

2017-18
HOOSIER GEOLOGIC | ATMOSPHERIC RECORD

hgr



EARTH AND
ATMOSPHERIC
SCIENCES



Hoosier Geologic | Atmospheric Record

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES

Chair: Jim Brophy

Co-Editors: Arndt Schimmelmann & Jim Brophy

Graphic Design: Ruth Droppo

<http://earth.indiana.edu/>

College of **Arts + Sciences**

Executive Dean: Larry D. Singell

Executive Director of Advancement: Travis Paulin

Director of Alumni Relations: Vanessa Cloe

<http://college.indiana.edu/>

Cover: This image of North and South America at night is a composite assembled from data acquired by the Suomi NPP satellite in April and October 2012. The new data were mapped over existing Blue Marble imagery of Earth to provide a realistic view of the planet.

The nighttime view was made possible by the new satellite's "day-night band" of the Visible Infrared Imaging Radiometer Suite. VIIRS detects light in a range of wavelengths from green to near-infrared and uses filtering techniques to observe dim signals such as city lights, gas flares, auroras, wildfires, and reflected moonlight. In this case, auroras, fires, and other stray light have been removed to emphasize the city lights.

NASA Earth Observatory image by Robert Simmon, using Suomi NPP VIIRS data provided courtesy of Chris Elvidge (NOAA National Geophysical Data Center). Suomi NPP is the result of a partnership between NASA, NOAA, and the Department of Defense. Caption by Mike Carlowicz.

The Department of Earth and Atmospheric Sciences

GREETINGS FROM THE CHAIR

We remain committed to providing the finest undergraduate and graduate education possible. Our undergraduates are moving on to graduate school while our graduate students are all finding jobs. Much of this success is due to the support of alumni like you who have generously given to the department in so many different ways.

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NEW NAME, NEW CURRICULUM

The Department of Earth and Atmospheric Sciences at IU is changing as the fields of Earth and Atmospheric Sciences make new advances and as we expand into new areas like Tectonic Geomorphology, Surface Dynamics, and Atmospheric Sciences.

PAGE 6

EAS Disciplines

1. CLIMATE AND EARTH PROCESSES:

Atmospheric Sciences, Biogeochemistry, Surface Processes

Earth's surface and environment are in a dynamic zone that extends from the base of weathered bedrock to the top of trees. In this zone, the atmosphere, water, biota, and tectonics interact to influence landscapes, water resources, natural hazards, climate, biogeochemical cycles, and life.

PAGE 8

2. ENERGY RESOURCES:

*Mineralogy and Petrology, Stratigraphy
Indiana Geological and Water Survey*

Numerous projects in mineralogy and sedimentary, igneous and metamorphic petrology have been or are presently being carried out on all 7 continents. Nearly all of this research is funded by NSF, NASA and corporate grants. Current investigations include research on basalt and tonalitic magma generation, magmatic processes and sulfide ore formation, structural and rheological properties of metamorphic rocks, pure and applied clay mineralogy, the mineralogy of natural zeolites, and planetary mineralogy.

PAGE 18

3. ORIGIN AND EVOLUTION OF LIFE:

Geobiology, Geoarchaeology, Paleontology

These disciplines investigate the interactions between life and environments throughout Earth's history. Principles of paleontology form the foundation that bridges geologic, biologic, chemical, and anthropologic sciences. Geobiology relies on analysis of fossils in their geologic, and thus historical and environmental contexts to test hypotheses about the history of life.

PAGE 24

4. SOLID EARTH DYNAMICS:

Geophysics, Structural Geology, Tectonics

Critical to our understanding the Earth is knowledge of the physical processes that shape the Earth's formation, evolution, and present-day dynamics. The combination of state-of-the-art geophysical instrumentation and advanced computational capabilities makes it possible to observe and quantitatively model complex geological systems in ways that were previously unimaginable.

PAGE 36

5. FIELD COURSES:

*The Judson Mead Geologic Field Station
Field Course at Olduvai Gorge, Tanzania*

NEW IN 2018! *EAS Alumni College Field Course at Olduvai*

Our department has long maintained a strong commitment to field-based geoscience investigations and education to achieve a fundamental improvement in our understanding of the Earth.

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News about Faculty, Students, Staff, and Department - PAGE 46

Tracks and Trails from Deep (sort of) Time - PAGE 52

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2012-2017 Benefactors - PAGE 62

People In Memory: Erle Kauffman, John Hayes - PAGE 66

Alumni Contact Form - PAGE 68

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DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES

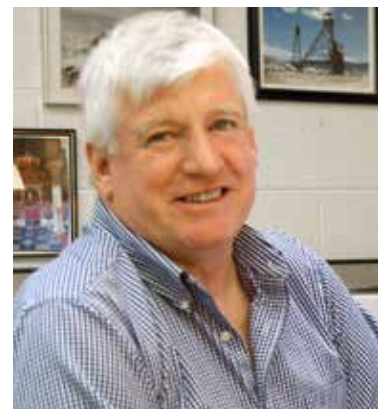
explore your Earth!



Greetings from the Departmental Chair

Dear Alumni,

I hope that you find the current edition of the HGR informative and exciting. As a department, we are very proud of our accomplishments this past year. Some of the highlights include an Atmospheric Sciences program that is growing by leaps and bounds. This year they placed their first graduate in a broadcast booth as a weather forecaster. David Polly, our newly named Schrock Professor, and several other faculty have been instrumental in landing a multi-disciplinary, multi-department, multi-million dollar Grand Challenges grant entitled "Prepared for Environmental Change." Chen Zhu, our reigning aqueous geochemist, has been named a fellow of the American Association for the Advancement of Science (AAAS), which is a truly prestigious honor.



We remain committed to providing the finest undergraduate and graduate education possible. Our undergraduates are moving on to graduate school while our graduate students are all finding jobs. Much of this success is due to the support of alumni like you who have generously given to the department in so many different ways.

The near 60-year-old Geology Building is slated for renovation sometime in the next few years (following a complete renovation of Ballantine Hall on the other side of campus). The upside is that we will have modern teaching and research facilities in the end (though much smaller offices). The downside is that we will have to move much of our work to other buildings on campus for at least a year. Come visit us in a few years and see for yourself what the renovation will have accomplished!

All-in-all, it has been a good year for our faculty, staff and students. I am proud to serve as Chair of a department that is full of such fine colleagues and co-workers.

