



Geological Sciences

MSU College of Natural Science | *Newsletter for Alumni and Friends*

From the Department Chair...

We have a lot to share with you in this edition of our alumni newsletter!

As has been the case for the past several years, the department continues to grow. We hired three new faculty members this year, all of whom are profiled on page 3 of this newsletter. Allen McNamara will be joining us in May 2016 as our first endowed professor, made possible with generous support from an anonymous alumnus of the department. Allen is joining us from Arizona State University, where he is an international expert in modeling deep earth processes including mantle convection and plate subduction. Susannah Dorfman will join us this fall from Lausanne Switzerland. Her expertise is high pressure mineral physics, which complements Allen's research, as her data can help test the deep earth models. Lisa Falk joined us at MSU this summer from Woods Hole Mass., where she recently completed her Ph.D. in petrology and geochemistry. We are actively searching for three additional endowed faculty members, including a candidate to fill the Thomas A. Vogel Solid Earth Chair.

Two of our faculty retired this fall after many years of service to Michigan State. Professor Ralph Taggart retired after 44 years, and Merle Heidemann retired after 37 years. You can read more about these exceptional individuals on page 2.

The department recently completed renovations of several lab, office and classroom spaces in the Natural Science Building. These spaces had not been renovated for many decades and had deteriorated, greatly reducing their functionality for research and teaching. Two of the most transformative renovations were done in the hydroecology/geochemistry and geomicrobiology labs for Matt Schrenk

and Jay Zarnetske, who recently joined the department as assistant professors (see article on page 6). These labs are being equipped with the latest analytical instruments to measure detailed biogeochemistry and microbiology on a wide range of research samples. We also renovated three of our teaching labs with the addition of projectors and large LED screens to enhance our students' educational experience.

“As has been the case for the past several years, the department continues to grow.”

Several of our faculty members received major grant awards this year, enhancing the research profile of the department. For example, Matt Schrenk is the lead MSU researcher on a new \$7 million interdisciplinary grant from NASA on Rock-Powered Life that will explore interactions between water and rock, and energy for life (see page 8), and Bruno Basso is leading a \$4.9 million project funded by the National Institute of Food and Agriculture that will help develop climate-, nutrient-, and water-smart technologies (see page 4).

We also profile Warren and Anneliese Wood, who have been very important and generous alumni over several decades. Gifts from the Woods have allowed the department to develop several programs to enhance

connections between faculty and students (see page 5 for details). Warren also serves as a visiting faculty member in the department, where he works on arid hydrology research.

The department is once again hosting alumni receptions at local restaurants or pubs during upcoming science meetings on both coasts. These receptions provide an excellent opportunity for you to catch up with old friends and colleagues and to talk with our faculty and students about the advances that we are making in the department. Please join us if you are in the region. Our first reception will be in Baltimore, Md., between Nov. 1 and 4, likely on Nov. 2, during the Annual Meeting of the Geological Society of America, and the second will be between Dec. 14 and 18 in San Francisco, Calif., during the American Geophysical Union meeting.

We send e-mail invitations for these receptions to all the alumni on our e-mail list; if you have not received these invitations in the past few years, please contact Elizabeth Wheeler (szufnar@msu.edu) to ensure that we have your current contact information.

Finally, if you happen to be planning a trip through East Lansing, please let me know ahead of time, as I would be happy to meet with you and show you around the department if I am in town. Also, please let us know of any big events in your careers that you would like shared with our alumni and friends in our next annual newsletter. ☺



*David Hyndman, Ph.D.
Chair,
Department of Geological
Sciences*



Ted Swearingen, M.A.T., geology, '73, is part owner of Swearingen Realty Co., a family-owned/operated real estate business in Colonial Heights, Va. He is also a Virginia real estate appraiser and principle broker of the company.

Bruce Peters, geology, '82, is vice president of strategic client partnership, Oil and Gas Division, for QuEST Global Services.

Jim Tolbert, geology, '82; M.S., geology, '85, recently retired from environmental consulting after 28 years helping corporate clients address their environmental liabilities. He is now working to facilitate a dialogue on climate change, and is leading the Grand Rapids, Mich., group of Citizens' Climate Lobby.

Frank Rabbio, geology, '85; M.S., geology, '88, recently opened an office in Evergreen, Colo., for LLOG Exploration, and is now senior geologist with LLOG, working in the deepwater Gulf of Mexico.

