New faces of the Geosciences

- Mining Engineering returns
- Geoscience salaries
- Alumni profiles
- Faculty research awards
- East Africa Field Camp
- The campus rocks!
New faces of the Geosciences

THE THEME FOR THIS NEWSLETTER is “New Faces of the Geosciences.” By that we mean new faculty, new types of students, and new opportunities and priorities for graduates. We have new faculty members to introduce and profiles of recent graduates in a variety of careers to share. We also want to tell you about the return of the undergraduate mining engineering program. Three of your favorite teachers and mentors are enjoying their retirements, and other faculty have earned significant awards. Sadly, two faculty members experienced untimely deaths in separate accidents—and we miss them terribly.

Students these days are a bit different from when I was (or many of you were) sweating over finals and cheering for our teams. They understand the need for natural resources, but are equally concerned about people and the environment, and their own lifestyle choices. They want to know how to make use of natural resources sustainably (leaving no legacy for others to deal with), and how to allow indigenous peoples to benefit from the development. They are concerned with how Earth works, but they want to use that knowledge to directly aid those who live in the path of volcanic flows, or in earthquake hazard areas—while learning details about the internal operations and mutual interactions of features from the core to the atmosphere, and beyond. They want to combine engineering applications with natural science observations. In short, they want to “do” and not just “learn.”

The programs administered by the Department of Geological and Mining Engineering and Sciences (GMES) at Michigan Tech are well suited to provide students with the background they need to make their choices well-informed, and to be successful in their careers and lives. Not many departments include programs in the sciences (Geology and Applied Geophysics) and in engineering (Geological Engineering); we think this provides our students with experiences and judgment that other institutions cannot match.

Several years ago, during a financial crisis, the University administration merged the Department of Mining Engineering with the Department of Geological Engineering and Sciences, leading to the name we currently enjoy(!). But, shortly afterward, they suspended the undergraduate Mining Engineering program. We kept the name as it was, in order to continually remind the University and ourselves of the strong heritage we all benefit from, and in hopes that one day we could bring the program back to campus. That time is now. A separate article describes the progress we are making, with the help of many of you.

At the end of many articles in this newsletter, you will find a link to an expanded version, available online. I hope you enjoy it all—please let me know. And thanks for your continuing support; we would not be the same without you.

Wayne D. Pennington, Professor and Chair

Note added while in press: Chair Wayne Pennington has been appointed Interim Dean of the College of Engineering. Check www.mtu.edu/geo for department updates.

HONORS

Jefferson Science Fellow and AGI President

WAYNE PENNINGTON, department chair, recently concluded a year as president of the American Geosciences Institute (AGI) for 2012.

The AGI is a nonprofit federation of 50 geoscientific and professional associations that represents more than 250,000 geologists, geophysicists and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society’s use of resources, resiliency to natural hazards and interaction with the environment.

Pennington also served as a 2009-2010 Jefferson Science Fellow at the US Department of State and USAID (Agency for International Development). During his appointment, he worked in the Office of Infrastructure and Engineering within the Bureau of Economic Growth, Agriculture and Trade. After USAID’s Office of Science and Technology was created in 2010, he shared his appointment in that office.

In those positions he worked on issues relating to earthquake hazard in Afghanistan, and science and engineering projects in Pakistan. In the wake of the 7.0-magnitude Haitian earthquake, he coordinated scientific and engineering teams heading to Haiti, presented talks for nontechnical audiences on the seismology of Haiti, and co-organized a workshop on infusing Haiti’s reconstruction with science and engineering. Read more at http://goo.gl/7vt0h and http://goo.gl/JXNpK
Median and starting salaries for geoscience-related occupations

In 2011, median salaries for the majority of geoscience-related occupations were 30 percent higher than the median salary for all occupations within each state. Table courtesy of American Geosciences Institute.

### 2011 Median Salaries for Geoscience-related Occupations

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Median Salary Range</th>
<th>Lowest Salary</th>
<th>Highest Salary</th>
<th>Percent of Median Salary for All Occupations in State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect. &amp; Eng. Mgrs.</td>
<td>$90,080 to $143,050</td>
<td>MT 206%</td>
<td>KY 271%</td>
<td></td>
</tr>
<tr>
<td>Natural Sci. Mgrs.</td>
<td>$55,090 to $153,120</td>
<td>IN 76%</td>
<td>NJ 287%</td>
<td></td>
</tr>
<tr>
<td>Environmental Eng.</td>
<td>$61,890 to $104,340</td>
<td>FL 101%</td>
<td>DC 71%</td>
<td></td>
</tr>
<tr>
<td>Mining and Geological Eng.</td>
<td>$58,660 to $117,040</td>
<td>OH 74%</td>
<td>OK 295%</td>
<td></td>
</tr>
<tr>
<td>Petroleum Eng.</td>
<td>$59,880 to $116,200</td>
<td>MO 92%</td>
<td>MA 338%</td>
<td></td>
</tr>
<tr>
<td>Environmental Eng. Tech.</td>
<td>$30,040 to $88,280</td>
<td>IA -4%</td>
<td>NV 109%</td>
<td></td>
</tr>
<tr>
<td>Soil and Plant Sci.</td>
<td>$46,090 to $81,200</td>
<td>KY 52%</td>
<td>MD 101%</td>
<td></td>
</tr>
<tr>
<td>Atmospheric &amp; Space Sci.</td>
<td>$58,500 to $113,240</td>
<td>NH 66%</td>
<td>NJ 186%</td>
<td></td>
</tr>
<tr>
<td>Environmental Sci.</td>
<td>$43,270 to $112,230</td>
<td>MS 59%</td>
<td>DC 83%</td>
<td></td>
</tr>
<tr>
<td>Geoscientists</td>
<td>$31,520 to $144,970</td>
<td>SC 5%</td>
<td>OK 389%</td>
<td></td>
</tr>
<tr>
<td>Hydrologists</td>
<td>$55,890 to $94,110</td>
<td>SC 86%</td>
<td>CO 154%</td>
<td></td>
</tr>
<tr>
<td>Geographers</td>
<td>$54,980 to $92,000</td>
<td>TX 71%</td>
<td>VA 153%</td>
<td></td>
</tr>
<tr>
<td>Geological &amp; Petroleum Eng.</td>
<td>$33,440 to $66,040</td>
<td>WV 19%</td>
<td>AK 54%</td>
<td></td>
</tr>
<tr>
<td>Engineering Teachers, Postsec.</td>
<td>$26,290 to $61,950</td>
<td>DC -67%</td>
<td>NV 90%</td>
<td></td>
</tr>
<tr>
<td>Atomsph, Earth, Marine, &amp; Space</td>
<td>$66,610 to $111,620</td>
<td>MN 83%</td>
<td>PA 221%</td>
<td></td>
</tr>
<tr>
<td>Sci. Teachers, Postsec.</td>
<td>$44,720 to $105,530</td>
<td>OK 51%</td>
<td>RI 186%</td>
<td></td>
</tr>
<tr>
<td>Environmental Sci. Teachers,</td>
<td>$35,240 to $119,610</td>
<td>IA 13%</td>
<td>WA 186%</td>
<td></td>
</tr>
<tr>
<td>Geography Teachers, Postsec.</td>
<td>$43,690 to $91,310</td>
<td>OK 47%</td>
<td>CA 137%</td>
<td></td>
</tr>
</tbody>
</table>