Happy Reading

Jim Brophy

Departmental Chair

find *your* major

path
ways

to **CAREERS** in
EARTH &
ATMOSPHERIC
SCIENCES

New Name, New Curriculum

New Undergraduate Curriculum

The Department of Earth and Atmospheric Sciences at IU is changing as the fields of Earth and Atmospheric Sciences make new advances and as we expand into new areas like Tectonic Geomorphology, Surface Dynamics, and Atmospheric Sciences.

We have introduced a new curriculum to reflect this growth and to provide students with opportunities to explore a wide range of topics in Earth and Atmospheric Sciences.

Designed as multiple pathways to a successful degree, the curriculum includes three new core introductory 'Earth' courses for majors that expose students to the breadth of our fields including G225 Earth Materials, G226 Earth Processes, and G227 Earth History and Climate, and two 300-level courses G314 Data Analysis and G333 Sedimentation and Tectonics. With the exception of Earth Materials and Data Analysis, all courses are team-taught, thus exposing our students to a larger cross section of the faculty early on in their careers.

We now offer a B.S. degree in Earth Sciences, a B.S. degree in Atmospheric Sciences, and a B.A. in Earth and Atmospheric Sciences.

At the upper level, the two B.S. degrees diverge significantly. The B.S. in Earth Sciences permits the packaging of existing geology courses within multiple informal tracks while the B.S. in Atmospheric Sciences includes upper level courses in Atmospheric Sciences. The B.A. in Earth and Atmospheric Sciences is very flexible and permits students to package courses at the 100-, 200-, 300- and 400-levels to create a degree that is tailor-made to their own interests.

The new "pathways" process helps students choose course offerings that are more closely aligned with career opportunities. These pathways may lead to careers in Geology, Energy and Environment, Integrated Earth Sciences, and Atmospheric Sciences.

Are you interested in **sustainability** and
environmental issues?

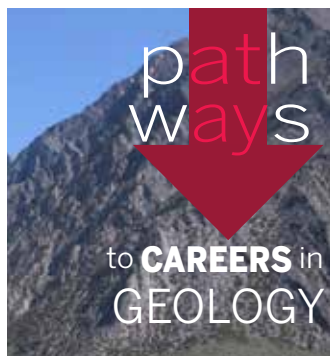
Are you concerned about
climate change?

Do you want to know more about
natural resources and
alternative energy sources?

Are you interested in how scientists **predict** the
weather?

Would you like to make this
your career?

**we can help
with that!**

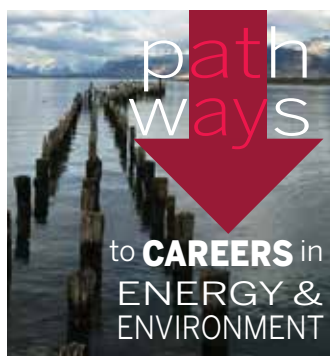


Earth Sciences

We offer B.S. and B.A. degrees in Earth Sciences. The Earth Sciences major is flexible and students can pursue different pathways such as:

GEOLOGY:

This pathway places emphasis on Earth materials (rocks and minerals), Earth structure, and Earth history. Students choose among courses in mineralogy, petrology, tectonics, sedimentary geology, and geophysics.



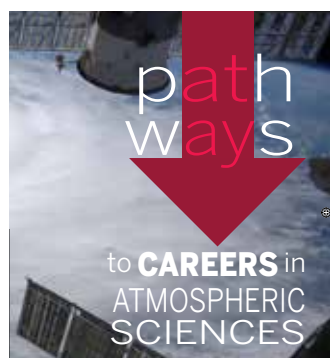
ENERGY AND ENVIRONMENT:

This pathway explores applications of Earth and Atmospheric Sciences centered on contemporary energy and environmental issues. Students choose among courses in hydrology, economic geology, aqueous geochemistry, surface processes, and energy resources.



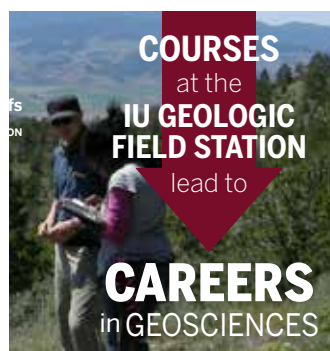
INTEGRATED EARTH SCIENCES:

This pathway broadly explores concepts across Earth and Atmospheric Sciences. Students choose among courses in atmospheric dynamics, meso-scale meteorology, climate change, geobiology, sedimentary geology, geochemistry, hydrology, and geophysics.



Atmospheric Sciences

The Atmospheric Sciences degree is designed to provide the education and training students need to begin a promising career in meteorology, Atmospheric Sciences, or Environmental Science,s working for government weather agencies or private industry. We offer either a B.S. or B.A. degree.



