



From the Department Chair...

To say this past year was challenging is an understatement. MSU continued to impose deep budget cuts on programs across campus – something all units have experienced for several years. As these continued cuts are unsustainable, last year the university began restructuring to deal with the continued decline of support from the state of Michigan. This year, less than 30 percent of the university's budget came from the state and that number will continue to decline. In response, the university examined closing several units, including our department.

As the new chair of the department, I am pleased to report that such a drastic measure has been avoided. Thanks to many supporters across campus and among our alumni, it was emphasized that the department is a critical asset for the university.

Under the leadership of Ralph Taggart, we developed a plan with the support of university administrators to enhance the success of the department over the next five years. The closure recommendation is off the table and the difficult work has begun. I would like to thank everyone who voiced their support for the department; the energy and passion provided by alumni helped make this a possibility. I also extend our thanks to Ralph Taggart for the leadership he provided during his time as chair.

Understanding the paradigm of funding is beyond what I will try to explain in this short article. Instead, consider the reality that our budget decreases every year and the only viable options for continued excellence involve increased research funding and philanthropy. Simply

put, these sources must dramatically increase to offset the shortfall in state funding.

We cannot focus on how things have been done in the past or wish that things were different.

Rather, with a solid plan, a renewed focus and a strong passion for what we do best, we are leveraging this experience into a great opportunity.

Faculty need top-notch graduate students who can help increase research productivity, and the department needs to leverage its competitive strengths to compete for research funding opportunities. As more research becomes interdisciplinary, we must enhance our partnerships across traditional academic boundaries and apply a systems approach to solve complex problems. We are already on a positive trajectory to meet the goals of our plan, including a significant increase in research grants awarded to our faculty.

Now that we have weathered the worst of the budget crisis, we focus on the difficult task of organizational change. We are committed to being successful in this new academic environment, and as such, the department will evolve.

There will undoubtedly be changes as we cannot run a department on past strategies. Instead, I ask for your help as we recruit students, expand our research and hire new faculty in areas of recognized strength.



David Hyndman

Yes, we will be getting new faculty positions in the future as part of our plan. The university is committed to our plan and we will be welcoming new faculty into the department. The fundamental aspects of earth science blends with many research thrusts of the university, and we will be playing an important role in interdisciplinary research related to water, energy and the environment.

As with research, an increase in philanthropy will play a role in our success. Whether it is increasing fellowships to fund graduate students or endowing professorships for specific faculty positions, gifts from alumni and friends will forever shape our direction.

The National Research Council recently released its rankings of graduate programs. While the department greatly improved relative to the last rankings from 1995, a notable highlight is that we were in the top 21% of Earth Sciences doctoral programs for student support. This is one indication of the strength of commitment we have to quality education. The Department of Geological Sciences is well positioned to play a strong role in the university through our research and educational missions. I hope you will stop by the department if you pass through East Lansing or connect with us online to see how we are making a difference by educating the next generation of scholars to solve the world's most-challenging problems.

Finally, I would like to thank everyone who came back to campus to celebrate the career of Duncan Sibley. We wish him the best as he enjoys his retirement. He served the department, university, and students well during his career at MSU. 🍷

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



K. Rodney Cranson, B.S. '61, M.S. '65, recently completed the 3rd Edition of *Crater Lake - Gem of the Cascades* - the geological story of Crater Lake National Park.

Mark Petrie, B.S. '79, M.S. '84, has been working for the state of Michigan since 1984 and is a geologist in the Department of Natural Resources and Environment in the environmental response program.

Tom Taylor, M.S. '79, Ph.D. '82, authored an invited paper in the August 2010 *AAPG Bulletin*, a special issue on prediction of sandstone diagenesis.

Lawrence Lemke, B.S. '83, has been promoted to Associate Professor of Geology at Wayne State Univ. and is serving as the director of the Environmental Science Program.

Jeff Webster, B.S. '83, is Group Vice President for Tyson Foods and leads the Renewable Products unit. He created a partnership with ConocoPhillips and Syntroleum and recently opened America's first commercial scale Advanced Biofuels plant.