### 2011 Starting Salaries for Geoscience-related Occupations

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Starting Salary Range</th>
<th>Lowest Salary</th>
<th>Highest Salary</th>
<th>Percent of Median Salary for All Occupations in State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect. &amp; Eng. Mgrs.</td>
<td>$55,452 to $100,901</td>
<td>KY 78%</td>
<td>RI 174%</td>
<td></td>
</tr>
<tr>
<td>Natural Sci. Mgrs.</td>
<td>$56,256 to $98,675</td>
<td>KY 85%</td>
<td>RI 188%</td>
<td></td>
</tr>
<tr>
<td>Environmental Eng.</td>
<td>$40,040 to $88,890</td>
<td>FL 30%</td>
<td>RI 87%</td>
<td></td>
</tr>
<tr>
<td>Mining and Geological Eng.</td>
<td>$41,470 to $77,480</td>
<td>TN 37%</td>
<td>ND 142%</td>
<td></td>
</tr>
<tr>
<td>Petroleum Eng.</td>
<td>$53,452 to $135,120</td>
<td>WV 91%</td>
<td>MA 216%</td>
<td></td>
</tr>
<tr>
<td>Environmental Eng. Tech.</td>
<td>$23,678 to $54,642</td>
<td>KY -22%</td>
<td>RI 48%</td>
<td></td>
</tr>
<tr>
<td>Soil and Plant Sci.</td>
<td>$32,210 to $59,500</td>
<td>TN 6%</td>
<td>MD 47%</td>
<td></td>
</tr>
<tr>
<td>Atmospheric &amp; Space Sci.</td>
<td>$39,430 to $79,050</td>
<td>WI 18%</td>
<td>MD 95%</td>
<td></td>
</tr>
<tr>
<td>Environmental Sci.</td>
<td>$26,326 to $56,451</td>
<td>OK -11%</td>
<td>RI 53%</td>
<td></td>
</tr>
<tr>
<td>Geoscientists</td>
<td>$35,782 to $69,057</td>
<td>WV 28%</td>
<td>OK 133%</td>
<td></td>
</tr>
<tr>
<td>Hydrologists</td>
<td>$47,091 to $80,290</td>
<td>ID 56%</td>
<td>WV 187%</td>
<td></td>
</tr>
<tr>
<td>Geographers</td>
<td>$44,110 to $61,390</td>
<td>PA 27%</td>
<td>MA 44%</td>
<td></td>
</tr>
<tr>
<td>Geological &amp; Petroleum Eng.</td>
<td>$21,870 to $36,780</td>
<td>UT -32%</td>
<td>MA -14%</td>
<td></td>
</tr>
<tr>
<td>Engineering Teachers, Postsec.</td>
<td>$24,088 to $44,075</td>
<td>KY -21%</td>
<td>RI 20%</td>
<td></td>
</tr>
<tr>
<td>Atomsph, Earth, Marine, &amp; Space</td>
<td>$31,397 to $75,742</td>
<td>WV 12%</td>
<td>NH 114%</td>
<td></td>
</tr>
<tr>
<td>Sci. Teachers, Postsec.</td>
<td>$35,163 to $79,990</td>
<td>KY 10%</td>
<td>RI 117%</td>
<td></td>
</tr>
<tr>
<td>Environmental Sci. Teachers,</td>
<td>$24,363 to $69,900</td>
<td>WV -13%</td>
<td>MD 73%</td>
<td></td>
</tr>
<tr>
<td>Geography Teachers, Postsec.</td>
<td>$26,650 to $63,648</td>
<td>TN -12%</td>
<td>NH 80%</td>
<td></td>
</tr>
</tbody>
</table>

1 The U.S. Bureau of Labor Statistics reports this wage as “greater than $90.00 per hour or $187,200 per year.” BLS reports 30 Petroleum Engineers in Massachusetts.

2 Value based on salary of $187,200. 3 Percent different from the median salary for All Occupations (Standard Occupational Code: 00-0000) within the state.

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Geology Club 2013 Wall Calendar—get yours now

**THE MICHIGAN TECH** Geology Club has published a gorgeous wall calendar as a fundraiser. Undergraduate and graduate students and faculty all contributed photos for the calendar, which were selected by members of the club. You’ll find a few of these superb calendar images featured throughout the pages of this newsletter. The calendar costs just $10 including shipping and handling. Please make checks payable to the MTU Geology Club, and send your check to: Kelly McLean, GMES department, 1400 Townsend Drive. Houghton, MI 49931. Any questions? Call or email Kelly at 906-487-2531 or kelly@mtu.edu. Too late for 2013? Advance orders for 2014 calendars are also welcome.
Mining Engineering returns to Michigan Tech

AFTER A HIATUS of several years, we are pleased to be able to announce that Mining Engineering is returning to Michigan Tech. This is a result of many factors, including not only the return of mining to the Upper Peninsula, but also to the increasing awareness that all engineers, including mining engineers, should be able to receive the type of holistic education that Michigan Tech offers. Some of you helped provide that awareness, and we appreciate your support.

In order to ensure the incoming Mining Engineering students receive an accredited degree as we increase the teaching staff and associated curriculum, the degree is being offered as a technical emphasis under the BSE (Bachelor of Science in Engineering) program. We already have added a temporary instructor (see faculty profiles) who is leading senior design and teaching senior-level courses. Within a couple of years we expect to have developed sufficient support to provide a full ABET-accredited degree program.

The new program is, and will be, interdisciplinary (and interdepartmental), administered through the GMES department. We think this is unique in the nation, and it affords us an opportunity to create a new program to meet the needs of the mining community today. In other words: “It’s not your grandfather’s mine anymore.” Today’s mining engineers must be well-trained in environmental, business, and other disciplines in order to be productive in the industry; a “silo” mentality to education cannot lead to this type of training. Michigan Tech is ideally suited to provide a quality interdisciplinary education to today’s mining students, being able to start with a clean slate and not locked into existing curricula.

But we can’t do it alone. We need the support of the current mining community and interested alumni and friends. This support can take the form of advice and close association with the program as it matures, which is being provided through an advisory committee formed specifically for this purpose. Or it can take the form of financial assistance: it is clear that we cannot expect the State of Michigan to provide funds for increasing faculty numbers or even for new laboratories and field experiences, and we look to our friends in industry and the community for this assistance. And, of course, we continue to appreciate your support as you recommend Michigan Tech to prospective students for the education that will lead to satisfying careers in the Earth science and engineering fields.

Read more at http://goo.gl/jM8Em

On the cover: Jim Wark ’54, 2012 Aerial Photographer of the Year, shares with us his stunning photo of the Copper River Delta in the Gulf of Alaska. See page 10.
Considering a career in the geosciences? GMES alums offer advice.

Anna Colvin ’08, Geologist, GeoGlobal Energy

Anna Colvin earned a BA in Earth and Environmental Studies at Wesleyan University in 2004, and an MS in Geology at Michigan Tech in 2008.

Colvin’s graduate research focused on remote sensing of active volcanoes, ASTER image interpretation, crater lake geochemistry, volcanic hazards, and international collaboration between Michigan Tech and the national volcano monitoring institution in El Salvador.

“Completing a graduate degree is a bit like running a marathon,” says Colvin. “You have to stay focused and continually work towards your goal.”

The best part of the experience, according to Colvin, was the synergy and multidisciplinary collaboration among GMES students, postdocs, and professors applying remote sensing techniques to volcanology and ground water resources. “Students had an interesting mix of life experiences and intellectual curiosity. Many had lived or traveled in Latin America. The GMES department hosted scientists from all over the world to discuss their research.”

Participating in geology fieldwork and remote sensing workshops in El Salvador and Costa Rica increased both her confidence and ability to plan and execute projects in Latin America. “These experiences showed me the importance of transcending cultural difference in order to achieve a common goal,” she says.

After graduating Colvin took a job as a geologist in a private geothermal energy company called GeoGlobal Energy. She is currently based in their Santiago office in Chile, and participates in geology, geochemistry and geophysical exploration campaigns as well as geothermal drilling at Chilean geothermal fields. “Chile doesn’t yet have any operating geothermal power plants. It’s very exciting to be working at the forefront of the industry in this country.”

“I am the type of volcanologist whose internal fire is lit when I am talking, thinking, dreaming about geology. It is important to feel passionate for your work whatever it may be. Follow your gut if you feel that you are a geologist at heart.”

—Anna Colvin

John Lyons ’11, USGS Mendenhall Postdoc Alaska Volcano Observatory

John Lyons earned a BS in Geology from Missouri State University in 2002, and an MS in Geology from the University of Idaho in 2004. He spent two years in the Peace Corps, and then earned a PhD in Geophysics from Michigan Tech in 2011.

“Graduate school really formed me into a life-long learner and explorer,” says Lyons. His research involved characterizing eruptive behavior at Fuego Volcano, Guatemala, initially by using some classic observational techniques while in the Peace Corps, and then transitioning into the use of cutting-edge geophysical and remote sensing methods as his PhD research gained depth and breadth.

The secret to his success? “All of the great field work opportunities; living at the base of an active volcano, and learning Spanish in the Peace Corps; the addition of volcano seismologist Dr. Greg Waite to the faculty; Dr. Bill Rose’s incredible passion for geology, volcanology, and international experiences; exploring the UP… the list goes on. It is also difficult to surpass the variety and richness that two years in the Peace Corps program provided. Those two years provided the basis for the rest of my PhD, and, I believe, changed the course of my life.”

Upon graduation, Lyons initially worked abroad on volcano-related geophysics, first on a short postdoc in Japan at the Earthquake Research Institute—University of Tokyo, and then at the Instituto Geofísico, Escuela Politécnica Nacional in Quito, Ecuador. He is now back stateside in Anchorage, Alaska, starting a USGS Mendenhall postdoc with the Alaska Volcano Observatory, where he will be working on characterizing and modeling infrasound and seismic signals from active volcanoes in the Aleutian Islands.

“If you are interested in what geophysics can tell you about dynamic Earth processes, then go for it. And it certainly helps to have the support of great teachers, mentors, and fellow students along the way, so be sure to surround yourself with them.”

—John Lyons

Michaela (Polster) Crum ’08, Geological Engineer, Cliffs Natural Resources

Michaela Crum graduated with a BS in Geological Engineering with a minor in Mining from Michigan Tech in 2008. “When I first started college, everyone told me that it really didn’t matter what your major is when you start out, because most likely it will change. This proved entirely false in my case,” says Crum. “After taking my first geology classes, I knew that was the right decision for me. Dr. Bill Gregg was a particular influence on her studies. “He brought his [continued on next page]
industry experience and wisdom to the classroom to make the material interesting, applicable to real world examples, and easy to comprehend.”

Crum fondly recalls the intense summer field courses, ten weeks long. “It develops respect for the field, friendships between students, and unity within the department unlike any other discipline at Michigan Tech.” A tour of the Tilden Mine that summer was influential in her life, and was the day she decided to focus her studies toward mining.

“The GMES department gave us the academic freedom to pursue a unique senior project—a Slope Stability Analysis at the Tilden Mine for Cliffs Natural Resources. That’s where I met the wonderful people I work with today—my senior design project resulted in a summer internship with Cliffs and later, a full time job. The members of my senior design team are now working successfully in the mining industry as well.”

Crum is now a geological engineer with Cliffs Natural Resources, a diverse mining company with operations all over the world. She works within a department that provides global research and technical services to all of the operations. Her projects include geologic computer modeling of coal and iron ore deposits along with exploration drilling programs and reservoir analysis.

“I love making friends and being part of organizations,” she adds. “Learning time management skills and exactly how much I can handle at once was a very important lesson I learned at Michigan Tech. It has helped throughout my life and career ever since.”

“My best friends today are still the same people I met in college and I hope we will stay in touch for many years to come. Michigan Tech is also where I met my wonderful husband, Allen!”

“Think about what you like to do. Do you like to be outside? Do you like to travel? Do you like science, puzzles, looking at or creating maps? Geological Engineering involves all of these activities no matter what you do with your degree.”

—Michaela Crum

Chris Pascoe ‘01, Chief Mining Engineer, Resolution Copper Company

Chris Pascoe earned a BS in Geological Engineering (1999), a BS in Mining Engineering (2000), and an MS in Geological Engineering (2001)—all from Michigan Tech.

Pascoe began at Michigan Tech in the summer of 1994, and finished seven years later. His goals changed over time. “My original plan was to focus on the area of groundwater and hydrogeology and then changed to more of the geophysics side associated with the oil and gas industry,” he explains. “I ended up concentrating more on the mining side, but still with a focus on the geologic sciences. I then decided to get a degree in mining engineering in order to gain additional knowledge.”

Pascoe was able to secure a good, practical MS project in the mining industry with partial funding from a mining company. The project involved building a 3D geological model of an iron ore deposit in Michigan and studying the distribution of gypsum in the deposit. “It provided me with a set of tangible skills that I was able to leverage to get my first job.”

Now an engineering manager at Rio Tinto, Pascoe works on a mining development project called Resolution Copper, one of the largest undeveloped copper resources in the world. “The mine will be more than 7,000 feet deep, and is very technically challenging from a geotechnical perspective and also because the virgin rock temperatures at depth are more than 175 degrees F. This project will supply approximately 25 percent of the US copper supply once in production. I manage a group of mining engineers, geotechnical engineers, and consultants to work on the future design and development strategy. The engineering scope that I am responsible for is worth multiple billions of dollars in terms of infrastructure and the plant that will be constructed. From an engineering perspective, this is one of the preeminent projects in the mining world.”

Pascoe believes the study of geological engineering provides a unique learning experience. “I find that decisions must be based on a valid interpretation of oftentimes uncertain, incomplete and/or conflicting pieces of information. A strong background in geosciences provides this type of practical grounding and perspective.”

During the course of his career, Pascoe has enjoyed the good fortune of traveling to six continents and many different countries. “A career in the geosciences can be very international in nature, if one wants it to be.”

Gari Mayberry ‘99, Scientist, USAID/Office of Foreign Disaster Assistance

Gari Mayberry earned a BS in Geology from Wesleyan University in 1997, and an MS in Geology from Michigan Tech in 1999.

Her Master’s research at Michigan Tech focused on using satellite imagery to investigate the evolution of a volcanic ash cloud generated from the December 26, 1997, Boxing Day eruption of Soufriere Hills Volcano in Montserrat. “It was
pretty easy to come up with various theories,” she recalls, “but to focus on one and paint a complete picture was challenging.” The experience helped Mayberry to be independent and to solve problems. “Enhancing those skills helped to ready me for the workforce.”

While at Michigan Tech, Mayberry did a fellowship at NASA Goddard Space Flight Center in Maryland. “I was working on running a wind trajectory model, which was new to me, and my results weren’t making much sense,” she recalls. “About two weeks before my stay was over, I began to get results that made sense. Ultimately, I felt like I really accomplished something during my brief time at NASA.”

Now an employee of the US Geological Survey (USGS), Mayberry is stationed at the US Agency for International Development’s Office of US Foreign Disaster Assistance (USAID/OFDA) headquarters in Washington, DC. She serves as the liaison between USGS and USAID/OFDA, and advises USAID/OFDA on issues related to geohazards. “I help evaluate risks around the world, to make possible more effective planning, engagement with local authorities and communities on risk mitigation measures, and rapid response when necessary.” Mayberry also manages the USAID/OFDA Volcano Disaster Assistance Program and the Earthquake Disaster Assistance team.

“While at Michigan Tech I had the opportunity to work with different volcano observatories, agencies, and universities. The contacts I made and the experiences I had helped me to get hired for my first position with USGS and serve me to this day.”

“If you like geology, then study it. I was interested in geology as an undergrad and then really fell in love with volcanology. I was hesitant to get a Master’s degree focused on volcanology because I was told there weren’t any jobs in it. Luckily, I went ahead and did and was fortunate to get a great position.”

—Gari Mayberry

Rob Porritt ’07, PhD Candidate, University of California, Berkeley

Rob Porritt earned a BS in Geological Engineering in 2007. “The GMES department is unquestionably one of the most important influences on where I am now,” says Porritt. “Department Chair Wayne Pennington suggested I pursue an internship, which blossomed into my PhD research. My Enterprise and undergraduate advisor, John Gierke, helped me learn about research, team building, and team leading.”

The coursework gave Porritt a strong science background. “Some of the specialized classes in my last two years were very helpful at making me familiar with the specific questions I am now addressing. The professional meetings, such as SEG, which I attended while at Tech, were also useful to make contacts and see what the future could hold career-wise.”

To Porritt, the hard parts were the common challenges: “Learning personal independence, struggling with tough classes, and finding a part-time job (or five). But I think the biggest challenge for me were the Enterprise/Senior Design projects. These projects really forced me to grow both in terms of research ability and in terms of teamwork. The challenges were invaluable to my personal growth.”

The most enjoyable time at Tech was time spent with friends. “Largely they were friends I met at the residence halls, but I quickly made friends in the GMES department, and the activities we planned through the department (such as rock hunts, broomball, and chili cook-offs) were a lot of fun.”