IU Geologic Field Station

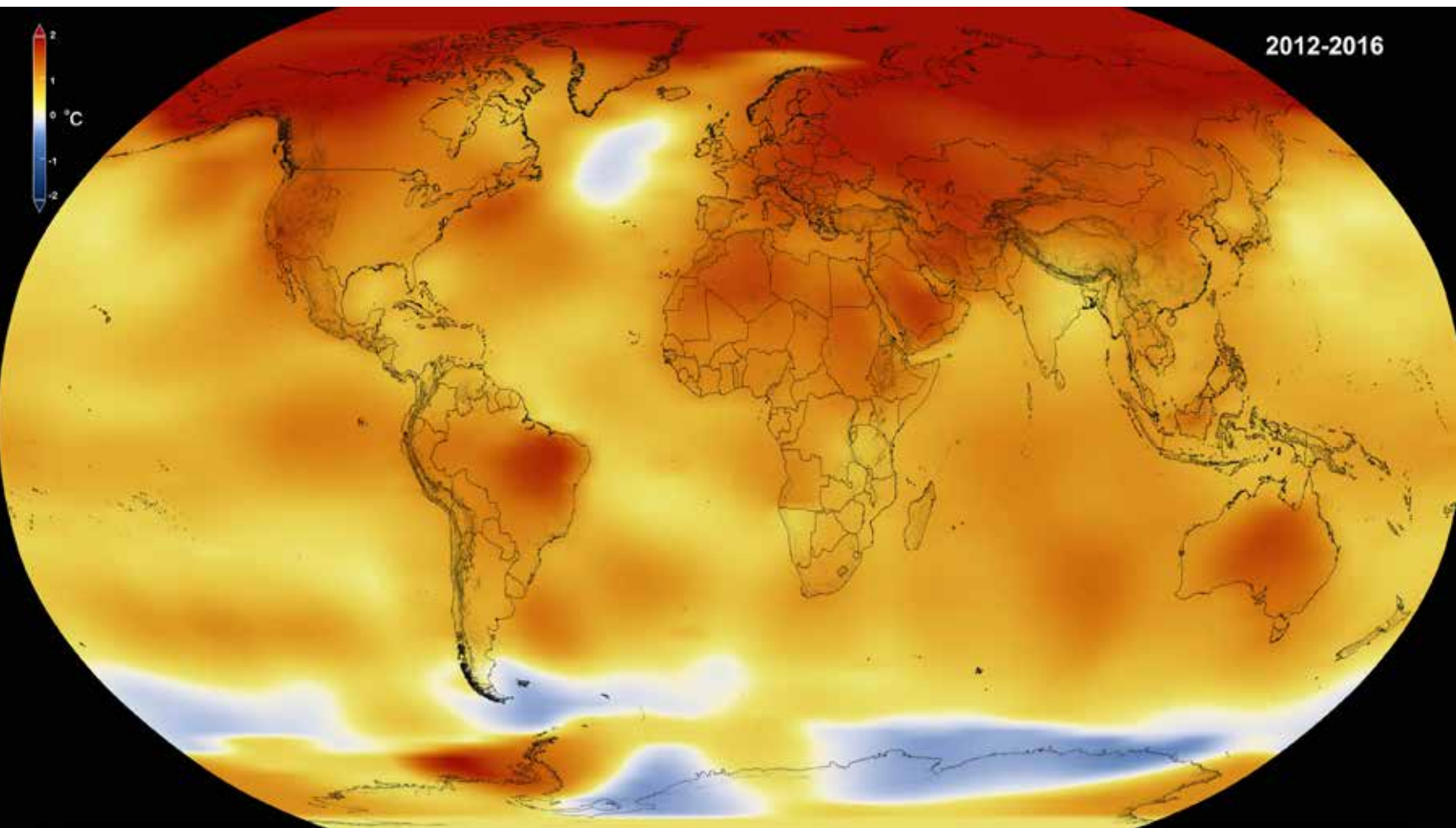
We teach the geological skills that lead to the most sought-after professional skills for geoscience careers in academia, government intelligence and space agencies, USGS and state geological surveys, and many more possibilities.

Climate and Earth processes are two of the most rapidly expanding areas in the geosciences. Research in these areas seeks to understand the character and dynamics of Earth's habitable zone, especially the complex interactions of its biosphere, hydrosphere, atmosphere, and geosphere coupled with human-induced perturbations of these natural systems. It embraces studies of Earth's climate and its connections operating on multiple spatial and temporal scales with the hydrologic and biogeochemical cycles that are influenced by pervasive surficial processes.

Knowledge of these systems, especially their drivers and sensitivities to change, is integral to informed use of energy, mineral, water, and land resources and the environmental consequences of human activities. These advances permit understanding of paleoclimates and ancient environments from key proxies preserved in the rock record that have been verified in the modern world. The critical zone that lies as the interface of the natural and anthropogenic worlds urgently needs improved understanding. Bridges between sub-disciplines of the geosciences that focus on problems such as the role of fluids in Earth systems and controls on the movement of dissolved and suspended materials can help.

Earth and Atmospheric Sciences at Indiana University possess research expertise in these important domains. Research that incorporates observation, analyses, experiments, and modeling has achieved critical insights into these geological and biogeochemical pathways, from molecular processes and chemical reactions, to local- and regional-scale water and sediment budgets, and ultimately to global dynamics of atmospheric composition and oceanic temperature.

The department is a key player in IU's Integrated Program in the Environment.



NASA, NOAA analyses reveal record-shattering global warm temperatures in 2015. Posted Jan. 20, 2016
<https://www.giss.nasa.gov/research/news/20160120/>

ATMOSPHERIC SCIENCES

Chanh Kieu, Cody Kirkpatrick, Paul Staten

Atmospheric Sciences at Indiana University is a dynamic program with exciting opportunities to undertake field, satellite, or modeling research. Our faculty members actively conduct both observational and modeling studies of weather and climate processes across scales, from cold fronts and tropical cyclones, to global atmospheric cloud and circulation patterns.

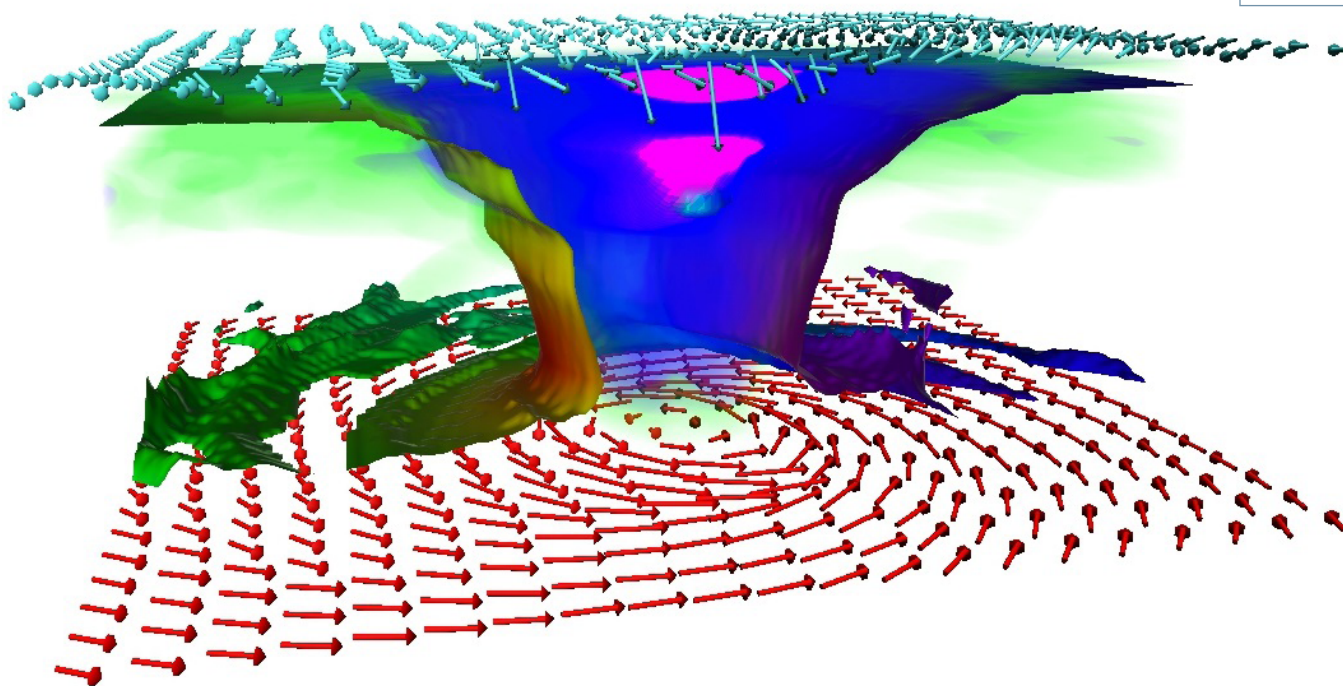
The Atmospheric Sciences Group is an active participant in the interdisciplinary research of other Earth and Atmospheric Sciences faculty, including paleoclimate research and global climate change studies.