Randy Westmoreland, B.S. '83, is the environmental lead at Detroit Edison for licensing a new, next-generation nuclear power plant in Monroe, Michigan.

Sal Caruso, B.S. '86, received the Ford Motor Company Vehicle Engineering Quality Award for developing and implementing auto industries first Dual-Rate Air Extractor.

Martha Whitaker, B.S. '88, is an instructor and undergraduate advisor

for the Univ. of Arizona Department of Hydrology and Water Resources. She received three awards for advising this year, including the Outstanding New Faculty Adviser Award from the National Academic Advising Association.

Jason Price, M.S. '94, Ph.D. '03, was recently awarded a research grant from the NSF to study the influence of radiation damage on the solubility of epidote-group minerals during chemical weathering. The project utilizes detrital epidote-group minerals from the Yangtze and Nile deltas.

Rob Ellis, B.S. '95, M.S. '99, was recently promoted to Principal Scientist/Principal-in-Charge (PIC) at the international engineering consulting firm ARCADIS. He works with a federal client and an auto manufacturing company, focusing on environmental site evaluation and remediation services.

Kurt Spearing, M.S. '98, started a tenure track position at Morningside College in Sioux City, Iowa. He is also finishing his dissertation dealing with fossil felids.

Erik Smith, B.S. '04, recently started teaching 7th grade at the Denver School of Science and Technology. Each homeroom in the school is named after a different university, and Erik's is Michigan State.

Andrew Steen, B.S. '07, is a development geologist at Chevron's Gulf of Mexico Business Unit. He has an upcoming publication on Fluid Flow and Compartmentalization on the Flank of a Salt Structure, Offshore Louisiana: Constraints from Temperature, Pressure, Salinity and Seismic Data. 📌

Alumni Advisory Board

The Department of Geological Sciences' Alumni Advisory Board has been assisting the leadership over the past year. Their support in strengthening the alumni network and providing guidance to the department has been tremendous.

Please join the department in acknowledging these alumni for their efforts. More details on the board can be found on the updated department website at geology.msu.edu.

Vivian Bust, M.S. '81, is Senior Reservoir Engineer/Geologist at Gaffney-Cline & Associates in Houston, Texas.

Rachel Hannah Páez, M.S. '00, is a Senior Exploration Geologist at ExxonMobil Development Company in Houston, Texas.

John Snyder, B.S. '51, Ph.D. '57, is retired from the National Science Foundation in Arlington, Virginia.

William Stelzer, M.S. '64, is a geological consultant in Lansing.

Thomas Taylor, Ph.D. '82, is Principal Research Geologist at Shell Exploration & Production in Houston.

Karen Wayland, Ph.D. '01, is a senior policy advisor to Speaker of the House Nancy Pelosi on energy and environment issues in Washington, D.C.

Warren Wood, Ph.D. '69, is a Visiting Professor of Geological Sciences at Michigan State University.

News From the Department of Geological Sciences

Recent Grants

Danita Brandt was awarded a Target Foundation Community grant for “Read with me, learn with me, the history of life from A-Z.”

David Hyndman, Anthony Kendall and Warren Wood received an NSF grant for “Sustainability of the High Plains Aquifer region: Coupled landscape, atmosphere, and socioeconomic systems.”

David Hyndman and Anthony Kendall received three additional grants, including one from the USGS for converting to biofuel cropping systems for Great Lakes regional water sources, one from NASA on the influence of land use and climate changes on Great Lakes coastal wetlands, and they are part of a team on an EPA grant for nutrient management models to constrain harmful algal blooms.

Julie Libarkin received an NSF grant for “Confronting the Challenges of Climate Literacy” and is also part of the NSF grant “CCEP-I: The Great Lakes climate change science and education systemic network (GLCCSESN).”

Julie Libarkin and Duncan Sibley received an NSF grant on “Automated analysis of constructed response concept inventories to reveal student thinking: Forging a national network for innovative assessment methods.” They also received an NSF grant on “Building global climate change literacy through analogical reasoning.”

Remke van Dam and David Hyndman received a grant from the Army Research Office to support an upcoming international conference on “Novel methods for subsurface characterization and monitoring.”

Emily Geraghty Ward and Julie Libarkin received an NSF grant on “Cultural Validation of Geoscience Assessment.”

Sibley Retires After 36-Year Career at MSU

Duncan Sibley retired this summer following a 36-year career at MSU. He joined the faculty in 1974 and became a world-recognized leader in research on the origin and evolution of carbonate rocks. His research was conducted using field studies, petrographic analyses, and laboratory experiments.

Sibley was named Director of MSU’s Integrative Studies in General Science in 1999 and spent seven years improving the teaching of science to non-science majors. This experience ignited a passion and new focus for his research.

Sibley is dedicated to improving our understanding of how students learn and has been working on new strategies for helping faculty teach science. In 2007 he became Director of the Center for Research on College Teaching and Learning and added to this the responsibilities as Associate Dean for Faculty Development in the College of Natural Science in 2008.

Sibley graduated from Lafayette College in 1968 with a bachelor’s degree in Geology. In 1971, he earned his master’s degree from Rutgers University, where he worked with Ray Murray on dolomite petrogenesis. Three years later, he earned his Ph.D. from the University of Oklahoma, where he worked with Harvey Blatt on sandstone diagenesis.

His career in geology has directly affected his many students, yet his focus on improving the teaching of science may be his lasting legacy. Although he officially retired in June, he is continuing his research on science education and teaching online undergraduate classes from his new home in Santa Fe, New Mexico.

Selected Recent Publications

Michael Gottfried co-authored “The evolution of mammal-like crocodyliforms in the Cretaceous Period of Gondwana” published in the August 5, 2010, issue of *Nature*.

Kazuya Fujita and Kevin Mackey published a paper “Seismicity Map of Eastern Russia 1960-2010” in the September issue of *Seismological Research Letters*.

Brian Hampton was featured on the cover of the August 2010 edition of *Tectonics* and co-authored the paper “A detrital record of Mesozoic island arc accretion and exhumation in the North American Cordillera: U-Pb geochronology of the Kahiltna basin, southern Alaska.”

Michael Velbel and alumnus Anna Losiak co-authored a paper “Denticles on Chain Silicate Grain Surfaces and Their Utility as Indicators of Weathering Conditions on Earth and Mars” and were featured on cover of the September 2010 *Journal of Sedimentary Research*.

Grahame Larson and Kevin Kincare co-authored a paper “Late Quaternary History of the Eastern Mid-Continent Region” in *Michigan Geology and Geography*.

Robert Anstey and Victoria McCoy co-authored “Biogeographic associations among Silurian bryozoan genera in North America, Baltica and Siberia” in *Palaeogeography, Palaeoecology, Palaeoceanography*.

Water Research Plays a Growing Role in MSU Science

Water research has a long history in the department, but there is new energy in this field at MSU. Global demand for clean water is driving many areas of research at MSU, and the department is well-positioned to assist in these interdisciplinary projects. Among the leaders in the research are Professors David Long and David Hyndman, and Assistant Professor Remke van Dam.

Long oversees the Aqueous and Environmental Geochemistry Laboratory. The lab focuses on understanding the physical, chemical, and microbiological controls on water quality and addressing factors affecting human and ecosystem health.

He is currently studying a striking example related to human health in Europe. Clusters of people, separated by distance and nationality, are afflicted with Balkan endemic nephropathy. The disease strikes late in life and destroys kidney function until dialysis is the only option for treatment. Long and a multi-disciplinary team of researchers, including MSU environmental engineers, are investigating what the villages have in common that could cause the disease.

The Balkans clusters share a common geological feature - the karst bedrock - and all the communities use groundwater for drinking and irrigation. Researchers hypothesize that substances in the rock are seeping into the groundwater and could be a factor. A definitive cause has not yet been found, but the interaction in the groundwater between the toxic agent and the geology of the landscape is playing a significant role in Long's research.

While Long conducts field research all over the world, he finds Michigan's diversity of water features ideal for research. "The environmental setting of Michigan with its lakes, rivers, wetlands,

formation brines, is a wonderfully natural laboratory to study the natural interactions of physical, chemical, and microbiological processes affecting water both in the present and in the past," Long says. "We also study the effect of human activities on these interactions."

For example, Long recently led students to Torch Lake in the Upper Peninsula - an EPA Superfund site. The students helped take sediment cores from the lake bottom to analyze the environmental history of the lake and test the hypothesis that cleaner, recent sediments were burying the older contaminated sediments. This is typically how lakes clean themselves. Since sediment is deposited over time, the cores tell the story of copper buildup in the lake through the years.

The cores revealed that the levels of copper were higher in recently deposited surface sediments. This was unexpected since mining activities had ceased many years ago. Long worked with colleagues in the Department of Microbiology and Molecular Genetics to determine that microbial activity may be one of the causes of the higher concentrations. Their findings indicate that microbes in the water may be scavenging copper released from the lower layers of sediment and encasing themselves in it as protection. He is currently working to better understand this process.

Long describes the problem as an environmental legacy since damage continues long after the activities causing the contamination have stopped. At Torch Lake, natural cleansing processes do not appear to be taking



Remke van Dam (left) and Andrew Steen (B.S. '07) conducting fieldwork around Harsens Island in Lake St. Clair, Michigan.

place. He notes that Torch Lake is a prime example of the complexity of environmental processes and the need for multidisciplinary teams to examine these complicated environmental issues.

At another Michigan site, Long and his students investigated an area where a tannery had used a wetland as a dumping ground for its chromium-contaminated waste. Once the tannery had closed, the local community wanted to use the land for a park and proposed removing the contaminated soil. Interestingly, little chromium was found in plants, animals, or groundwater, even though the soil was highly contaminated.

Long hypothesized that microbial activity in the soil had created an environment that worked to immobilize the chromium. Long and his students found evidence for factors causing immobilization. These results supported a leave-in place remediation strategy.

Van Dam approaches the issues of pollution, remediation, and environmental contaminants from a hydrogeophysics perspective. The application of geophysics to the

Water Research

(continued)

movement of water is not new, but it is a growing field. Van Dam has just finished gathering data for a study on the movement of contaminants in groundwater.

“We don’t have good models for transport prediction”, van Dam says. “The current models can’t predict where contaminants will flow or diffuse after a spill. For this study, we injected easily traceable compounds into the ground and then collected high-resolution, three-dimensional images to make maps of the subsurface layers.”

Van Dam, Hyndman and several graduate students ran the experiments from 2008 to 2010 at the Macrodispersion Experiment Site in Mississippi. The site is an active Air Force base and it posed unique challenges for the researchers because radio waves from their equipment interfered with Air Force communications.

“We were forced to switch to night work for six weeks,” van Dam says. “We arrived around 5 and stayed there all night. It was rough, especially on the students.”

The hard work should pay off as van Dam takes the data into the lab. Over the next few years, researchers in the hydrogeology lab will be testing new models of contaminant transport that will more accurately predict how spilled agents move in the environment.

Water scarcity is another research thrust for van Dam who is working with both graduate and undergraduate students to study the uptake of water in the root zone of plants. They are increasing the understanding of how much water is used by plants and how much water runs off the land as waste.

Their research project has sites across Michigan, including a section of farmland on campus and at the Kellogg Biological Station. Each monitoring station is

Researchers Predict Sustainable Solutions for Water Use in High Plains Region

A team of researchers across disciplines at MSU are predicting sustainable solutions for communities across the High Plains that rely upon a diminishing water supply. The four-year, \$1.5 million grant from the National Science Foundation is led by Professor David Hyndman and connects with faculty in economics, sociology and geography to develop sustainable land management strategies.

The High Plains region has some of the most productive irrigated agricultural land in the U.S. the region, which extends from Kansas to South Dakota, relies on water from the Ogallala-High Plains aquifer. A patchwork of state laws, regulations and economics means any change requires complex solutions.

With this grant, researchers are connecting decades worth of scientific data with a suite of computer models to best predict solutions. The research will provide predictions and impact assessments for a range of potential solutions. Communities and governments will be able to use these predictions to adjust land management policies allowing the region to transition towards a sustainable practice of water use.

Seven faculty and staff from MSU are involved in the project, including Anthony Kendall, research associate of Geological Sciences; Jinhua Zhao, associate professor of agricultural economics; Stephen Gasteyer, assistant professor of sociology; Nathan Moore, assistant professor of geography; Shiyuan Zhong, associate professor of geography; and Warren Wood, visiting professor of geology. Three faculty from the Kansas Geological Survey are also part of the research team. ↗

equipped with probes that are used to image the electric conductivity of the soil in order to gauge the water content.

Van Dam says that the equipment may be familiar to many alumni, however, the efficiency has been greatly improved and they are able to take samples over a much larger area.

Hyndman is principal investigator on a recently awarded grant involving the High Plains Aquifer. The interdisciplinary grant will help shape a course to better manage this important natural resource by developing a sustainability plan based on economic,

sociological and geographic issues affecting the aquifer.

The emphasis on hydrogeology research is part of the department’s plan to catapult MSU’s Geological Sciences program into the top tier of U.S. geoscience research, with Long, Hyndman and van Dam leading the way. ↗



The High Plains Aquifer spans much of the central U.S. and is the focus of a recent NSF grant. In this image by Anthony Kendall, areas with irrigated agriculture as of 2000 are shown in dark green, while light green areas have only dryland agriculture.

Connect with us on the department’s new website:
geology.msu.edu

Improving How Students Learn About Earth

Associate Professor Julie Libarkin bubbles with enthusiasm for education. In her four years at MSU, Libarkin has changed the way students learn geology.

For Libarkin, her research is about improving learning. She coined the term “geocognition” to describe the study of how people perceive and understand the Earth.

“What do people not know?” asks Libarkin. “We often assume more knowledge than they have.”

Libarkin says instructors may assume that every student knows that the Earth has a magnetic field and has a basic understanding of fundamental Earth science. However, her research has shown that some incoming students don't have that basic knowledge.

Libarkin and her collaborators in the Geocognition Research Lab have developed a test to develop a picture of students' understanding. The Geoscience Concept Inventory (GCI) uses a set of rigorously-tested multiple choice questions to gauge students' knowledge of basic Earth science concepts. The test has grown in popularity and is being used across the nation by teachers and researchers.

In Libarkin's geology classes, she uses the GCI to test her students' learning. With the aid of electronic “clickers”, remotes which send information from the student to the professor, she can quickly assess the level of understanding in the class.

At the beginning of her Global Changes class, Libarkin asks how many students believe that the Earth's average temperature has gone up over the last decade. This provides an immediate understanding of how students currently perceive climate change. At the end of the class, Libarkin asks the same



Julie Libarkin leads the Geocognition Research Lab to study how people perceive and understand Earth and Earth processes. While rooted in geology, her research blends cognitive science and science education, and is funded by the National Science Foundation and the National Aeronautics and Space Administration.

question to compare the two responses. She can generate a graph of the responses moments after receiving the information and immediately evaluate her effectiveness in teaching the concept.

Libarkin's interest in education is not new. After receiving her Ph.D. in Geosciences from the University of Arizona, she spent three years as a post-doctoral fellow in the Department of Science Education at the Harvard-Smithsonian Center for Astrophysics. At MSU, Libarkin is jointly appointed to the Geological Sciences Department and the Division of Science and Mathematics Education.

Libarkin's research is also being used to redesign the teaching labs used for integrated physical science courses - MSU's general science classes for non-science majors - taught by geological sciences faculty. Libarkin notes that a concept such as water sources will not be studied as an abstract idea. Instead, water will be studied as part of the Michigan landscape. Under this process, students will be asked: Michigan's

drinking water comes from surface water, so why do we study aquifer sources in New Mexico to understand water issues when the Red Cedar River is on campus? By connecting the concept directly back to the individual students, Libarkin is able to chart their improvement in geocognition.

With a grant from the College of Natural Science and the National Science

Foundation, Libarkin has expanded her laboratory to include a room which is used to test new curriculum. Cameras record student volunteers trying the new lessons and the recordings are studied to evaluate the effectiveness of the new techniques.

But Libarkin isn't finished. She is evaluating how better graphics can highlight features missed by novices and how to measure attention using eye-tracking, a research method that determines where people look by charting the pattern of their eye movements. Her findings are then applied to geology courses as well as integrative studies courses for non-science majors at MSU.

Libarkin was awarded the College of Natural Science Meritorious Faculty Award this year for her leadership in science education. Her research is already improving the way science is taught and will continue to improve student learning for years to come. 🌱

Faculty Partner to Transition Petrology Research at MSU

Fundamental problems in geology are how continents and ocean basins are initiated and evolve. Continents form at subduction zones and ocean basins form as plates are pulled apart. These simultaneous processes are a natural cycle, and much like the Earth itself, the study of Geodynamics and Tectonics at MSU is undergoing a similar process.

Professor Tom Vogel retired from teaching four years ago, and while he may no longer be standing in front of a classroom full of students, his research continues as he collaborates with Assistant Professor Tyrone Rooney. Their different research thrusts in Geodynamics and Tectonics work together even though they are at opposite ends of their careers.

Vogel's retirement cannot be called traditional. The iconic faculty member is seen in the halls of the Natural Science Building on a daily basis and he has published 14 papers since his retirement.

Rooney, who joined the department in 2007, brings a research skillset which complements that of Vogel. As the department transitions to having Rooney oversee the geochemical facilities, the two have made exciting progress together in understanding the origin of continents.

Vogel's research over the decades established a strong foundation upon which Rooney is building and making great strides. More than a decade ago, Vogel had the idea of studying the formation of continents where there is no continental crust (oceanic arcs). Rooney has taken the idea and begun research involving zircons and isotopes.

"Layers in a zircon are like the rings in a tree in that they record what processes the rock has gone through over time," Rooney says. "The mineral is very resis-

tant and doesn't change much, making it an excellent geological history book."

Rooney and Vogel approach tectonics from different, yet complementary, perspectives. Vogel deals with tectonics at the macro-level and by comparing continental crust composition to volcanic rocks. Rooney focuses on micro-level process and uses geochemical modeling.

The microanalytical techniques employed by Rooney and students have led them to focus research on Central America as they see clues to a new continent in the process of forming. His research lab has been focusing on Panama and Costa Rica.

In addition to using the X-ray and ICP facilities at MSU, Vogel and Rooney are collaborating with several other universities around the country as they identify the sources of magma and analyze the chemical variations of zircons. Together, they are teaching each other new techniques as the research is slowly transitioned between the faculty members.

"We each have learned much from each other and the partnership has been extraordinarily beneficial to both of our research programs," Vogel says. "My research program has continued success, and equally rewarding is watching Tyrone build his research program and develop his lab into a major strength in our program."

With an ever-growing cadre of graduate and undergraduate students, the Rooney Lab is in the infancy of its research life-cycle, much like the new continental crust they are studying in Central America. As for Vogel, retirement has provided him more time for research and partnerships as petrology research at MSU transitions between the two labs.



Tom Vogel explores the inner crater of the White Island volcano in New Zealand.



Paul McKelvey (left), master student, and Tyrone Rooney (right) conducting research in a recent construction zone as part of ongoing work with the Panama Canal.

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As with generations of students before them, two dozen students traveled to the Upper Peninsula this fall for a field trip as part of the structural geology and plate tectonics class. Led by Professor Kazuya Fujita (above, seated on the far left), the trip included visits to Jasper Knob (above), the shores of Lake Superior, Presque Isle, Republic and the Harvey Quarry. The Geology Endowed Field Study Fund, established and supported by contributions from alumni, helped provide necessary funding for the trip. 🍀

Awards & Recognition

Kazuya Fujita received the 2010 College of Natural Science Undergraduate Teaching Award.

Michael Gottfried received a Leadership Award for outstanding service to the Society of Vertebrate Paleontology.

Brian Hampton received the 2010 Lorena V. Blinn Endowed Teaching Award from the College of Natural Science.

Julie Libarkin received the 2010 Meritorious Faculty Award from the College of Natural Science Alumni Association.

David Long received the 2010 Distinguished Service Award from the International Association of GeoChemistry.

Michael Velbel received the 2010 Outstanding Academic Advisor Award from the College of Natural Science.