Porritt is currently a PhD candidate at UC Berkeley studying seismology. “I am working on a project to understand the tectonic structure of the United States by using earthquakes to image the Earth as a doctor uses x-rays to study the internal structure of patients.” In June 2013 Porritt will begin an NSF EAR postdoc at the University of Southern California. He will work on a seismic imaging team investigating the formation of the North American Craton through a seismic array circling Hudson’s Bay.

“Stop considering and just do it; it’s interesting, exciting, has real-world applications, and you will never feel like you’ve ‘worked’ a day in your life as it’s more like getting paid to play.”

—Rob Porritt

Katie (Richards) Gray ’07, Geoscientist, Baker Atlas

Katie Gray earned a BS in Geology from Michigan Tech in 2007. “I started as a chemical engineer and then switched from chemical engineering to chemistry to chemical engineering to chemistry and finally found geology (three years into my schooling) and thought: ‘Why on Earth didn’t I find this earlier!?’ All kidding aside, I had a very difficult time in the geophysics and plate tectonics course. It was a tough class with a good teacher (Jimmy Diehl).

(continued on next page)
“Going on the field trip for Wayne’s well logging class is what made me want to become a field engineer. From that point on, there were no ifs, ands, or buts; I was GOING to be a field engineer and I was GOING to work for Baker Atlas/Baker Hughes!”

For Gray, making new friends and having professors that actually cared was the best part about her time at Michigan Tech. “If it weren’t for the professors in the GMES department, I honestly don’t know if I would have graduated. Bill Gregg was my advisor and he’s the one that convinced the Dean to let me stay in school. His passion for learning is what made me want to try hardest in his classes (all five that he offered). The one thing he told me that still sticks with me today is, ‘if someone tells you that you can’t, prove them wrong. You can do anything that person can, and you can do it better than they ever could. Also, never believe in Christmas tree folds, they don’t exist!’ (This was all in the same conversation.) When I told him that I wanted to be a field engineer for Baker Hughes, he told me to do it and be the best at it. His passion and persistence is what showed me that I could do anything I wanted, as long as I felt passionate about it.”

Gray most certainly achieved her goal. She started as a Field Engineer for Baker Atlas/Baker Hughes in July 2007 in Rock Springs, WY. She is currently working as a Geoscientist III for Baker Atlas in Houston, TX.

“Just try it. The Introduction to Geology course will definitely let you know whether it’s where you need to be or not. And if you are still wondering, take another course. Oh, and one more thing, if you like being knee deep in mud, enjoy wet feet in a river, windy days and field trips to remote locations no matter the weather, then this could very well be the major for you!”

—Katie Richards Gray

**Shannon Lemke ’00, Senior Geologist, Vitruvian Exploration II, LLC**


“I came into the department sure that I wanted to become a geoenvironmental engineer. The degree program is so well-rounded that we were introduced to many different career options within the GMES department. It wasn’t long before I changed my major to Geological Engineering and became interested in geophysics and oil and gas exploration. My interest in oil and gas led me to my work in Houston and my interest in geophysics led me to my husband (we met in electromagnetic geophysics class).”

Lemke now works for a small, private oil exploration company in Texas called Vitruvian Exploration II, LLC. “My job is to explore for oil resource plays in the continental United States.”

While at Michigan Tech, Lemke had a scholarship that covered tuition for four years, so she was very focused on finishing her degree on time. Consequently, she took a fairly heavy course load. At the same time she was a two-sport varsity athlete. “The real challenge was managing my time so that I could devote enough time to my studies to do well, while also having enough time for practice and social time. I really learned to focus on what needed to get done and that has been helpful in my career.

“The GMES department has great professors and small class sizes which for me meant much more individual attention in every class. We also had many opportunities to work for professors and do undergraduate research. I worked for two of my professors and I know their recommendations helped me land my first job. Plus, I think it’s the most fun you can have while becoming an engineer!”

“I loved everything about my time at Tech. I knew I was getting a top-notch education. I got to live in a beautiful part of the state with outdoor activities year-round. And most of the students are also far from home and that seemed to make a closer-knit student community than you might have had otherwise,” she says.

Shannon and her husband Seth started the Bill Gregg Endowment Scholarship. See page 23 for details.

**Darby VanAntwerp ’03, Hydrogeologist/Engineer, TRC**

Darby VanAntwerp earned a BS in Geological Engineering at Michigan Tech in 2003, and an MS in Hydrogeology at Clemson University in 2006.

“Through my courses at Michigan Tech, I learned ‘how to learn’, says VanAntwerp. “It is one thing to memorize theories and equations, but my coursework taught me to assess a problem and gather the necessary information to formulate a solution.”

In particular, she adds, “the summer Field Geology and Field Geophysics
courses were intense (long days, black flies) but the hands-on experience was invaluable.”

At Clemson, VanAntwerp studied numerical simulation of mass transfer during air sparging. “The goal of the research was to develop predictive models to aid in evaluation of potential remediation technologies at a contaminated site.”

Now that she has graduated, VanAntwerp works as a hydrogeologist/engineer at TRC, an environmental consulting firm in Ann Arbor, Michigan. “I primarily work on developing soil and groundwater investigations to assess potential contamination at industrial sites, and then evaluate the data gathered to determine the best approach for clean-up.’’

Time spent in the GMES department at Michigan Tech shaped her life. “Without the opportunity to be involved in research projects as an undergraduate through the GMES department, I am pretty sure I never would have pursued an MS degree and wouldn’t be where I am today. I also felt very well-prepared for entering the workforce. The friends, colleagues, and professors I met at Michigan Tech both in and out of the department enriched my life and still do!”

“If you like math, science, and the outdoors, you should check out Michigan Tech’s geological engineering program. I felt the staff and faculty I encountered genuinely wanted me to succeed.”

—Darby VanAntwerp

Read more at http://goo.gl/1bqST

**In Memoriam**

**WILLIAM J. GREGG, JR.** (1948–2008) was a long-time faculty member in this department who died tragically in an accident at the Quincy Mine on the 6th of December, 2008.

All four of Bill’s degrees were received from the State University of New York at Albany, at a time when that department was one of the premier geoscience departments in the country. In 1979, he joined Michigan Tech, initially conducting research into the oil and gas potential of shales, and along the way became an excellent teacher. He was awarded Michigan Tech’s Distinguished Teaching Award in 1993, and received a similar award from SUNY Albany. Most students in this department who have had Bill as an instructor say he was, by far, their favorite teacher and mentor.

Bill generously volunteered his time at the Quincy Mine, and he was, ironically, preparing to install safety equipment in the shaft when his fall occurred. Former students of Bill’s have contributed generously to a scholarship fund established in his honor (see page 23).

**RICHARD E. HORNATH** (1961–2009), who had recently transferred to this department from Civil and Environmental Engineering, died tragically in a kayaking accident on Baraga County’s Silver River on the 17th of April, 2009.

Richard’s degrees were from Caltech, Carnegie-Mellon, and University of Alaska–Fairbanks. He joined Michigan Tech in 1992, and helped turn it into a globally-recognized center of excellence in atmospheric research, particularly in the measurement and modeling of pollution transport around the world. He established measuring sites in the Azores, in Greenland, and elsewhere, and mentored many grad students and postdocs. He was fondly known for his power of persuasion, through the use of common kindness and respect.

Richard was an avid outdoorsman and an expert kayaker at the time of his accident. Former students and colleagues of Richard’s have set up a fund to honor him with annual visiting lecturers (see page 23).

Read more at http://goo.gl/lkChi and http://goo.gl/OrzMf
JIM WARK ’54 has been honored for the third time by Professional Aerial Photographers Association as the 2012 EPSON Aerial Photographer of the Year.

Wark graduated from Michigan Tech with a BS in both geological engineering and mining engineering and is a member of the Department of Geological and Mining Engineering and Sciences Academy.

This year Wark published his ninth book of aerial photography, *Leave No Trace: The Vanishing North American Wilderness*. Additionally, five of his aerial images were selected for the new United States Postal Service “Forever” postage stamps. Released in October 2012, the stamp set is titled “Earthscapes.”

*Leave No Trace* features North America’s pristine, remote, and very much endangered lands.

“An airplane can circle a mountain peak in minutes, capturing a full array of light, shadow, elevation and perspective that would take days to traverse on the ground,” Wark says. “Aerial photography provides an artistic view unattainable on foot—for times when we may not see ‘the forest, for the trees.’ For me, the chance to incorporate 20 years of my photography in this book was the assignment of a lifetime.”


### Praise for *Leave No Trace: The Vanishing North American Wilderness*

“...you’ve seen plenty of pictures of the Rocky Mountains, the Great Plains, and Utah’s Canyonlands, we trust. But you’ve rarely seen them this close up, this vivid, and captured by such a passionate eye.”

—O. The Oprah Magazine

“Jim Wark’s outstanding and mind expanding aerial photographs of American wilderness give us a bird’s eye view that few of us would ever behold without the assistance of his camera.”

—Michael Brune, Executive Director, Sierra Club
Research awards

**Gregory P. Waite**

**NSF CAREER Award: Predicting volcanic earthquakes**

Assistant Professor Gregory P. Waite was awarded a 2011 Faculty Early CAREER Development Award from the National Science Foundation. The CAREER award carries with it a grant for $415,000 for his research over five years. Waite will use the award to reduce the uncertainties related to volcanic earthquakes.

Waite uses syneruptive volcanic earthquakes to map magma conduits by modeling high-fidelity recordings of the events. This is only possible from recordings made at close range. To collect these data, Waite, his students, and colleagues hike high onto the flanks of erupting volcanoes to place seismometers, which detect ground vibrations, and infrasonic microphones to detect low-frequency pressure waves in the air. Improved models of the deformation field from these events—broadband ground translation and rotation—provide insight into the dynamics of small-scale eruptions. Waite and his students will collect data on sulfur-dioxide emissions, low-frequency sound, and ground tilt, along with seismic data to better constrain these models.

“Ultimately this work will push waveform modeling of volcano seismic signals into wider use,” says Waite. The people living near volcanoes are the ultimate beneficiaries of the research—local populations who need to be informed and warned of impending eruptions. Adoption of his methods, Waite believes, will lead to better understanding of hazards and their mitigation.

**Associate Professor Aleksey Smirnov**

**NSF CAREER Award: Reading magnetic fingerprints from deep time**

**Aleksey Smirnov**

Associate Professor Aleksey Smirnov was awarded a 2012 Faculty Early CAREER Development Award from the National Science Foundation. The award carries with it a grant for $470,000 for his research in the next five years. Smirnov will use the award to gain a better understanding of the Earth’s early magnetic field.

The first four billion years of Earth history (otherwise known as the Precambrian) was a time of many critical transitions in the Earth system, including the oxygenation of the atmosphere and the emergence of life. However, many of these processes and the links between them remain poorly understood. Deciphering the early history of our planet—including the early history of its magnetic field—represents one of the great challenges in Earth science. Available data are scarce, and key questions remain unanswered: When and how did the geomagnetic field start? How did it evolve at early stages, and how did it interact with the biosphere and other Earth system components?

Smirnov’s research will provide high-quality data on the strength of the Precambrian field by investigating the fossil magnetism of several suites of well-dated extrusive and intrusive rocks around the globe. This study will result in nearly doubling the size of current paleointensity database for the Precambrian, including the time periods for which no determinations of the paleofield strength currently exist. These data will provide important insights into early Earth’s geodynamo mechanisms and will have important implications in how we use the magnetic field records to decipher the geological history of our planet, including the age of the inner core.

**Shiliang Wu**

**Ralph E. Powe Junior Faculty Enhancement Award**

Assistant Professor Shiliang Wu, whose research focuses on atmospheric chemistry, air quality, and global environmental change, won the 2010 Ralph E. Powe Junior Faculty Enhancement Award. Wu has a joint appointment in civil and environmental engineering.

Given annually by Oak Ridge Associated Universities (ORAU) in Oak Ridge, Tennessee, the Powe Award recognizes junior faculty at institutions that belong to the scientific university consortium for their outstanding work in engineering and applied science; life sciences; mathematics and computer science; physical sciences; or policy, management or education. Wu also won a 2009 US Environmental Protection Agency (EPA) Early Career Award, receiving $299,596 from the EPA to investigate the effects of changing land use and land cover on atmospheric chemistry and air quality.

Wu was one of Michigan Tech’s first hires in sustainability in the University’s Strategic Faculty Hiring Initiative, an interdisciplinary project to attract outstanding faculty across departmental lines, focusing on various research themes.
**The campus rocks!**

**MICHIGAN TECH NOW** has two new beautiful Boulder Gardens, thanks to recently retired Geology Professor Bill Rose.

The first Boulder Garden was built in September 2010, and graces the campus mall near Dillman Hall. The brainchild of Rose, the boulders represent the geology of the local area.

Rose found most of the boulders on a field trip in Keweenaw County. “They are naturally shaped, glacially transported examples of all the major rock types in the Keweenaw Peninsula,” he said. “They include types that come from solidification of lava flows, conglomerates, and sandstones.”

The boulders have been arranged artistically, so people can walk around them, and they are supplemented with educational materials for research and teaching purposes. “In one two-hour class session, students can observe and analyze data that could only be done from many days of fieldwork, if they were to examine the same diversity of rocks,” Rose explains.

A second, the Mining Boulder Garden, is located on campus near Fisher Hall. It highlights the Upper Peninsula’s mining heritage and Michigan Tech’s role in the industry. It comes at a time when interest in mining is on the rise and Michigan Tech is reviving its mining degree program.

It will also provide a rare glimpse into an earlier epoch through its centerpiece, a Sudbury boulder. The three-ton rock was formed 1.8 billion years ago when a meteorite measuring six to nine miles across slammed into what is now Sudbury, Canada. It blew up on impact, and debris including cobbles, pebbles, and dust produced from that colossal impact was carried hundreds of miles through the air, eventually falling in the UP and Minnesota. One such piece of debris landed at a spot off County Road 510 near Marquette and now lives at Michigan Tech.

It includes the chaotic record of rock fallout that devastated a huge area, “everything from hell to breakfast,” says Rose. “It’s got pieces of everything that was here back then.”

The garden also features several smaller boulders donated by Cliffs Natural Resources, which come from the company’s Empire and Tilden mines in Marquette County.

“Most of them are a banded ore formation,” says Rose. “They were formed in the early ocean, which contained a lot of dissolved iron.”

It took a team to complete the two gardens, including Ashok Agarwal, a local contractor, rock artist, and geophysics alum; Lynn Watson, master gardener; Andy Niemi and Jerod Ledgerwood from the Michigan Tech grounds facilities department; and Bob Barron from the geological and mining engineering and sciences department.

For more information and photos about Michigan Tech’s boulder gardens, visit [http://goo.gl/LzuDr](http://goo.gl/LzuDr)

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*The first Boulder Garden, near Dillman Hall*

*The first Boulder Garden, near Dillman Hall*

*Banded-ore formation in the second Boulder Garden, near Fisher Hall*
New mineral named for Seaman Mineral Museum curator

A NEW MINERAL discovered in the Mammoth—St. Anthony mine in Arizona has been named georgerobinsonite. The mineral is named after George W. Robinson, professor of mineralogy and curator of Michigan Tech’s A. E. Seaman Mineral Museum. It is a lead chromate—a salt of chromic acid—that occurs as minute, transparent, orange-red crystals on cerussite, another lead carbonate and secondary lead mineral.

A team of Canadian scientists discovered the new mineral and reported on it in the October 2011 issue of the journal The Canadian Mineralogist. They decided to name it for Robinson because “George is a prominent curator who has contributed a lot to the mineral community,” said Frank Hawthorne, corresponding author on the journal article and a professor at the University of Manitoba. It is a convention in the profession not to name new minerals for their discoverers, Hawthorne explained.

“It’s a real honor,” said Robinson, who also said the naming came as a complete surprise to him. “It’s like a chemist having a new element named after him.”

Read more at http://goo.gl/XyS5K

RETIREMENT

JIMMY DIEHL AND SUZANNE BESKE-DIEHL retired in May 2011 after a transitional three-year phase. Their retirement was marked by a celebration in the Robbins Atrium on the sixth floor of the Dow Building, where they were surprised by the unexpected arrival of their son, who helped make it special. Both remain active in the Department and University, working with other faculty on proposals and assisting in projects. They also enjoy traveling and visiting with their grown children, as well as hiking in the Sierras, taking advantage of the fall weather to do so.