John Kmiec, geological sciences, '93, has been the utilities director for the town of Marana, Ariz., since 2012, where he has overseen the completion of their aquifer recharge facility design. This project, which is scheduled for completion in the summer of 2016, will recharge, through surface infiltration, up to 2.0 million gallons a day of highly treated wastewater effluent into the aquifer in the northern Tucson basin to ensure that water supplies are present for future residents.

David Szymanski, M.S., geological sciences, '99; M.S., forensic science, '04; Ph.D., geological sciences, '07, was recently promoted to associate professor of geology at Bentley University, Waltham, Mass. Szymanski was profiled in the April 2013 *Chronicle of Higher Education* in an article on universities recognizing innovative and transdisciplinary teaching and research, and also received the 2013 Joseph M. Cronin Award for Excellence in Academic Advising.

Chelsea Mack, geological sciences, '10, started a new job teaching math and science to middle school and high school students in Bellingham, Wash. She defended her master's thesis in October 2014.

Retirements



Heidemann

Merle Heidemann, senior science education specialist and associate director of the MSU Center for Integrative Studies in General Science, retired in May after 37 years at MSU. She worked with aspiring and practicing science teachers and taught three undergraduate courses that reflected a learner-centered approach to teaching, where the role of the instructor is to develop and construct tasks and environments that require the learner to take

a leading role in their own education. She also used this philosophy when working with practicing science teachers, using a problem-based learning and "process of science" approach. Heidemann graduated 262 master's-level students during her time at MSU.



Taggart

Professor **Ralph Taggart** retired in May after 44 years of service with joint appointments in the Departments of Geological Sciences and Botany. His talents in front of the classroom were recognized in 1999 with the College of Natural Science Ronald W. Wilson Teaching Award for teaching non-science majors in integrative studies. He is also the co-author of a widely used biology textbook, *Biology: The Unity and Diversity of Life*, and is a popular lecturer. Taggart has

devoted countless hours to service at the department, college and university levels; he served as chair of the geological sciences department, chair of the University Committee on Academic Governance, and spent eight years on the Academic Faculty Council.



New Faculty

The Department of Geological Sciences has added several new faculty members since its last newsletter:



Falk

Lisa Falk is an assistant professor specializing in integrative geoscience. She comes to MSU from Woods Hole Oceanographic Institution

in Woods Hole, Mass., where she was a postdoctoral scholar in the Department of Geology and Geophysics. At Woods Hole, Falk headed a project to investigate kinetic effects in the clumped isotope geochemistry of carbonate minerals from high-pH environments. Falk received her Ph.D. in geochemistry and petrology from Columbia University, where she studied serpentinization and carbonation of peridotite in the Oman Ophiolite.



Dorfman

Susannah Dorfman is an assistant professor who comes to MSU from École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland,

where she has been a postdoctoral researcher in the Earth and Planetary Science Laboratory in the Institute for Condensed Matter Physics. Her research focus is high-pressure mineral physics. At EPFL, Dorfman initiated the laser-heated diamond anvil cell research program and used electron microscopy and synchrotron X-ray techniques to characterize the chemistry of iron-bearing lower mantle materials. She received her Ph.D. in geosciences from Princeton University.

Endowed professorship offers new opportunities to explore how Earth works

Allen McNamara will join the department in August 2016 as an endowed professor of geodynamics. McNamara comes to MSU from Arizona State University, where he was an associate professor of geodynamics in the School of Earth and Space Exploration. He received his Ph.D. in geological sciences from the University of Michigan in 2002, and his bachelor's degrees in physics and geology from MSU.



McNamara

McNamara's research focuses on understanding how the Earth's internal engine works and how it has changed through time. He is interested in understanding the compositional evolution of Earth's interior and how that influences large-scale convection. McNamara's research also deals with understanding how observations of seismic anisotropy can provide a map of how the Earth's interior is flowing. At MSU, McNamara plans to focus more on exploring how convection within Earth's mantle drives plate tectonics at Earth's surface.

Originally from Lansing, McNamara decided to return to Michigan State University for several reasons.

"I've always maintained a strong fondness for the Department of Geological Sciences since I was an undergraduate here. The quality of education I received was second to none, and I've always enjoyed seeing the department not only maintain its excellent teaching program, but continue to grow into new research areas," said McNamara, who also believes the recent move to expand Solid Earth Geoscience research in the department is very forward-thinking. "Combined with the university's strong investment in high performance computing, I anticipate a bright future for computational geoscience at Michigan State."

MSU's High Performance Computing Center is an attractive draw for McNamara because in the past he has maintained his own, individual supercomputers for his research. At MSU, he will be able to access the university's state-of-the-art high performance computers in his work.

The endowed professorship in geodynamics is a new position in the department.

"I am very honored and humbled to be selected for this endowed professorship," McNamara said. "Even more so, I am proud to return to the very place that so strongly built the foundation of my scientific career. This department has shaped me in such positive ways, and I yearn to carry that forward to new generations of young scientists."

"The endowed professorship will greatly facilitate my research, and I look forward to building new collaborations within the department toward better understanding how the Earth's interior works and evolves over time and how it drives plate tectonics at the surface."

Spreading the seeds of big data

Michigan State University is spreading the seeds of big data to improve agricultural practices across the United States.

Through a \$4.9 million grant from the U.S. Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA), MSU will lead a team of scientists to develop big-data approaches to better manage water and fertilizers and to adapt to changes brought on by climate variability.

The team is working to optimize the use of water and nutrients in agricultural landscapes across the United States to reduce environmental impact, while maintaining long-term sustainability of agriculture and food production systems.

"... we aim to help farmers ... make better decisions for the environment and maximize production and/or profits."

"Our research shows the interactions between soil, crop, climate, hydrology and agricultural management, and determines their effects on crop yield and the environment," said Bruno Basso, professor in the MSU Department of Geological Sciences. "This project links science with technology and big data analytics; we aim to help farmers better adapt to temperature extremes, droughts or excess water in fields so that they can make better decisions for the environment and maximize production and/or profits."

Increased levels of nitrous oxide in the atmosphere from fertilizer, water runoff carrying phosphorous that contributes to algal blooms and nitrate leaching into



MSU's Bruno Basso poses with one of the unmanned aerial vehicles used to measure soil and crop conditions.

groundwater are problems related to agriculture.

"Our team will develop and promote water-, nutrient- and climate-smart technologies," Basso explained. "To help increase the resiliency of our nation's cropping systems, our goal will be to integrate crop models with yield maps, plus satellite, airborne and unmanned aerial vehicle (UAV) imagery. Then we will make all of the information more accessible to producers and stakeholders."

As part of the grant, Basso will also deploy the System Approach for Land-Use Sustainability model, pioneered at MSU. SALUS predicts crop yield, plus soil, water and nutrient conditions in current and future climates. It can also evaluate the effects of crop rotations, planting dates, irrigation and fertilizer use and project crop yields and their impact on the land and the environment.

Additional high-tech tools in MSU's arsenal include the use of UAVs to scan farm fields. One of MSU's UAVs has three sensors: a multispectral camera to measure chlorophyll and plant nutrients status; a thermal camera, used to monitor

plant temperature; and a laser scanner, which measures individual plant height down to centimeters.

These integrated suites of tools can increase water and nutrient use efficiency. They will allow farmers to quickly pinpoint problem areas and address them precisely, as opposed to using a shotgun approach.

The project includes Extension and education components.

In addition to Basso, who is the principal investigator on this project, MSU researchers on this grant are geological sciences faculty members David Hyndman (who is the co-principal investigator), Anthony Kendall, Joyce Parker and Jane Rice; Phil Robertson, Kellogg Biological Station; Jeff Andresen, geography department; and Jinhua Zhao, economics department.

External partners are Jerry Hatfield, USDA-ARS Lab for Agriculture and the Environment in Iowa; Jim Butler, Kansas Geological Survey; Nick Brozovic, University of Nebraska; and Jonathan Winter, Dartmouth University. 🌱

Warren and Anneliese Wood: Making education value-added

When comparing his 14 years as a faculty member at Oxford University to his 12 years of being a faculty member at MSU, Warren Wood (B.S., geology, '59; M.S., geology/geophysics, '61; Ph.D., geology/hydrology, '69) noticed that the big difference between the best Oxford students and the best MSU students was that the one-on-one tutorial teaching style at Oxford gave those students a better integrated education.

“We had such positive experiences at MSU that we want others to have the same experiences. That’s what we’re hoping our gifts will do.”

“Oxford students live their education, they don’t apply it,” said Wood, who is currently a visiting professor of hydrogeology at MSU. “MSU students learn the material in a semester, but because it’s not often placed in a broader context, it’s not clear where the information fits in a bigger career picture. Paid internships are an excellent way for students to integrate the material, but there aren’t enough of those to go around.”

So Wood and his wife, Anneliese Funk (B.A., humanities, '62), crafted a giving philosophy that aims to help MSU students get a better-integrated education. They have proposed starting several programs that would foster a closer student-professor bond, as well as internship programs.

“My wife and I met at MSU,” Wood said. “We both came from small communities with limited opportunities,” he continued. “So we were awed and excited by the world



Warren and Anneliese Wood

our MSU education exposed us to. We had such positive experiences at MSU that we want others to have the same experiences. That’s what we’re hoping our gifts will do.”

The couple created their own named endowed fellowship to attract the very best graduate students to study geological sciences at MSU. Wood said they are in the process of restructuring that to fund some of their proposed enrichment programs, including a “coffee with the professors” program; financial support for volunteer government intern programs with various agencies such as the U.S. Geological Survey, the Environmental Protection Agency and the Corps of Engineers; annual field trips; and a summer institute for gifted geology students who would live and study together with a professor at a field research site. The couple is working with geological sciences department chair David Hyndman to make sure the proposed enrichment programs align with the chair’s priorities.

An expert on the hydrology of arid areas, Wood’s 54-year career has spanned the

globe. He worked for the U.S. Geological Survey for 40 of those years, and also served as visiting or adjunct professor at universities in Texas, China, the United Kingdom and Saudi Arabia. In addition to his MSU position, he still serves as adjunct professor at King Fahd University in Saudi Arabia; visiting research associate in the School of Geography at the University of Oxford in the United Kingdom; adjunct professor at the University of Nebraska; and scientist emeritus with the U.S. Geological Survey. Anneliese retired from the Fairfax County library system in Virginia.

“I feel we need to focus on how we can make education more value-added for students,” Wood said. “I see the way universities are funded as problematic. Because we’ve shifted to tuition and grant-based support, many tenure-track faculty members are focused on funded research, and teaching is done by contract professors. I’m hoping our proposed programs can bring more students and professors together.”

Renovations transform geochemistry research labs

“The new lab space will allow us to pursue state-of-the-art research ...”



Two geochemistry labs have been transformed to provide the space and equipment necessary for today's research needs.

“We hired two new faculty who needed geochemical lab facilities, and these rooms had the appropriate infrastructure to be renovated for this purpose,” said David Hyndman, department chair. “Both rooms were in great need of renovations as they were not functional for modern geochemistry research and education.”

The new faculty members are Matt Schrenk and Jay Zarnetske, both assistant professors.

“The new lab space will allow us to pursue state-of-the-art research in geomicrobiology, at the interface of geochemistry and molecular biology,” Schrenk said. “We are especially excited that the research facilities will enable us to study microorganisms living underground—in subsurface habitats—and to study their activities and their evolution.”

“We are really excited to be developing a strong and versatile Watershed Science and Hydroecology Lab and, in doing so, improving the overall infrastructure for MSU water resources research,” said Zarnetske, whose research group specializes in hydroecology, which seeks to understand the influence of physical hydrology on ecosystems and biogeochemical cycles across scales from microns to kilometers.



In his newly renovated lab, Matt Schrenk, assistant professor, explains to his students the strategies for culturing microorganisms from subsurface environments. The top photo shows the lab during renovations.

“Given this large research scope, we do extensive work in the field and in the lab, and collaborate across many disciplines and departments at MSU,” Zarnetske explained. “Our new lab now houses multiple state-of-the-art analytical instruments to study biogeochemical patterns in our surface and ground waters, as well as a place to run controlled laboratory experiments. We are using these patterns and experiments with new transferable models that we hope will aid in protecting and improving our precious water resources.”

The new labs are critical for bringing in research grants and recruiting graduate students and faculty. ♡

Contact Us

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Preparing next generation of K-12 educators to teach new science standards

A new national science curriculum—Next Generation Science Standards for K-12 education—is placing new demands on teachers. And MSU teacher candidates will be prepared.

“Our strength is our evidence-based curriculum; we research what our students know and we will ensure that our curriculum meets these new demands,” said Joyce Parker, assistant professor of science education in the Department of Geological Sciences. “We will be making explicit connections to these new standards through the Integrated Science Education (ISE) courses here at MSU.”

In 2011, the National Research Council released *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, a study that served as the basis for the Next Generation Science Standards. While some states have already adopted the new standards, Michigan plans to do so this fall.

“I’m excited about the new standards,” said Jane Rice, science education specialist in the Department of Geological Sciences who teaches ISE 301, Science for Elementary Schools.

“This course focuses on helping future elementary teachers get up to speed with the science they’ll be teaching,” Rice said. “In the courses we teach at MSU, we focus on the integration of science content and the doing of science at the same time. This engages future teachers who are not science majors in actually doing science that they can use to make decisions.”

For example, Rice’s students take part in hands-on activities that have them investigating their own daily energy usage

and coming up with ways to reduce their personal carbon footprints.

This is all “science that you can apply to your life,” Rice said.

One of the courses required for most prospective secondary education teachers is a capstone course—ISE 401.

“These students are science majors, so they’ve already taken many science courses and been consumers of a lot of labs; but they have never had to plan a lab, adjust a

lab, test a lab—which is a big part of secondary science teaching,” Parker said. “In this course, they work through a huge number of labs, having to think of it from the teacher side, rather than the student side. Over the course of the semester, you can see them slowly work their way ‘around the podium,’ to think more like teachers and less like students.

“ISE 401 is probably the only course where they get to see all the components of the Next Generation Science Standards come into play at once,” Parker added. “Teachers will have to know—and teach—all of the sciences and science practices; and this course helps them in



Jane Rice (left), science education specialist in the Department of Geological Sciences, and Merle Heidemann, recently retired senior science education specialist and associate director of the MSU Center for Integrative Studies in General Science, pose in front of an ISE 301 course project display. MSU students investigated their daily energy usage and developed ways to reduce their personal carbon footprints.

those sciences where they don’t have a major or a minor.”

“Once these new standards are in place, K-12 students who right now may not be very engaged in science may become more engaged because of the emphasis on ‘doing’ science,” Rice said.

“There is a clear hope that instead of memorizing a lot of facts, K-12 students will understand a few powerful concepts and be able to apply them, to look at data, to question the world,” Parker said. “It’s not the content that’s shifting; it’s what we expect students to do with the content.”

USDA grant to fund summer 2016 workshops for K-12 teachers

A \$5 million, five-year USDA grant was recently awarded to geological sciences faculty Bruno Basso, Dave Hyndman, Joyce Parker and Jane Rice on precision agriculture. Parker, science education assistant professor, and Rice, a science education specialist,

will provide professional development and curriculum materials based on the project to teachers around the Midwest.

Starting next summer, three-day summer workshops for K-12 teachers will be offered in Nebraska, Iowa and Kansas.

“We’ll be helping these teachers deepen their science knowledge by bringing in some of the research findings in their area—place-based education,” Rice said.

“We like this model because there is a multiplier effect; one teacher in a lifetime reaches a lot of students,” Parker said.

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NASA grant funds study on Rock-Powered Life

Matt Schrenk, assistant professor in the geological sciences department, is part of an interdisciplinary team that is using a five-year, \$7 million grant from the National

Aeronautics and Space Administration (NASA) to study how rocks can provide energy for life and how that may impact the origins, evolution, distribution and future of life in the universe.

Schrenk will join scientists from a variety of disciplines and institutions to study what is called Rock-Powered Life. The team will try to understand how rocks and water interact at low temperatures to release energy capable of supporting microbial life on Earth, and where these processes may occur elsewhere in the universe.

“This work is significant in that it ties together studies of how water-rock reactions occur with studies of how energy and materials are channeled into life,” Schrenk said. “The research will provide important insights into conditions associated with the early evolution of life on Earth and will help guide our exploration of life on other planets and moons.”

The project will also seek to determine the extent to which researchers can or cannot detect the biosphere hosted by such water-rock reactions by using robust physics-oriented remote sensing methods. 🌱



Pictured above is a high pH (alkaline) serpentinite spring in Newfoundland, Canada. Water-rock reactions generate energy to support microbial growth, but can create challenging conditions that test the limits of habitability.