The Department's diverse, close-knit group of researchers enjoys a collective expertise in atmosphere-hydrosphere-solid Earth interactions. We are among the most active users of IU's high-performance parallel computing facilities which include the new Big Red II machine - one of the world's 70 fastest supercomputers.

CHANH KIEU Assistant Professor | Atmospheric Sciences

My research focuses on theoretical and numerical studies of hurricane dynamics and structure. The fundamental questions that my research group currently tackle are how far in advance can we predict hurricane intensity within a given accuracy, the abnormal structure of a hurricane's inner core at a very high intensity limit, and potential changes in hurricane intensity and frequency in future climates.

My research employs extensive theoretical tools along with cloud-resolving model simulations on the IU exceptional high-performance computing system.





CODY KIRKPATRICK Lecturer | Atmospheric Sciences

Cody conducts research in mesoscale meteorology - the atmospheric scale that includes circulation sizes from tornadoes and individual thunderstorms up to hurricanes - and the high impact weather that these phenomena produce. His primary area of interest is improving our prediction of how thunderstorms move, and understanding why certain storms may produce hail or tornadoes while other storms nearby do not. Recently, he has also cultivated interest in the meteorology of wildfires, and how these conditions may evolve under Earth's changing climate.

On August 21, 2017 EAS faculty and staff participated in a campus-wide "Celeste Fest" celebrating the solar eclipse



PAUL STATEN Assistant Professor | Atmospheric Sciences

Atmospheric Sciences at Indiana University is "green and growing," so to speak, and the Staten Lab is no exception. Last year, Staten hosted an international working group on the "Width of the Tropics," on campus to discuss the evidence for, and consequences of desertification and shifting wind and rain patterns.

The Staten lab is also now home to four graduate students, with research topics ranging from modeled tropical rain cycles in Earth's geologic past to climate's effects on midlatitude clouds as observed by satellite.

Undergraduate students also play an active role in the lab, with a Sustainability Scholar helping to run the weather research forecast model each morning. This model is being used to teach students about water use on campus, and to create high-resolution local forecasts specifically for the upper midwest.



Undergraduate student Zoey Mintz forecasts the weather for the coming week on Hoosier News Source.

Department, college, and campus support continue to provide favorable growing conditions for the Atmospheric Sciences program. The renaming to "Department of Earth and Atmospheric Sciences" not only highlights the department's strength in diversity, but also provides the Atmospheric Sciences program a named home. Graduate Fellowships from the college have attracted top talent to the program, and the recently announced Grand Challenge on Environmental Change has spurred the search for new faculty. The new Big Red 2+ and Carbonate supercomputers provide exciting capabilities and processing power to the active group.



BIOGEOCHEMISTRY

Simon Brassell, Erika Elswick, Lisa Pratt, Ed Ripley, Peter Sauer, Juergen Schieber, Arndt Schimmelmann, Laura Wasylenki, Chen Zhu

SIMON BRASSELL Professor of Geological Sciences



Simon's research activities continue to be focused on the use of the molecular and isotopic compositions of sediments to elucidate paleoclimates and paleoenvironments, and to study the fate of organic matter in the geosphere. Recent investigations by Devon Colcord as part of her M.S. and Ph.D. studies have included assessment of climate records in lake sediments from Greenland, studying cores collected by the GetGamm program led by Lisa Pratt. Two publications in Organic Geochemistry have verified that the distributions of molecules

biosynthesized by bacteria known as branched GDGTs (glycerol dialkyl glycerol tetraethers) include contributions from autochthonous sources within lakes augmenting their origin from surrounding soils, and confirmed this conclusion by the first direct measurement of the carbon isotope composition of these molecules in collaboration with Professor Ann Pearson at Harvard University. Another recent publication in Organic Geochemistry reports the results from the M.S. thesis of Amishi Kumar, who elucidated the separate contributions of polycyclic aromatic hydrocarbons originating from both natural and anthropogenic sources of both petrogenic and pyrolytic compounds within sediments from the Santa Barbara Basin, offshore California.

Over the past couple of years, investigations led by Ph.D. students Devon Colcord and Andi Shilling are elucidating changes in climate recorded by biogeochemical indices in a series of early Pleistocene lacustrine sediment cores recovered from Olduvai Gorge. This research is part of a larger collaborative project led by Jackson Njau, Nick Toth, and Kathy Schick that aims to explore environmental change during critical intervals of hominin evolution established at Olduvai. The laminated sediment sequence from ~1.8 Ma provides an extraordinary opportunity to determine short-term changes in climate that triggered responses in the lake phytoplankton and surrounding vegetation at a time of high hominin diversity.

Simon continues to work on profiling ancient climates and is a co-author of a recent paper focused on a comprehensive collation of temperature records for the Cretaceous, which has been published in Earth Science Reviews. He is also collaborating with Arndt Schimmelmann and Maria Mastalerz in analysis to better understanding the specific nature of catalytic processes transforming organic matter during diagenesis in the New Albany and other shales.

Simon teaches both a fully online introductory oceanography course that utilizes web-based resources in student exercises exploring a wide range of oceanographic phenomena and a College critical approaches class on records of global climate change.

