was faculty advisor for the student chapter of the Society for Mining Metallurgy and Exploration.

Before coming to MTU, Dr. Gertsch was Director of the Excavation Laboratory, Earth Mechanics Institute, Department of Mining Engineering, Colorado School of Mines. He was project manager and principle investigator for research contracts that included DOE Yucca Mountain Project, Sandia National Laboratories, the Gas Research Institute, excavation machine manufacturers, and mining and construction companies.

Prior to that, he was Principal Investigator in the Rock Mechanics and Explosive Research Center at the University of Missouri-Rolla (UMR). There he both taught and established several successful research programs focused on novel drilling techniques, and the improvement of current art mechanical rock fragmentation.

During 10 years in the mining industry, he was general manager of the Yellow Aster mine, where he designed, constructed, and operated a heap-leach gold operation. He also managed, designed, constructed, and operated a barite mine. He designed and consulted on other mines, including gold, barite, trona, copper, potash, and sapphire.

Dr. Gertsch had a lifelong interest in space exploration. He also enjoyed reading about history, taking photographs and fishing. He joined the Navy in 1969 and retired in 1972 as a captain, having served in the Vietnam War.

A memorial service was held on September 9 in Colorado Springs.

What's ice cream got to do with it?

FIRST-YEAR ENGINEERING students must take two semesters of Engineering Fundamentals. They learn a variety of skills, but they don't get much geology.

By the time they select a major during their sophomore year, geological engineering or the mining minor may not even be on their radar screens. Once they start looking for jobs as seniors, many tell us they wish they had known about these programs back when they were starting out.

So here is what we have done.

As part of the first-semester Engineering Fundamentals, students must sign up for 10 "points" worth of "explorations" in various topics. All engineering departments offer a variety of explorations. But we have taken a two-pronged approach.

Early in the semester, we offer a few "big" explorations (4 points each). These include: geological engineering tours of the Quincy Mine (Dr. Gregg); experiments with refraction seismology (Dr. Young); drilling and blasting (Mr. Gillis); and earthquake seismology (Dr. Pennington). We also offer seminars (1 point each) with invited speakers through the Remote Sensing Seminar Series. Last but not least, each student also receives an invitation to an "Ice Cream Social" offered twice, late in the term. And they receive 2 points for attending!

We have found that students who tend to sign up for one of the big explorations are at least mildly interested in a career that includes outdoor activities, or just learning about the earth.

So they decide, "What the heck – it's free ice cream, after all." and come to the Ice Cream Social.

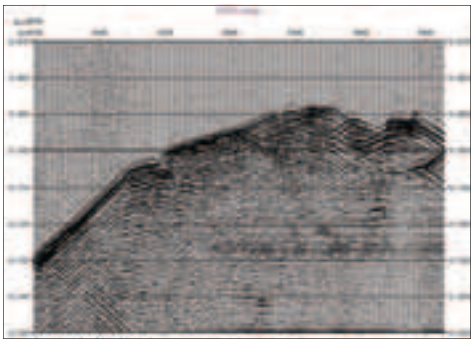
Quite a few faculty, staff, graduate students, and undergraduates also attend the event, which takes place in the Robbins Atrium ("Chez Robbins") on the 6th floor of the Dow Building.

The potentially interested students have a great opportunity to talk with people from GMES and learn more about the programs and careers available. Some spend over an hour with us. Many decide to major in one of our programs (usually Geological Engineering, since they are already on the engineering track). A surprising number of others, such as Mechanical Engineering majors, decide to minor in Mining or in Geological Engineering, hoping to work in drilling or tunneling when they graduate.

And it was all because of some free ice cream.

The Quest for Oil: Turpening on Permeability

OIL HIDES UNDERGROUND in porous places, and finding them has always been a problem. Research professor Roger Turpening (GMES) has received a contract from the U.S. Department of Energy in hopes of making it a little easier.



"Our overall goal is to make images of the permeability of the earth," Turpening explains. "In our business, that's a big deal. It's the Holy Grail, it's so hard to do."

"At the moment the best we can do is to make a point measurement, not an image, by taking a piece of rock out of a hole that one is drilling. We have no idea what the permeability is between holes. Fragments of theory seem to indicate that the more permeable the earth, the more seismic energy it will soak up," he adds. "Proving this experimentally has not been simple—in fact, all investigative aspects (theory, lab experiments and field data) of the problem need work.

"But you can see if you were an oil company and you could make such images, it would be incredibly valuable. In an oil field, you could drill a crooked borehole and hit just the sweet spots."

The field data portion of the problem could be improved significantly by using a site where Turpening and his longtime research colleague Wayne Pennington, chair of GMES, have been conducting studies for years. The old oil field near Traverse City has two wells bored thousands of feet deep, and the scientists have been using the site to improve seismic imaging techniques used for finding oil. It will take two more holes to conduct needed experiments on the relationship between seismic energy and permeability.

Says Turpening: "If you could image the earth's permeable places, you'd be king."

- article adapted from *Tech Topics*

Above is a sample of seismic data. It shows a "fan" of data collected by a receiver at 5,830 feet depth in one well, from sources at depths ranging from 4,140 to 5,950 feet in another well. The details seen in this (and hundreds of others) will, after processing, yield images of the interior of the oil-bearing reef.

"It's a gorgeous hunk of the Keweenaw."

SO SAID BOB BARRON of Michigan Tech's GMES department. He recently coordinated the recovery of a 33,000-pound copper boulder from Lake Superior.

Barron and two other divers secured foot-and-a-half wide straps around the boulder at a depth of 40 feet, and a U.S. Army Corps of Engineers barge and crane lifted the specimen from the lake bottom.

The boulder measures 18 feet across. At 8 feet wide and more than a foot thick, it is the largest mineral specimen ever taken from Lake Superior.

"Everything went just perfectly," Barron said. "We got it to the surface, cleaned it off a bit with a fire hose, and you could see the colors come out. It is predominantly light green, with some brown, and even some blue areas."

The boulder is part of one of the richest deposits of copper on Earth, near Michigan's Keweenaw Peninsula. For years, divers have explored a ridge of copper about a mile offshore and recently came across this copper behemoth.

The final destination of this enormous copper boulder is the Quincy Mine, one of the most productive copper mines ever operated. The boulder will form the centerpiece of the new home for Michigan Tech's A.E. Seaman Mineral Museum, which is also the official mineral museum for the state of Michigan.

Bob Barron has just returned from Germany, where he gave an invited talk (three times!) about diving to collect agates from underneath the waters of Lake Superior. More on that later…

-article adapted from *Tech Topics*

The A.E. Seaman Mineral Museum

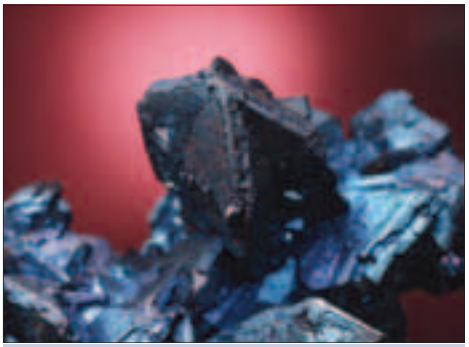
Check out the Museum's wonderful Online Gift Shop at www.museum.mtu.edu

FOR QUITE SOME time, the A.E. Seaman Mineral Museum was directly "under" the auspices of the GMES Department.

During the restructuring that resulted in the suspension of the undergraduate mining engineering degree program, it was decided that the Museum should be no longer a part of our unit.

On the other hand, ties between the Museum and the Department continue to be extremely strong. Ted Bornhorst and George Robinson have positions in each unit, and students are always involved in the Museum's activities.

The A. E. Seaman Mineral Museum has the most extensive academic mineral collections in the world, including the largest collection of Lake Superior native copper. It maintains a strong educational component focused on sustainable mining and the importance of minerals to society. The goal is to become a respected mineralogical and cultural resource worldwide.



Above: this very fine chalcocite specimen from the Flambeau Mine, Ladysmith, Wisconsin, shows a sharp 3.5-cm twinned crystal. It was recently donated to the museum by Kennecott Minerals.

- photo by John A. Jaszczak

Alumni, corporations, friends, and governments all help the museum move forward. Here are just a few examples:

- With help from MTU alumni Kenneth Brunk '69, Barney Guarnera '64, and K. Marc LeVier '71, the venerable Mining & Metallurgical Society of America awarded a $7,500 Jackling Fund grant. It will be used for the new museum facility on Quincy Hill.

- Kennecott Minerals Co., with help from Jon Cherry, Project Manager, and Larry Bunkall, Government and Public Affairs, recently donated two world-class chalcocite specimens from its now-reclaimed Flambeau Mine in Ladysmith, Wisconsin.

- Phelps Dodge is supporting geochemical and mineralogical research.

- Bill Shelton, Gene Meieran and Marc Weill made donations of significant high-quality specimens for the Museum's collection this past year.

- Senator Carl Levin, Senator Debbie Stabenow and Representative Bart Stupak have secured some $1.8 million in federal funding to date in order to help fund the new museum facility on Quincy Hill.

These are just a few highlights. For more info, visit the Museum's web page at www.museum.mtu.edu.

Or, better yet, visit the Museum at its current location on the fifth floor of the EERC building (attached to the GMES Dow Building) on your next trip to Houghton.

- Stanley J. Dyl II, Director of Advancement and Planning

The new Center for Water and Society

The Michigan Tech Center for Water and Society (MTCWS) was established in June 2005 under the Sustainable Futures Institute (SFI).

It is a "virtual" Research Center—it will not occupy physical space, but will be a consortium of people at Michigan Tech whose focal point is water-related activities. Its mission is to support all disciplines at Michigan Tech related to water issues. The goal is to establish Michigan Tech as a state, regional, national and international leader in research, education, outreach and, in particular, interdisciplinary approaches to solving water-related problems.

Alex Mayer, Professor of Geological Engineering in GMES is the Center's first director. Objectives for the first five years are as follows:

- Establish Michigan Tech as the "think tank" for resolving water issues in the state of Michigan.
- Expand international activities at Michigan Tech related to water issues (see field trip described in this newsletter).
- Support and expand current K-12 and community education/outreach water-related activities at Michigan Tech.
- Develop new degree programs and coursework and emphasize existing, unique educational offerings related to water.

Insights on the Earthquake in Pakistan

Earlier this year a massive earthquake rocked parts of Kashmir and Pakistan. The quake, which measured a 7.8 on the Richter scale, caused 79,000 deaths and nearly 90,000 injuries.

Wayne Pennington spent some time in the area years ago, and was able to provide insight to *National Geographic* magazine about why casualties were so high—and why the area is so susceptible.

Pennington lived in Pakistan while working for Columbia University during the 1970s. On December 28, 1974, a magnitude 6.0 earthquake struck an area of the Himalayas very close to his network.

"When the earthquake struck on October 8, 2005, it hit just to the east of the area affected by the 1974 event," Pennington explains. "In that area, roads and villages are carved into the side of the mountains. A little shake and the uphill side will likely have rocks that come loose and fall. The downhill side just slides away completely."

Seismologist Roger Bilham of the University of Colorado told *National Geographic* that the slip from the 2005 earthquake was long overdue.

"This suggests that the fault planes are storing up the strain elastically," notes Pennington. "There is serious concern that the entire area along the front of the Himalayas, along Pakistan, India and Nepal, is 'waiting' for a tremendously large earthquake to take place—certainly the strain energy is available."

Jeff Sudderth, *Michigan Tech Lode*

New Books … by Students, Faculty, and Alumni

TWO TECHNICAL BOOKS have recently been published by faculty and students in the GMES Department:

Soil and Groundwater Contamination: Nonaqueous Phase Liquids, edited by Alex S. Mayer (faculty) and S. Majid Hassanizadeh, published by the American Geophysical Union.

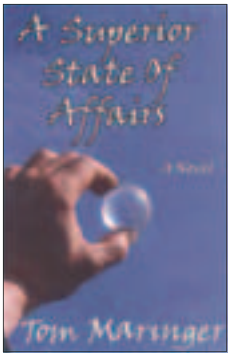
*Seismic Data Processing with Seismic Un*x: a 2D Seismic Data Processing Primer*, by David Forel (PhD candidate), Thomas Benz (MS, '97), and Wayne Pennington (faculty), published by the Society of Exploration Geophysicists.

ALUMNI OF OUR programs also write books. Anybody who learned geology or mining at Michigan Tech is sure to enjoy *A Superior State of Affairs*, by Tom Maringer (class of '76).

Mariner's novel, a thriller, is based in the Houghton-Hancock area, with climactic scenes taking place in the Quincy Mine. The book's story line is best described as "The X-Files comes to the UP". For anyone familiar with the area around Houghton and Hancock, this book provides a terrific escape.

The story is set in the year 2017, but everything in town is just like it is right now, with only a few exceptions. My familiarity with the scenes in the book probably enhanced the fun of reading it, and fun it was indeed.

It turns out that an old miner, Arne Harjaala, has a strange story to tell. He worked in the Quincy Mine at the time of a major disaster, in 1906. When he wandered out of the collapsed area, it was 1944, but he was certain it was only a few hours later. There is some special secret here, and the bad guys want to find out what it is. The Northern lights play a large role, as do a huge blizzard and members of the Ojibway community. Markedly absent are members of law enforcement, for reasons that our local constabulary would not approve of.



Be prepared to accept some slightly preposterous assumptions. Once you get over that, the character development and the familiar locations help make the excitement of the chase and the cliff-hanging scenes more real than most thrillers. The characters become alive, and I would swear that they are based on people I know (though I assume not).

If you are looking for a fun book to read choose this one. You'll be glad you did, and it might even make you homesick for the Keweenaw in winter.

- review by Wayne Pennington

Note: *A Superior State of Affairs,* by Tom Maringer ($22.95 ▪ 500 pages ▪ paperback ▪ ISBN 1418427624) is available at the A.E. Seaman Mineral Museum, and online at www.authorhouse.com and at www.shirepost.com/DIGGER.html.

How to make a gift to GMES

Although Michigan Tech is a state institution, it receives only about one-third of its funding from state appropriation. Your gift helps keep the GMES department on the cutting edge.

There are three ways to give:

- Use Michigan Tech's online gift form at www.mtf.mtu.edu/giving.
- Call the Michigan Tech Fund at 906-487-2310
- Mail a gift to the Michigan Tech Fund at the address below:

Michigan Tech Fund
1400 Townsend Drive
Houghton, MI 49931

Important note: to make sure 100 percent of your gift goes to the GMES department, please specify GMES account #1325AO.

Many thanks!

GMES hosts Dr. Jaroslav Kadlec

Dr. Jaroslav Kadlec, or Jarda as he was known around the department, collaborated with Dr. Jimmy Diehl to submit a successful proposal to the National Science Foundation. He stayed with the GMES department for a year-long visit, which ended last month. Kadlec's home is in Prague, where he works as a Quaternary geologist at the Institute of Geology, Academy of Sciences of the Czech Republic.

NSF-NATO Post-Doctoral Fellowships are administered by the National Science Foundation and were created by NATO for promising young scientists who are less than five years out from their doctorate degree.

Kadlec's research project combined sedimentological and mineral magnetic studies on the Late Holocene fluvial sediments of the Morava River in the Czech Republic. He used the equipment in Michigan Tech's Enviromental Magnetism Lab to better understand the behavior of the Morava's large river system, as well as its response to differing climatic conditions and human activity over the last millennium.

Accompanying Kadlec to Houghton were his wife, Dr. Renata Kadlecova, and his teenage daughters Barbora and Venda. Renata works for the Czech Geological Survey and is the chair of the hydrogeology section of the Survey. She spent the year learning English, and enjoyed not having to meet project deadlines at the Survey. The family took advantage of the Houghton winter to snowboard. They also managed a trip to see the great American West—much to the disappointment of the girls, who wanted to visit New York City.

Social Geologist Extraordinaire

DR. BILL ROSE is a pioneer in a nearly empty field. "I call it social geology," he says.

It came about when he and his fellow geologists tried to warn populations living in the shadow of volcanoes.

"We'd work hard and make these elegant communications with the latest technology," he recalls. "We'd have maps with red areas generated by fancy computerized methods and based on the best scientific models of volcano behaviors. We'd think these things were wonderful, but we found out that the people living on the volcano didn't think they were wonderful at all. They didn't believe them."

What the scientists and the people had was a failure to communicate. Social geology is an attempt to remedy that failure. "We need to listen to what those people say about the volcano and develop information with them, so they'll believe us and benefit from it," says Rose.

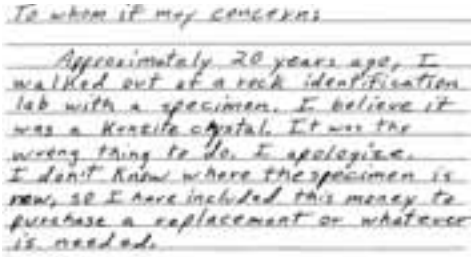
To address the issue, Rose developed the nation's first Peace Corps Master's International Program in Mitigation of Natural Geological Hazards.

"I've worked on volcanoes for 40 years with numbers of grad students. They go to the site for two or four weeks and then come home. Now we'll have students there for the long term, and they won't just do geology. They'll also work with the people in the community. This is pretty neat," he adds. "I couldn't have done it when I was a young guy building a resume. NSF is supporting it; they think social geology is where geology should be."

As an expert on the dangers of volcanoes, Bill Rose has done pretty well. He's a go-to guy for the likes of *National Geographic* and the top PBS science series "Nova". He no longer worries about getting the next big grant or making the next big discovery. He has found a way to keep a research program he loves while bypassing the usual frenzy involved in an active academic career.

"It's ideal for a senior professor," says Rose. He works only one semester a year on campus. In the spring, he's out in the field, traveling to volcanic hot spots or visiting colleagues at universities and institutes around the world.

-adapted from *Tech Topics* and *Tech Today*



To whom it may concern:

Approximately 20 years ago, I walked out of a rock identification lab with a specimen. I believe it was a Kunzite crystal. It was the wrong thing to do. I apologize. I don't know where the specimen is now, so I have included this money to purchase a replacement or whatever is needed.

Note recently received, with a check, from a chagrined alumnus.

On the Faultline

MichiganTech

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