BILL ROSE retired in January 2012, but waited until June to celebrate the event, so the event could be marked by a gathering on the roof(!) of the Dow Building. Weather cooperated, and it was a wonderful time. Bill remains active. (As Department Chair Wayne Pennington likes to say: “I don’t have to pay him to keep working here anymore.”) Rose has established Boulder Gardens and field experience funding endowments. He continues his international activities and remains engaged with colleagues and students.

Sue and Jimmy Diehl

Bill Rose has plenty to keep him busy during his retirement
SIMON CARN joined the faculty as an assistant professor in 2008 and was recently promoted to associate professor. He holds a PhD in Volcanology from Cambridge University, an MS in Volcanology and Magmatic Processes from Université Blaise Pascal, and a BA in Earth Sciences from Oxford University. His research uses satellite measurements to constrain global volcanic SO2 production and emissions from individual volcanoes. He also validates OMI SO2 retrievals using correlative data from ground-based, airborne and space-borne instruments; tracks volcanic SO2 and ash clouds operationally for aviation hazard mitigation; conducts remote sensing of tropospheric volcanic plumes using DOAS and FTIR, and quantifies anthropogenic emissions of SO2 from sources such as copper smelters and oil and gas fields. Other interests include mitigation of the environmental and health impacts of volcanic degassing using satellite data.

LOUISA KRAMER joined the faculty as an assistant professor in 2010. She came to Michigan Tech from the University of Leicester, UK. She holds a PhD and MS in Atmospheric Science and an MS in Physics with Astrophysics from the University of Leicester. Her research interests include the impact of long-range transported pollution on the Arctic; remote sensing of gases from volcanoes; surface-atmosphere fluxes of reactive gas species from soils and snow; satellite remote sensing and validation; and the development of instrumentation for measuring atmospheric trace gases.

COLLEEN MOUV joined the faculty as an assistant professor in 2012. She holds a PhD and MS in Oceanography from the University of Rhode Island, and a BS in Biology from Western Michigan University. She came to Michigan Tech from the Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center at the University of Wisconsin-Madison. Her research interests include oceanography and limnology, aquatic optics and remote sensing, development of novel aquatic satellite products, aquatic biogeochemical processes, phytoplankton ecology, and response of aquatic systems to environmental change.

THOMAS OOMMEN joined the faculty as an assistant professor in 2011. He came to Michigan Tech from Tufts University. He holds a PhD in Geotechnical and Geoenvironmental Engineering from Tufts University, an MS in System Engineering from University of Alaska—Fairbanks, and a BS in Civil Engineering from M. S. Ramaiah Institute of Technology, India. Oommen’s research focus is in geotechnical earthquake engineering, engineering geology, rock and soil mechanics, numerical modeling of landslides and slope risk assessment, GIS-based geohazard evaluation, remote sensing for geotechniques and infrastructure management, and machine learning and computer vision methods for natural hazard-induced damage estimation.

MUHAMMAD RAZA joined the faculty as an instructor in 2012 to instruct senior-level mining engineering courses and to advise senior design projects. He is a PhD candidate in Mining Engineering at Missouri S&T. He holds MS degrees in Mining Engineering and Computer Science, and a BS degree in Mining Engineering from University of Engineering and Technology, Pakistan. Muhammad has a diverse and vast experience of teaching mining engineering curriculum as he has served as a lecturer and an assistant professor in Pakistan, and as an instructor at Missouri S&T. His PhD research focuses on cable shovel stress and fatigue failure modeling in excavation engineering. His other research and teaching interests include mine design and planning, optimization of mine operations and layout, ore body modeling and reserve estimation, and reliability studies of mine equipment. Muhammad enjoys outdoor activities such as camping, hiking, and traveling during his spare time, and has played cricket and hockey for his school.

JEREMY SHANNON joined the faculty as a lecturer in 2010. He holds a PhD in Geology, and MS and BS degree in Geological Engineering, all from Michigan Tech. Shannon’s teaching responsibilities include Understanding the Earth, Environmental Geology, Structural Geology, Depositional Systems, and Field Geophysics. In addition to teaching, he is also the
academic advisor for undergraduate majors in geology and geophysics. Prior to returning to Michigan Tech, he was an assistant professor at Finlandia University.

SHILIANG WU joined the faculty as an assistant professor in January 2009. He holds a PhD in Atmospheric Science from Harvard University. He comes to Michigan Tech from Harvard. His research interests include interactions among climate, atmospheric chemistry, air quality, and land use/land cover, impacts of global change on atmospheric chemistry and long-range transport of air pollution, anthropogenic perturbations to the atmosphere and implications for environmental sustainability, and atmosphere-biosphere interactions, especially in the context of global change.

JASON GULLEY joined the faculty as an assistant professor in January 2013. He comes to Michigan Tech from the University of Texas at Austin’s Jackson School of Geosciences where he was an NSF Earth Sciences Postdoctoral Fellow at the Institute of Geosciences. He holds a PhD in Geology from the University of Florida. Gulley is investigating how spatiotemporal variation in recharge to glacier beds affects links between the evolution of subglacial drainage systems and the velocity structure of glaciers and ice sheets. His research involves adapting natural and artificial tracer techniques developed to understand flow paths and residence times in karst aquifers and glaciers. He frequently uses caving techniques to install instrumentation, make observations, and conduct experiments in englacial and subglacial drainage systems. He is also interested in understanding the processes governing self-organizing fluid flow and secondary porosity generation in carbonate platforms.

MORE IMAGES FROM THE 2013 GEOLOGY CALENDAR

Get yourself a Geology Club 2013 Wall Calendar, or pre-order a calendar for 2014. Call Kelly at 906-487-2531 or email kelly@mtu.edu. See page 3 for more info.
LINDSEY KENYON graduated from Michigan Tech with a BS in Geology last April. The summer between her junior and senior year at Michigan Tech greatly shaped her life and career. That was the summer Kenyon tackled not one, but two extremely challenging seismology internships. The first was a Michigan Tech Summer Undergraduate Research internship. Kenyon worked with Dr. Greg Waite to determine the near-surface velocity structure of Guatemala’s Pacaya Volcano using the spatial autocorrelation method. The second internship was sponsored by the Incorporated Research Institutions for Seismology (IRIS). It was also the summer Kenyon made the contact that enabled her to visit and study Antarctica, one of her life’s dreams.

“The IRIS program has an orientation week in New Mexico to learn the many computational and field skills that are useful in seismology,” Kenyon explains. “Each intern goes to a university to work on a research project with a professor for eight to ten weeks. To fit this in the same summer as the SURF project, I did about three and a half weeks of research for SURF at Michigan Tech, starting the Monday after finals of spring semester. Then I completed one week of orientation and eight weeks of research at Indiana University, working under Professor Gary Pavlis. Finally, I came straight back to Michigan Tech for three more weeks of research on the SURF project before starting fall semester one week later.”

“I’m a greater believer in luck, and I find the harder I work, the more I have of it.”

—Thomas Jefferson

At Indiana University, Kenyon investigated the upper mantle structure of Southeast Alaska as revealed by teleseismic P-waves. “I spent my time preparing data for a 3D tomography model of where the oceanic plate is subducting under Alaska. It was very independent work, although I did get to do a week of fieldwork in Southern Illinois where I helped prepare for the installation of the seismometers, which will study the New Madrid fault.”

“It was challenging to learn when to spend a few hours figuring something out by myself and when to save time and ask for help. In class, I work hard and read the textbook, so I know the answers, but there is no textbook for research, so I had to learn how to say ‘I don’t know’ more often.”

“I also learned more about myself. While I am great at the computer work associated with my research, I need to interact more with other people. It helped me realize I want work that is more cooperative in nature, or has a fieldwork component to it.”

The IRIS internship provided funding for Kenyon to attend the American Geophysical Union Fall Meeting, where she presented a poster on both projects. “I ended up meeting my graduate school advisor at the meeting. She, too, had been an IRIS intern many years ago.”

Kenyon now attends the University of Alabama in Tuscaloosa, where she is earning an MS in Geophysics. “I really want to stick with the field of seismology. I will be doing field work in Antarctica, something I am truly excited about. After that I will most likely pursue a PhD in seismology.”
Collecting rock samples in the Australian outback

DANFORD (CHAD) MOORE, a geophysics major, began working with Geophysics Associate Professor Aleksey Smirnov during his first year at Michigan Tech, taking part in undergraduate research.

For two summers Moore and Smirnov camped in the Australian outback for about a month at a time, gathering samples of well-preserved, 2.7 to 3.5 billion-year-old Precambrian rocks. On one trip, the two gathered 900 samples from the Pilbara Craton in northwest Western Australia.

“We did the majority of our field work in the middle of the desert,” Moore explains. “The desert obviously brings to mind a complete lack of water, and for the most part this proved true for us. We used water for the normal things (i.e. drinking, cooking, cleaning, etc.), but we also used water-cooled drills to collect our core samples. When you collect nearly a thousand core samples over the course of a field season, you go through quite a bit of water, so a fair amount of our planning focused on water availability.”

“The outback is a beautiful and incredible place; however, it is also very hazardous,” adds Moore. “Almost all creatures found in the desert are either venomous or have the ability to rip you to shreds with bacteria-ridden teeth and claws. I don’t think there is a single critter in Australia that doesn’t have the potential to kill, and that includes the cute ones… strike that, it especially includes the cute ones.”

Back on campus, Moore spent countless hours in the lab preparing and measuring the specimens. As an undergraduate, he presented his results at an American Geophysical Union (AGU) meeting. He is now working in marine seismic acquisition for ION Geophysical Corporation.

“I am very thankful for having the opportunity to participate in undergraduate research,” adds Moore. “I can’t even begin to explain the impact it has had on my life.”
EARTHQUAKES IN THE UP?
Small earthquakes can occur almost anywhere, as stress accumulates locally and is occasionally released suddenly—even in the Upper Peninsula of Michigan and northern Wisconsin.

The shaking and loud noise experienced in October 2010 in Menominee County was a small earthquake, probably a magnitude 1 or 2. The resulting ridge and crack are 361 feet long, and the ridge is 4 to 5 feet high and 20 to 30 feet wide at its largest point. Residents report that both the ridge and crack appeared at the same time, apparently coinciding with the earthquake. The crack is 2 feet wide and 4 to 5 feet deep at its largest point. Trees are tipped away from the crack at about 14 degrees on either side.

GAMES department chair Wayne Pennington visited the site. “The most-likely explanation is that the underlying limestone experienced a ‘pop-up,’” relieving stress that had accumulated in the uppermost few tens of feet of that layer,” he explains. “The limestone is hard and brittle, and this movement can be described as the small earthquake that was felt. Overlying the limestone is about 20 feet of soft clay. This clay will deform in a ‘mushy’ manner, rather than breaking along a fault. It ends up being pushed together, and this is what formed the ridge.”

In an unrelated incident, last March, residents of Clintonville, Wisconsin (population 4,559) began to hear deep, rumbling sounds from time to time. To find out why, GAMES assistant professor Greg Waite and his grad students Josh Richardson and Kathleen McKee lent their expertise.

They installed four seismometers and eight sound sensors around Clintonville in an effort to record anything that could relate to the booms. “These types of noises have been reported for small shallow earthquakes in many places worldwide,” Waite said. “However, the noises in Clintonville were somewhat difficult to explain, because earthquakes are uncommon in Wisconsin, and most of the sounds were not accompanied by felt earthquakes.”

Waite and his graduate students arrived just in time to record a small earthquake at 8:09 p.m. on Thursday, March 29. “At about that time, several calls from the southeast part of town were made to the Clintonville police department, reporting booming sounds,” Waite said. “These booming sounds were due to the earthquake.”

It was the second recorded instance. The first was on March 20—a larger 1.5 magnitude event. This earthquake was large enough to be recorded at stations up to 230 km (140 miles) away.

“The goal of this work is not only to provide confirmation of earthquakes as the cause of the sound, but to investigate the occurrence of this small swarm of earthquakes in an area where they are so uncommon,” Waite said. “In addition, we are interested in the mechanism responsible for generating audible sound from these small events. The data from these sensors are being fed directly into the USGS (US Geological Survey) National Earthquake Information Center.”

Read more at http://goo.gl/23sGo and http://goo.gl/zQZcu
Seaman Mineral Museum lives on top of Mabbs mine shaft

THE IRONY OF AN OLD MINE shaft being discovered during the construction of a new mineral museum building is not lost on Ted Bornhorst.

Bornhorst is director of the A. E. Seaman Mineral Museum, whose new building straddles the old shaft. With the help of the Michigan Tech Archives, he has been able to trace historical references to the shaft as far back as the 1860s.

Actually, there are four shafts, ranging in depth from 80 to 200 feet, near the site of the new museum that sits on the southern edge of the Michigan Tech campus, adjacent to the Advanced Technology Development Complex.

Construction crews discovered the main shaft, and Michigan Tech facilities management personnel capped it using some 700 tons of concrete. Although some thought it would be nice to save a shaft as part of the museum grounds, it just wasn’t feasible.

“It was the Mabbs vein, named after brothers John and Austin, and it resided within the boundaries of the old Isle Royale Mining Company,” Bornhorst says. According to his sources, a vertically standing single mass of copper weighing 2,300 pounds was taken out 70 feet below what was the main “F” shaft in 1865.

“The Mabbs lode was a tabular vein, about five feet wide and cutting across the host rocks, comprising a cluster of small seams up to five inches thick, rather than a single, well-defined vein,” Bornhorst says.

Large amounts of water infiltrating the mine made mining difficult, but the F shaft reached down 160 feet, with drifts driven north and south within one year, according to Bornhorst. The F shaft soon produced nearly 24,000 pounds of copper, but still wasn’t making money.

“Despite John Mabbs’ objection, the company shut down the unprofitable mining operations at the Mabbs vein a year later,” Bornhorst says. Although mining was resumed later by the Mabbs brothers, and they raised another one-ton slab, the shaft ended operations by the 1870s.

The Mabbs are credited with bringing various mining technologies to the Keweenaw and the world, including an early power drill. They also attempted to bring nitroglycerin to the area, but they were threatened to be “ridden out of town on a rail,” according to newspaper accounts of the day.

“After more than 125 years out of sight, the Mabbs brothers are once again, and will be for years to come, a visible part of Copper Country history,” Bornhorst says. “The brothers were risk-taking entrepreneurs, innovators, and preservers of history, qualities exemplified by Michigan Tech students since its founding.”

Read more at http://goo.gl/D1sS2
Amie Ledgerwood: Lean facilitator extraordinaire

THE GMES GRADUATE PROGRAM is a complex system. It involves responding to prospective student inquiries, handling application submissions and reviews, visits, registration, office assignments, orientation, and most importantly, monitoring the bureaucracy as students progress towards completion. The Peace Corps Masters International Program is especially challenging to coordinate, as the students are abroad for over two years and in places where communication can be difficult.

Graduate coordinator Amie Ledgerwood continually strives to improve efficiency in all aspects. Her efforts towards improving the GMES department’s graduate program operation led to her involvement in Lean.

“Lean” is considered a philosophy of continuous improvement. A Lean organization focuses on increasing customer value, the elimination of waste and optimizing operations. Ledgerwood completed Lean training in 2012 and is now one of twenty-four Lean facilitators on campus.

“As humans, we are problem solvers,” she adds. “If you can find the root cause of a problem, you can begin to fix it.”

A great way to get started with Lean is to hold or participate in a Kaizen event—a method of tearing a process apart and putting it back together while at the same time reducing waste. “In order to tear it apart, you typically need to map it out—which hands touch which steps from start to finish—and think granular. It’s fun to see the results, both visual and functional.” It’s also important to be able to measure success, she says. “Success doesn’t always have to be dollars and cents.”

Ledgerwood used Lean Kaizen to improve the graduate application receipt, tracking, and review process. Her efforts resulted in a 27 percent reduction in process steps to prepare graduate student applications for committee review. Committee review time was also reduced to less than 20 days (prior average was 50 days).

GMES Professor John Gierke recently nominated Ledgerwood for the Michigan Tech Staff Making a Difference Awards. “It takes a special talent to observe the eclectic behaviors of different faculty and creatively figure out systems to help them function more efficiently,” he says.

Ledgerwood recently did an overhaul of the department supply room. “Amie used her newly found wisdom from her Lean training and the results were phenomenal,” notes department coordinator Kelly McLean. “With the new procedures she incorporated, it is now easy to find items with just a simple glance at the cabinets where they are kept.”

Adds Gierke: “We never seem to be out of any supplies and it is not because we have a large stockpile but rather the organizational system is now so efficient that the office staff can readily replenish supplies without us having to inform them we are empty. The system is easy and requires no training.”

“Lean is based on the Five S’s: Sort, Straighten, Sweep/Shine, Standardize and Sustain. It’s never really done,” adds Ledgerwood. “It’s important to revisit to make small improvements.”

In addition to reducing waste and improving a specific process, Lean is also about building a culture, one that respects all employees and enables them to pursue opportunities to improve their work and share ideas for continuous improvement.

A big part of Lean, Ledgerwood explains, is a no-blame atmosphere—where everyone can talk about the issues needing to be resolved.
JAY WELLIK IS A PEACE CORPS  Masters International student studying volcanic hazards. He is spending 27 months in Banyuwangi province, East Java, Indonesia, working at the Raung Volcano Observatory, where he installs and introduces digital seismic waveform analysis software packages including SEISAN and SWARM to the observatory staff. Wellik’s work at the Raung post is closely tied to work and observations made at the Ijen post. “These two volcanoes are close in proximity and may be linked magmatically,” he says.

The new installation of digital recording devices has opened up Raung and Ijen to brand new research possibilities. Wellik provides education in basic geologic and volcanic science to observatory staff members so that new scientific tools and instrumentation, provided by the US Geological Survey, can be used more robustly in the future.

Last October seismic activity at Raung increased dramatically above background levels. This kicked off a busy few weeks—and a furious few days in particular—for Wellik and the post.

“Geophysically speaking, not much came of the spike in activity,” he writes in his blog, House of Glass. “There were a few visible ash eruptions and other evidence of ‘Strombolian’ activity at the vent but nothing that reached beyond Raung’s massive summit crater. This happens sometimes with volcanoes: there will be much ado about nothing. Still, any warning signal has to be taken seriously. This is especially true at Raung where there are effectively no historical records that can be compared with observations today. It has led to uncertainty in the expected eruptive outcome, and as a result, Indonesia’s Center of Volcanology and Geological Hazard Mitigation prepared for the worse. They set their whole crisis response paradigm into motion, and I have seen and been a part of the unfolding of that process.”

In addition to his work at Raung and Ijen, Wellik is interested in demographic trends related to volcanic hazards. He is quantifying relative threat scores at each volcano across the globe. “Our goal is to provide some sort of meaningful hazard comparison across the entire planet that can be used to analyze long-term population trends in the context of potential disaster. The project has special relevance to Java, which is densely populated with both people and volcanoes,” he says.

Assistant Professor Greg Waite and Associate Professor Simon Carn are Wellik’s coadvisors.

To read more of Jay Wellik’s blog, House of Glass, visit http://jjwpcmi.wordpress.com/ and use the password: ’banyuwangi.’
**STUDENT NEWS**

**Jeremy Loucks | East Africa Field Camp**

**Jeremy Loucks** took part in Professor Jim Wood’s annual Kenya field trip during his senior year. Loucks is now a graduate student in the department. His goal is to become a historical geologist, and possibly a teacher as well.

Loucks found out about the trip from Dr. Wood while in one of his courses. “The trip offered a good mix of adventure and geology, and it counted for credit. Sometimes you just have to live big,” Loucks explains. The department gave Loucks a scholarship that covered his airfare, and a student loan covered the rest.

How was it? “Most days of the trip were spent in the field. We traveled all over the country, observing the unique geology of the region,” said Loucks. “We took two major trips, one of them traveling for a week north of Nairobi.”

“**I set out to learn Kenyan rift geology, to learn about a culture completely different than where I grew up, and to have one heck of an adventure. The trip accomplished all three.**”

~Jeremy Loucks

exercises using satellite imagery, our GPS tracking, and our field notes.”

The travel was sometimes challenging, due to some days having two-plus hour rides each way to get out to sites. “I will never, ever complain about traffic in the US ever again after seeing how other countries handle traffic,” notes Loucks. The group traversed rough, rocky areas, dodging the ever-present thorny plants that live in the rift valley.

“My understanding of geology, and how to map using current techniques, was drastically expanded,” adds Loucks. “I ate wonderful foods that I’d never even dreamed of. I spent a large portion of a seventeen-hour train ride talking to world travelers from Scotland, England, and Canada. I learned about an entirely new culture, one that I still read about and research today. Above all, it was a great trip with great people.”

This year’s field camp will be held in South Africa and Namibia in May and June. For more info, visit [http://www.geo-kenya.com/](http://www.geo-kenya.com/)
Giving: three special opportunities

Dr. William J. Gregg Annual Scholarship

This scholarship fund was established to honor the memory of Dr. William J. Gregg. Gifts go toward a scholarship award, for which juniors and seniors majoring in a program within the Department of Geological and Mining Engineering and Sciences are eligible. Awardees must maintain a minimum GPA of 3.0 and possess a love for geology. Two of Dr. Gregg’s former students established the scholarship fund in his memory. Seth and Shannon (Bair) Lemke both graduated from Michigan Tech in 2000, Shannon with a BS in Geological Engineering and Seth with a BS in both Geological Engineering and Geophysics. The couple provided initial gifts to set the fund en route to endowment. The annual award amount will be $1,000 or 10 percent of in-state tuition, whichever is greater. The Lemkes are challenging Gregg’s friends and former students to contribute to strengthen the endowment. Read more at http://goo.gl/cZZI2

Richard E. Honrath Jr. Memorial Fund

This memorial fund was established to honor the late Professor Richard E. Honrath and to further his vision of scholarship. Gifts made to the fund support the Richard E. Honrath Memorial Lecture, as well as provide scholarships for undergraduate and graduate students whose major or research demonstrates a commitment to protecting the environment and/or pursuing knowledge about the Earth’s natural forces. Invited lecturers are internationally recognized scholars in the area of atmospheric sciences who interact substantially with students during their visit.

In order to help bring the fund to endowment status, initial donations were matched on a 1:4 basis. Continuing gifts will strengthen the fund and enable improved scholarships, fellowships, and the annual lecture program. Matching funds were generously offered by Alex Mayer, Suzanne Van Dam, and two anonymous donors.

Bill Rose Geoscience Student Travel Endowment

Professor Bill Rose requests your help building an endowment that can support the travel of 10-20 students each year for professional field experiences.

“The best geoscientists are the ones who have seen the most rocks.” This is what we say to raise the importance of field experience in the eyes of students. In geoscience, it is hard to underestimate this. Bill Rose has taught for 42 years in Tech’s geoscience program, and every year has led groups of investigators from around the world to Earth’s volcanoes and volcanic regions. When he retired last December he started a special endowment fund to help students get more field experience.

Dr. Rose’s goal is to build an endowed fund of about $250,000. “I’ve counted more than 1900 Geo alums in the past 41 years. If everyone gave $100, we’d be there. But it gets better. I am willing to help substantially. I’ll match the first $100,000 of gifts dollar for dollar. I want to show my sincere support of this idea. I am convinced that field travel really helps students.”

Please visit www.mtu.edu/geo/department/giving/ to read more about these three funds (and others) and to give online. Prefer instead to give by phone, or via mail? Contact the Michigan Tech Fund at 906-487-2310, or mail a check to Michigan Tech Fund, 1400 Townsend Drive, Houghton, MI 49931. Please be sure to indicate the name of the fund you’d like to support. Many, many thanks!
It’s a mystery.

This copper piece arrived at the GMES department a couple of weeks ago in a box with no return address (as it was sent from a UPS store or something of the sort). Inside was the copper piece (wrapped extra carefully) and a note that it was “borrowed” from the lab in the 70’s—handwritten, unsigned, on a piece of paper from a hotel. Thank you, whoever you are! We are both touched and grateful for its safe return.