ERIKA ELSWICK Senior Lecturer and Director, Analytical Chemistry Laboratory



News From the Analytical Geochemistry Laboratory

Erika R. Elswick - Director

Fall 2017 has brought a lot of additional activity to the Analytical Geochemistry Laboratory with a full class in Methods in Analytical Geochemistry (G444/G544). In the spring we acquired a new ion chromatograph for the analysis of anions in water samples. The new Thermo/Dionex instrument replaces a much older unit, and is very student friendly. We continue to analyze aqueous solutions and solids for departmental members, as well as colleagues in other departments and units across campus.

During the summer of 2017 I embarked on a new project with a colleague to begin to instrument a wetland located in the National Forest land above the IU Field Station associated with the late 19th and early 20th Century mining activities. We ultimately hope to shed some light on this dynamic setting to develop models for remediation at higher altitudes.

Arndt Schimmelmann's international team of scientists from Vietnam, Germany, and Indiana University identified subterranean microbes in caves to voraciously consume the strong greenhouse trace gas methane from air. Cave air typically exchanges with the atmosphere on short time scales. Methane depletion in cave air on several continents indicates that the subterranean microbial sink for methane is substantial enough to warrant inclusion in global greenhouse gas modeling. In contrast, laboratory experiments at Indiana University with strong radiation from radon isotopes excluded the possibility that elevated natural radioactivity in caves can significantly contribute to oxidation of methane in air.



Furthermore, Schimmelmann's team continues to develop remediation strategies to mitigate radiation geohazards in mud-built homes in developing countries (see website: <http://eosvnu.net/projects/mud-built-homes/>). Outreach activities in mountain villages established personal contacts and reliable logistic support for our research.

As a third collaborative research project with Vietnam National University in Hanoi, the laminated sediment from a volcanic maar lake in central Vietnam near Pleiku is being explored as a geological archive for prehistorical monsoon strength. The record of distinct flood layers of the past can be radiocarbon-dated and may offer a reliable statistical basis to judge the effects of climate change on modern precipitation patterns in central Vietnam.

Two images from sediment coring activities in a central Vietnamese maar lake. The image on the left shows our mobile coring platform where inner tubes from trucks provide flotation. The entire platform with anchors cost only about \$150 and worked extremely well. We pulled 20 wonderful sediment cores from up to 21 m water depth with penetration into sediment of up to 3.5 meter. At one time we needed a special heavy-duty core catcher. On the right, a local machine shop in Pleiku lathed a core catcher for us from an old rusty artillery shell at a few hours notice. In Vietnam everything is possible if you know your way around. Our Vietnamese colleagues are experts in improvising.



LAURA WASYLENKI Associate Professor of Geological Sciences | Biogeochemistry of Metals

Laura Wasylenki was on sabbatical in 2016-17, spending seven months at Stanford University and three months at École Polytechnique Fédérale de Lausanne in Switzerland. She is investigating mineral-fluid reactions that attenuate the migration of toxic heavy metals in soils and near-surface groundwater. At the Stanford Synchrotron Radiation Lightsource, she shone bright beams of X-rays onto samples of iron and manga-

nese oxyhydroxide particles that she had loaded with small amounts of tungsten, a likely carcinogen that has been widely introduced to the environment during weapons production and testing. She is studying the molecular-scale mechanisms by which adsorption to common soil particles can immobilize this toxic metal. She plans to test some of the new knowledge derived in the laboratory on a tungsten-contaminated field site in SW Indiana with new graduate student Coley Smith. In Switzerland, Wasylenki began a collaboration with an environmental microbiology group interested in molecular-scale mechanisms of uranium immobilization. While in Switzerland, she also made time to observe with great joy plenty of steeply dipping Jurassic carbonates adorned with Late Holocene glaciers and was joined on one occasion by former student Michael Haluska, M.S. '15.



Wasylenki in the Lauterbrunnen Valley with Jungfrau in the center and Eiger on the left.

EARTH SURFACE PROCESSES AND ENVIRONMENT

Doug Edmonds, Laura Wasylenki, Brian Yanites, Chen Zhu

DOUG EDMONDS Associate Professor of Geological Sciences | Sedimentology
Malcom and Sylvia Boyce Chair in Geological Sciences



It has been an exciting year in the Sedimentary Systems research group. The heart and soul of Doug's research group are the scientists and students. That is why Doug is so pleased with the recent success of people in his group. Notably, two post-doctoral researchers under Doug's supervision have accepted faculty positions at other universities. Dr. Alejandra Ortiz is now an assistant professor at North Carolina State University and Dr. Jon Czuba is now an assistant professor at Virginia Tech. On top of that, Dr. Rebecca Caldwell successfully defended her Ph.D. in July and will start her full-time position at Chevron in late 2017. In other news, Ph.D. student Scott David received a Dissertation

Year Fellowship from Indiana University in recognition of his successes. Ph.D. student Elizabeth Olliver published her first paper in *Estuarine and Coastal Shelf Science*, and Ph.D. student Jeff Valenza was offered an internship at Chevron during summer 2017. M.S. student Graham Johnston accepted a full-time position with ExxonMobil starting in late 2018. M.S. student Matt Wanker just completed a month-long field season at the Judson Mead Geologic Field Station surveying gravel tracers in the Jefferson River.

In addition to all these student successes Doug and his group have initiated a new and exciting project looking at floodplains in Indiana as part of research funding by the Petroleum Research Fund of the American Chemical Society and the Grand Challenges project funded by IU. This past May during flood season, Doug and his group measured water discharge and sediment transport in the floodplain channels of the East Fork of White River. The floodplain channels are interesting geomorphic features that regulate the connectivity of the river and floodplain, control sedimentation patterns, and ultimately influence the biodiversity. These data will be used to calibrate models aimed at trying to understand the function of these channels.

Doug's research site: <http://earth.indiana.edu/edmonds/sedSystems>



top: Graham Johnston measures the water discharge through a floodplain channel using an acoustic Doppler current profiler.

middle: Students pondering the nature of floodplain channels.

bottom: Jon Czuba surveying the water line of the East Fork of the White River.



Study: River deltas ‘self-organize’ to withstand human and natural disturbances

Quoting IU Newsroom, October 31, 2017:

River delta channels that carry water, sediment and nutrients may appear to be random and arbitrary in how they are organized. But research by a team that includes an Indiana University geologist finds there is order to the complexity.

The researchers, using field observations and mathematical modeling, concluded that deltas self-organize according to an “optimality principle,” creating networks of channels that increase the diversity of ways in which sediment is transported.

“Channel networks are the blood vessels of a delta system, and their job is to deliver water, sediment and nutrients to the larger delta environment,” said study co-author Douglas Edmonds. “We have uncovered an organizing principle that describes how these channel configure themselves to do that job.”

The article, “Entropy and optimality in river deltas,” is published in the *Proceedings of the National Academy of Science*.

Edmonds is an associate professor and the Malcolm and Sylvia Boyce Chair in the Department of Earth and Atmospheric Sciences in the IU Bloomington College of Arts and Sciences. Other authors are at the University of California, Irvine; the University of Nevada, Reno; the Swiss Federal Institute of Technology in Lausanne; and the University of Padua in Italy.



BRIAN YANITES Assistant Professor of Geological Sciences | Geomorphology



In the spring semester, Brian teamed up with 6 graduate and 3 undergraduate students in his Advance Geomorphology course to analyze river response to Typhoon Morakot in southern Taiwan using Google Earth. The typhoon caused 22,000 landslides. The students quantified how this material has impacted river systems in these landscapes. The work has implications for understanding the cascade of hazards that can exist for decades following such an event. The work is currently under review for publication.

In May, Brian and Ph.D. student Brigid Lynch traveled to southwestern Peru to measure rates of river erosion and geomorphology. The goal of the collaborative project is to tease apart tectonic and climate drivers of canyon incision along the western flank of the Andes. The IU team will combine estimates of basin-wide erosion rates from cosmogenic nuclides with river morphology metrics to calibrate a model of river incision.

This model will be used to constrain the dynamics of canyon incision and ultimately help quantify when these canyons began forming. While conducting field work, the research team observed the eruption of the Sabancaya.

In July, Ph.D. student Nate Mitchell attended the Tobacco Root Mountain Geological Society's annual "Field Conference". Following the meeting, Nate conducted field work throughout central Idaho, measuring river morphology and rock strength in the Salmon and Clearwater watersheds. The goal of the project is to unravel how rock-type influences the rate of landscape transience.



Brian's research website: <http://earth.indiana.edu/yanites/geomorphology>.

Chachani and El Misti volcanoes loom over Arequipa, Peru's second most populous city.



NSF grant to fund IU research on how tectonic, climate processes are reshaping landscape

Quoting the IU Newsroom:

Indiana University Bloomington geoscience researcher **Brian Yanites** has been awarded a three-year, \$317,663 grant from the National Science Foundation to study how tectonic and climate processes interact to shape the landscape of southern Taiwan.

The research, which includes collaboration with Taiwanese scientists, will expand scientists' understanding of forces involved in earthquakes, floods and landslides, potentially improving the capacity for preventing or responding to natural disasters.

Yanites said Taiwan is an ideal place to study the interplay of tectonic and climate forces and how they shape the land. It experiences frequent earthquakes, some of them devastating, and an average of four typhoons per year. Its mountains and valleys are prone to erosion and landslides. "Everything is sort of amped up in terms of tectonics and climate," Yanites said. "There is just so much there, and everything happens so fast."

The researchers will analyze how the landscape is changing in response to earthquakes, tectonic uplift, rainfall and floods. The work will include measuring the size and shape of river channels, determining how much sediment the rivers can carry and what will cause them to flood. Researchers will also use a process called cosmogenic nuclide analysis, which involves measuring the buildup of rare isotopes in rocks to determine how the landscape has changed in recent and geologic time.

CHEN ZHU Professor of Geological Sciences

Adjunct Professor, Environmental Sciences | Adjunct Professor, Environmental Health

Chen is pleased with the recent successes of his students and the publications of their papers. In June, Guanru Zhang successfully defended his dissertation on modeling the CO₂ plume development at Sleipner in Norway, the world's first industrial scale carbon storage project to abate the global warming trend. His work was published in the *International Journal of Greenhouse Gas Technology, Energy & Fuels*, and the *International Journal of Energy Research*.

In July, Yilun Zhang successfully passed the qualifying exam. After years of development, a new strain of research employing the use of nonconventional isotopes to study reaction kinetics has come to fruition. Chemists have known since 1884, via J.H. van't Hoff that, at equilibrium, reactions do not stop; the rates of forward and backward reactions are equal. But how can one measure rates at equilibrium when concentrations are constant? Post-doc Zhaoyun Liu spiked a rare Si isotope into solutions at equilibrium with quartz and observed isotope

changes with time. That allowed one to calculate the quartz reaction rates at equilibrium. These results, published in the new journal *Geochemical Perspective Letters*, have far reaching significance because it tested the range of applicability of the principle of detailed balance, something often assumed

but not verified in many models for society's mega-environmental projects. This innovative experimental method shows great promises to use a number of other isotopes of Ca, Mg, Fe in kinetics studies of carbonates, sulfides, and oxides.

Chen's research website:
<http://www.indiana.edu/~hydrogeo>



Zhu named a Fellow of AAAS

On November 20, 2017, Chen Zhu was named a Fellow of the AAAS (American Association for the Advancement of Science) for distinguished research, teaching, and service contributions to the fields of geochemistry and chemical hydrology, particularly linking theoretical concepts to field observations.





Energy Resources and Sustainability

Economic Geology encompasses all areas in the geological sciences that pertain to the extraction or production of geologic materials for profit. Natural resource utilization throughout the world includes geologic materials such as metals, non-metals, fuels, and water. Here at IU we have faculty and research scientists who are involved in both field/analytical and experimental studies of all of these natural resources. We have an active group investigating the genesis of metallic ore deposits that occur in magmatic, hydrothermal, and sedimentary environments. Several faculty and research staff are also involved in studies that relate to the genesis and localization of petroleum, coal, and natural gas.

Our mineralogy and petrology program involves the study of rocks from all terrestrial and some planetary environments. We have active projects in sedimentary, igneous, and metamorphic rocks funded by NSF and NASA and sited on all 7 continents and on Mars.

Sedimentary geology utilizes sedimentary rocks to investigate the processes that shaped the surface of the early Earth and understand the history of how those processes have interacted to control the Earth system. In addition to traditional techniques like facies analysis and provenance analysis, cutting-edge application of techniques ranging from stable isotope geochemistry to detrital zircon geochronology are leading rapid developments in what can be learned from the sedimentary record.

Rainbow over the Stillwater Mining Company. This is a palladium and platinum mining company with headquarters located at Billings, Montana, United States. It is the only palladium and platinum producer in the USA. Ed Ripley's research area.

MINERALOGY AND PETROLOGY

Dave Bish, Jim Brophy, Chusi Li, Ed Ripley, Juergen Schieber, Bob Wintsch

DAVE BISH Professor and Haydn Murray Chair of Applied Clay Mineralogy

EAS Professor David Bish was awarded a Fulbright US Scholar Grant (Fellowship).

Bish awarded a Fulbright Fellowship

During the spring of 2018, Dave will spend six months in Napoli, Italy, studying cultural artifacts from Pompeii. Scientists

working there recently discovered a ceramic workshop in ancient Pompeii where all stages

of ceramic production are represented, from unfired raw materials, to fired ceramics, to overfired materials. Dave will use mineralogical analyses such as X-ray diffraction, trace element analysis, and thermal analysis to interpret the sources of the raw materials and the firing conditions (temperatures and times). The research will be done at the University of Federico II in Napoli and the University of Sannio in Benevento, Italy.



JIM BROPHY Professor of Geological Sciences | Chair, Department of Earth and Atmospheric Sciences

Jim's primary research interests have centered around the chemical and physical processes involved in magmatic differentiation. He is currently in his second year as departmental chair and continues to work with the College and University to maintain the Department's reputation in research, teaching and service.

His goal is to have every faculty member thrive during these difficult times. Not surprisingly, he has found little time to retreat to his lab and actually get some research done, but there is always hope for the future.



ED RIPLEY Professor of Geological Sciences | Geochemistry, Economic Geology

Ed's research interests include the genesis of metallic ore deposits and the application of stable isotopic geochemistry to petrologic problems.

Ed is currently President of the Commission on Ore Deposits in Mafic and Ultramafic Rocks (CODMUR).

He presented a short course on Ni-Cu-PGE deposits with Chusi Li at the September meeting of the Society of Economic Geologists in September 2017 in Beijing.

He is also preparing for the 2020 International Ni-Cu-PGE Symposium which will be held in Duluth, MN.

Current research continues to focus on processes that control the genesis of Ni-Cu-PGE deposits. Studies are in progress at the Stillwater Complex (MT), the Duluth Complex (MN), The Eagle and East Eagle deposits (MI), the Tamarack deposit (MN), and several deposits in China. Our current NSF proposal centers on the Cu isotope variability in rocks and mineralization in the Midcontinent Rift System.



BOB WINTSCH Professor of Geological Sciences | Metamorphic Petrology, Structural Petrology, Tectonics, Geochronology



The more seasoned (mature?) I get, the more busy I also seem to get. In spite of my years of service, I do not seem to have atrophied in situ. On the contrary, I am having a very busy year. I taught my usual introduction to petrology class, G222 in the spring, and led a field trip across the Appalachians as far as Providence RI in May.

I then did more fieldwork in New England in the summer, on either side of being invited to the University of Utrecht to work in the rock mechanics lab of Chris Spiers. Two weeks of great experiences. Jody joined me after that and we did a little touring including a climb to the highest point in the Netherlands – a church tower. We also visited museums in Holland and Belgium including the Van Gough, but also several battlefields, Napoleon's Waterloo, and 1st and 2nd WW battlefields. Belgium really got beaten up, but had nothing to do with starting any of those wars!

This fall I am teaching a field course where we will participate in the New England Intercollegiate Geological Conference (New Hampshire-Maine border). Then I have accepted an invitation to China for field work in hard rock tectonics – around Beijing and in the southwest along the Red River shear zone that accommodated the extrusion of Indochina following the collision of India with Southern Asia. From there I will go to South Korea to accept another invitation to use their SHRIMP to date detrital zircons from high-grade quartzites suspected to be Silurian. I will return to Bloomington, just barely miss Thanksgiving, but with this schedule I have opted not to attend either the GSA or the AGU. I am sure to need a little home time and a little rest. Wishing you all the best for the New Year! Bob



Images from G420, a regional tectonic field course across the Appalachians from central Pennsylvania to Boston crossing many suspect terranes. Emphasis was placed on interpreting the rock record.

SEDIMENTARY GEOLOGY | STRATIGRAPHY

Simon Brassell, Doug Edmonds, Lisa Pratt, Juergen Schieber, Bob Wintsch

JUERGEN SCHIEBER Professor of Geological Sciences | Sedimentary Geology

The past year has seen the completion of our latest flume (see below), a facility that can mimic orbital flow (wave action), tidal current regimes, and high shear stress situations. With its completion the flume lab has now four flumes that can experimentally explore every flow condition, chemistry, and flow regime that one might encounter on the continental shelf and in deep sea environments. Because we additionally have the technical know-how to preserve and then petrographically study flume produced sediments and compare them to the rock record, this is a unique research facility for shale studies that has no equivalent elsewhere in the world. The lab continues to conduct research on shale sedimentology that is well received and published in a variety of geoscience journals (ca. 7000 citations for the lab and its various activities). Some of the research

we do even supports innovative interpretations of mudstones found on Mars (as part of the Mars Science Lab mission). Current graduate students and academic visitors work on a range of projects, including field studies, flume research, and petrographic investigations. The research conducted at the lab is sought after by industry and valued in academia as demonstrated by requests for short courses (see below) and symposia at the national (AAPG in Houston) and international level (University of Vienna; China University of Petroleum).

Juergen's research site: <http://www.shale-mudstone-research-schieber.indiana.edu>



The wave and tide flume in the 5th floor flume lab. It is a unique facility with sophisticated electronic controls that allow us to program entire experiments so that they can be repeated identically as specific variables are modified to explore parameter space.



As part of an appointment as a Visiting Professor at the University of Vienna (Summer 2016), I taught our Shale Short Course to geoscience students and geologists from OMV, the national oil company of Austria.

Indiana Geological and Water Survey

NAME CHANGE REFLECTS NEW CAPABILITIES

Our Department isn't the only one in the Geology Building that has a new name. The long-standing "Indiana Geological Survey" has made way for the "Indiana Geological and Water Survey," reflecting the Survey's expanded efforts in the study and dissemination of information about the quality and quantity of Indiana's surface- and groundwater.

"I think it's no surprise to anyone who follows the news that water is a growing issue in the 21st century."

"I think it's no surprise to anyone who follows the news that water is a growing issue in the 21st century," said Survey Director Todd Thompson. "As a midwestern state, we assume that sufficient water exists for human and livestock consumption, agriculture, and business uses. However, we have a limited inventory of the quantity, and even less knowledge of the quality, of this important resource. At the Indiana Geological and

Water Survey, we hope to more accurately define water resources statewide." The name change was codified in Indiana Senate Bill 416, which took effect on July 1, 2017.

ECONOMIC IMPACT STUDY

A new study conservatively estimates that the Survey has an annual economic impact of \$110.4 million on the state of Indiana. Conducted by Capstone Class 7933 in IU's School of Public and Environmental Affairs as their class project, the study cites the Survey's online tools such as IndianaMap and the Petroleum Data Management System at nearly \$25 million alone. The value of projects that would never be completed without the IGWS's freely available or low-cost data is listed at more than \$56 million annually. The study surveyed users of IGWS information and implemented the input-output model IMPLAN as part of their methodology.

OUTREACH ACTIVITIES

The Indiana Geological and Water Survey is reaching more Hoosiers than ever before with an increased effort on outreach programs for the general public. From the well-known Quake Cottage program to partnerships with Indiana State Parks, more than 10,000 Hoosiers participated in IGS outreach activities in 2016. New additions in 2017, including scouting workshops, library programs, quarry tours, and Master Naturalist courses, have reached another 9,750 people by the end of September 2017. Polly Sturgeon, the Survey's Outreach Coordinator, has also promoted new lesson plans, StoryMaps, and social media campaigns to increase awareness of Indiana geology around the state.

NEW STAFF

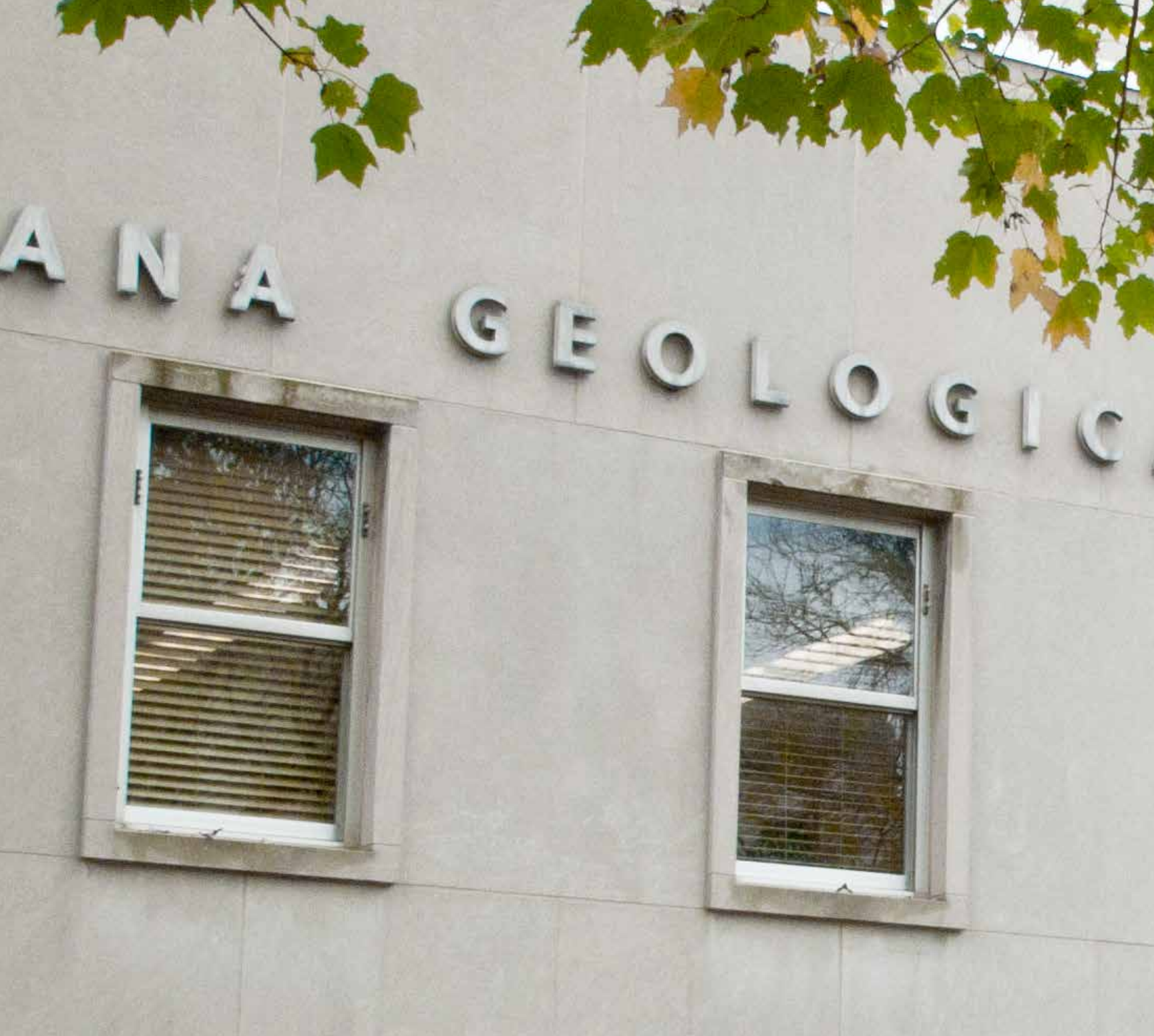
In the past year, a number of new employees have joined the Survey:

José Luis Antinao, Ph.D., Research Geologist (surficial); Alyssa Bancroft, Ph.D., Research Geologist (stratigraphy); Shalom Drummond, Admin. Support Team Member; Lee Florea, Ph.D., Assistant Director for Research; Eric Gamble, Research Geologist (hydrogeology); Megan Harris, Program Coordinator; Jennifer Lanman, Archives and Collections Manager; Clayton McGuire, System Analyst/Programmer/Web Designer; Gary Motz, Assistant Director for Information Services; Brandon Phillips, Internal Projects Coordinator; and Don Tripp, