

FALL 2016

GEOLOGICAL ENGINEERING



UNIVERSITY OF WISCONSIN-MADISON



ENGINEER
AIDS EFFORTS
TO PRESERVE
ANCIENT SITE



Bill Likos

GREETINGS!

This year has been marked by changes to our program structure, continued growth of our student body, and outstanding accomplishments

from our students and faculty.

I am happy to report that, starting in fall 2016, our administrative structure has become more closely aligned with the Department of Civil and Environmental Engineering (CEE) to ensure our long-term success as we continue on our current pace of remarkable growth. GLE now includes more than 145 undergraduate students and 20 graduate students, the largest the program has ever been! Aligning the GLE administrative structure with CEE provides a stable link to the College of Engineering while allowing us to maintain our unique interdisciplinary connection with the the Department of Geo-science, to independently manage our curriculum and dual major in GLE and geoscience, to continue to offer BS, MS and PhD degrees in GLE, and to hire the best and brightest faculty needed to support our growing program.



SUPPORT GLE!

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**ENGINEERING
FORWARD**

Or contact:

Rob Herrick (608) 308-5359

rob.herrick@supportuw.org

The job market for our graduates remains very strong, which reflects the strong nationwide demand for engineers (and the shortage of available engineers). Analysis from the Bureau of Labor Statistics indicates that anticipated growth in employment of mining and geological engineers remains greater than for all other engineering occupations over the next decade. Our graduates have been receiving multiple offers with very competitive

salaries. Indeed, this is a good time to be graduating from GLE!

Our students continue to make us proud. Undergraduate student Miles Tryon-Petith was among 60 college students nationwide selected for a Udall scholarship in recognition of commitment to issues related to the environment or American Indian communities. Graduate students Merve Gizem Bozkurt, Jiannan Chen, Hulya Salihoglu, and Kuo Tian wrote an outstanding article about Harry Poulos, a leading authority in foundation engineering, which appeared in *GeoSTRATA* published by the American Society of Civil Engineers (ASCE). Eleanor Bloom presented her research on sustainable systems for residential heating and cooling at a conference in Japan. We also made a huge showing at the ASCE Geo-Institute conference held in Chicago, where our students and faculty gave more than 16 presentations! GLE was in full force at the conference and we had a great time celebrating with alumni, students and friends at a memorable reception on the Chicago River.

In faculty news, Professors Tracey Holloway, Andrea Hicks, and Lucas Zoet joined as new GLE program faculty. Professor Holloway is affiliated with the Nelson Institute for Environmental



Alumni gathered in Houston at the home of Steve Erbstoesser for a mini reunion and brat fry, including (left to right): Moo Lee (MS '86), Tom Doe (PhD '80), Jay Avasthi (PhD '81), Steve Erbstoesser (BS '74), Giin-Fa Fuh (PhD '78), "AZ" Hayatdavoudi (MS '73), and Paul LaPointe (PhD '80).

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Studies and conducts research on links between air quality, energy and climate. Assistant Professor Hicks, who joined the Department of Civil and Environmental Engineering in fall 2015, specializes in quantifying the environmental impact of products and processes using life cycle assessment tools. Assistant Professor Zoet is a faculty member in the Department of Geoscience and studies glacial process through a combination of glaciology and glacial geomorphology.

We are excited about both the past and future of our program and would like to invite all our alumni back to Madison Sept. 13-15, 2017, for the Geological, Mining and Geotechnical Engineering 2nd Technical Conference and Alumni Reunion. This event will be in the form of a two-day conference with guest presentations from GLE and mining engineering alumni and friends. Please contact Ryan Shedivy (MS '12) at rshedivy@golder.com for questions about the reunion, mark your calendar, and be on the lookout for additional information to follow as we move forward with planning this exciting event.

Finally, I would like to thank all of our alumni who continue to support this outstanding program. Our growth and success would not



GLE students, alumni, and friends celebrated along the banks of the Chicago River during the ASCE Geo-Institute conference held in August. The Badgers made a huge splash at the conference and gave more than 16 presentations on ongoing research and student activities.

be possible without your generous support. Information about supporting GLE can be found at gle.wisc.edu/support-gle or by contacting Rob Herrick (Rob.Herrick@supportuw.org). We will use your gifts to continue providing exceptional student experiences.

As always, feel free to reach out to me at likos@wisc.edu or (608) 890-2662.

ON, WISCONSIN!

*William J. Likos, Professor,
Director, Geological Engineering*

Longtime engineering dean passes away

As dean of the University of Wisconsin-Madison College of Engineering, Paul Percy constantly sought ways to help students succeed in engineering. In ongoing efforts to educate “global” engineers, he focused on diverse and interdisciplinary experiences, innovations in teaching engineering, and on hands-on work that connected the technical aspects of engineering students’ education with real challenges facing society.

“Engineering is where science meets society,” he said in a 2012 interview, referring to myriad global challenges, including energy needs and pollution. “These are problems that can’t be solved without engineers and can’t be solved by engineers alone.”

Percy, who served as dean from 1999 until his retirement 2013, died Oct. 20, 2016, after a lengthy illness.

Read more and learn how you can make a gift in Percy’s memory that helps carry on his commitment to undergraduate education here: go.wisc.edu/percy-passes-away





ENGINEER AIDS EFFORTS TO PRESERVE ANCIENT SITE

Using state-of-the-art, non-destructive evaluation and underground imaging techniques, Dante Fratta reveals buried secrets without lifting a shovel. And in summer 2016, Fratta, an associate professor of geological engineering and civil and environmental engineering, was part of international team of experts who used modern methods in an effort to preserve the ancient Church of the Nativity in Bethlehem. Their research, published in a preliminary progress report, Aug. 3, 2016, already has helped prevent an important piece of world history from crumbling.

Located in the center of Bethlehem, the Church of the Nativity is a World Heritage Site and a major tourist attraction, particularly for Christians, because it is located atop the site where Jesus Christ is said to have been born. But the structure itself is damaged and degraded; in 2008, the World Monuments Fund placed it on a watch list of the 100 most endangered world sites. In 2010, the Palestinian Authority announced plans for a multimillion-dollar restoration effort, the initial phase of which concluded earlier in 2016.

The church's age—originally built in 339 A.D.—and many additions and iterations also pique archaeologists' interest. And when a recent excavation came precariously close to undermining the support beneath a structural column within the Church of the Nativity's Hall of Saint Jerome, Palestinian authorities wisely called a halt to all digging until experts could assess the edifice.

Those experts—a team led by Professor Miguel Pando and hailing from such diverse locales as Portugal, Peru, North Carolina and Wisconsin—traveled to Israel in July 2016 with one primary mission: Measure everything they could about the ancient building in order to protect it from damage. Each person brought unique knowledge and expertise: Together, they spent a week placing sensors, measuring vibrations, scanning surfaces with lasers, and probing beneath the soil with ground-penetrating radar (GPR) and seismic waves. They created virtual three-dimensional maps of the hall that featured detailed descriptions of all cracks and damage, and they also installed a network of sensors that will monitor the church long-term and ensure it doesn't deteriorate further.

Throughout their investigations, the researchers also were conscious and respectful of the varying political views and religious customs prevalent in the region. In fact, not one, but four, different denominations oversee all activities at the Church of the Nativity. Different sections of the church belong to the Roman Catholic, Greek Orthodox, and Armenian Apostolic, and Syriac Orthodox church authorities. And even though the Hall of Saint Jerome falls under the auspices of the Armenian Church, all of the churches needed to grant approval for every protocol.

One of the researchers' early recommendations was that one of the columns in the hall desperately needs retrofitting and stabilization before any future excavations can proceed. However, even though they have returned to their homes, the researchers continue to communicate and interpret data from the sensors they left in place. In the future, they also will guide future excavations so that archaeologists can learn more about ancient history in the region.

Support through the Civil & Environmental Engineering annual fund, which enables us to respond quickly to emerging opportunities, helped make Fratta's participation in this important research possible.

Dante Fratta

BADGERS GO BIG IN CHICAGO!

The Geo-Chicago conference, held in August 2016 in Chicago, Illinois, brought together geotechnical-focused engineers from across the world, prompting a dialogue on sustainability, energy and the geoenvironment. Hosted by the Geo-Institute of the American Society of Civil Engineers, the event featured special lectures, encouraged networking and allowed engineers to exhibit their research.



UW-Madison engineers gave more than 16 presentations at the conference, making a “huge splash,” says Bill Likos, professor and director of the geological engineering program.

Presentations documented ongoing research and student activities, allowing visitors to see the excellence of the program firsthand. “I was proud to be part of the UW family,” says Idil Deniz Akin, a geological engineering PhD student.

At the event, Akin gave the presentation, “Water vapor sorption of polymer-modified bentonites,” which was about developing alternative sorption-based screening tests for the chemical compatibility of geosynthetic clay liners.

The event united Badger alumni, graduate students, visiting scholars and professors, boasting 27 UW-Madison representatives total—probably the largest appearance by any group at the event.



A courtyard in the Church of the Nativity complex



The Mosque of Omar (center), located in Manger Square, near the Church of the Nativity



Team leader Professor Miguel Pando catalogs evidence in St. Jerome Hall, site of much of the researchers' work

When GLE graduate student Eleanor Bloom presented her research on sustainable systems for residential heating and cooling at a conference in Kashiwa, Japan, she earned second place in a poster session featuring student research from several countries.

The graduate school program in sustainability science at the University of Tokyo, Kashiwa Campus, hosted the conference.

The conference highlighted the school's graduate program, the Graduate Program in Sustainability Science–Global Leadership Initiative (GPSSGLI) and compared it to unique graduate student programs in sustainability globally.

Participants also visited Kashiwa's Smart City, which is part of an ongoing partnership between the city and the university in which graduate students study sustainability through real-world applications of environmental sustainability, health and wellness, and business innovation in a part of Kashiwa called the Smart City.

Here's a quick Q&A with Bloom about her experiences in Japan.



What's unique about Kashiwa's graduate school program in sustainability?



The graduate program is focused specifically in sustainability science, which was a new term for me. It really had a very strong social aspect to it, which is something I don't always think about as much because I'm an engineer. They also added the component called the Global Leadership Initiative because all the students go see different countries and get to experience the challenges felt in sustainability all over the world.



What did you see in Kashiwa that you'd like to see in Madison?



The Kashiwa graduate program and the Smart City put a lot of emphasis on the health and wellness component of cities, which is one of the key goals for the Smart City. They provide free health centers, public gyms, and access to health resources. They really value health and longevity in their view of sustainability, and I'd like to see more of that here.



In your opinion, what do you think was the most interesting thing you experienced?



It was neat that I got to go to the Smart City, which is something I would not have done if I was just traveling or visiting Tokyo. The Smart City is a small-scale, sustainable city. It has residential energy tracking, public bike rentals, smart car infrastructure, and public transit via bus and train.

The city also has a lot of public health programs. I think it's so interesting that the city can work with the university and to see how the city grows.



How will you incorporate what you learned into your graduate studies?



It was good to step back out of my limited, technical view in engineering. While I'm already in a graduate program at UW–Madison, I think the GPSSGLI would be a great program for the university to promote to prospective graduate students who want to get graduate-level education in sustainability.

Unearthing the source of radium in municipal wells

Rocks and sediment in the aquifers deep below the earth naturally add elements such as radium to the groundwater. Yet, even as our public drinking water systems draw on this groundwater, the levels of radium—a known carcinogen—historically have fallen well below the U.S. Environmental Protection Agency’s (EPA) maximum contaminant levels.

Yet, there are exceptions—particularly in the eastern and central United States—and Assistant Professor Matthew Ginder-Vogel and Madeline Gotkowitz, a hydrogeologist at the Wisconsin Geological and Natural History Survey, are leading an effort to find out why.

They are starting locally, in Wisconsin, where elevated radium levels in some municipal wells are a concern. In May 2016, for example, the city of Waukesha earned a unanimous vote from Great Lakes governors for its proposal to tap water from Lake Michigan after city wells repeatedly were found to contain levels of radium that exceeded limits set forth in the EPA’s Safe Drinking Water Act. Waukesha is located in the “Radium Belt” in eastern Wisconsin, where deep, saline brines are the predominant source of radium to municipal wells. However, in the south-central part of the state the geologic sources of radium are not as well defined. Ginder-Vogel is hoping to determine the sources of radium in the groundwater of the Mt. Simon aquifer, which Madison and many other communities in Wisconsin, Illinois and Minnesota use for drinking water. Since the aquifer stretches across several states, the project could have a far-reaching impact.

The aquifer is structurally complex, which makes it difficult to make overarching assumptions about the radium’s source. Because the aquifer is made of limestone-cemented sandstone and held together by calcium carbonate minerals, it’s possible, says Ginder-Vogel, that decaying uranium

and/or thorium in the cement is releasing radium as a byproduct. “Additionally, there are interbedded shales within the aquifer itself, as well as saline brines at the bottom,” says Ginder-Vogel. “So everyone’s question is, if all three of these components are possible sources of radium, where is it actually coming from?”

Ginder-Vogel and Gotkowitz are working on extracting groundwater samples from area wells to evaluate their isotopic composition. By comparing the isotopic ratio, they can start to determine where exactly the radium is coming from. “If the isotopic composition of the samples is similar to the uranium-thorium ratio in limestone, I can say it came from the limestone,” Ginder-Vogel explains. “If it’s similar to the uranium-thorium in the shales, I know it came from a shale.”

The scientists are working closely with the Madison

Water Utility, since their tests can help municipal well managers plan for the future. For instance, if the brines moving toward the bottom of the well are causing the high levels of radium, it’s possible to abandon that part of the well entirely. Although such a change could mean a reduction in the amount of water produced, it would be a small concession for safe and drinkable water.



Madeline Gotkowitz (left) and graduate student Madeleine Mathews collect a water sample for Radium analysis. Inset: Matt Ginder-Vogel





IN THE MEDIA: Professor Jean Bahr

To celebrate its 50th anniversary, the journal *Water Resources Research* featured Geoscience Professor Jean Bahr in a Q&A that centered around past water research and how it can inform future research that focuses on water systems for the development and benefit of society. Bahr is a member of the journal's editorial board.

READ THE Q&A:

eos.org/agu-news/water-resources-research-at-50-journals-lasting-impact-expected-to-grow/



College of Engineering
UNIVERSITY OF WISCONSIN-MADISON

Geological Engineering
1415 Engineering Dr.
Madison, WI 53706

GLE student among 60 Udall Scholars nationwide

Fourth-year student **Miles Tryon-Petith** is among two UW-Madison students and 60 college students nationwide selected for the scholarship, awarded to college sophomores and juniors by the Morris K. Udall and Stewart L. Udall Foundation. The awards are worth up to \$7,000 each and recognize student leadership, public service and commitment to issues related to the environment or issues in American Indian communities.

Tryon-Petith, who majors in geology, geological engineering and geophysics, received an honorable mention from the Udall Foundation in 2015. He has spent several months in Freiburg, Germany, studying and aiding the city's Green City initiative and also has worked in the UW-Madison Office of Sustainability as a student operations coordinator and a leader in the Student Move-Out Recycling Project.

The Udall Foundation is a federal agency dedicated to promoting leadership, education, collaboration and conflict resolution in the areas of the environment, natural resources and public lands. The foundation's goals are to strengthen Native American nations, resolve environmental conflicts and foster appreciation and admiration for the country's many natural resources.

*Congratulations,
Miles!*

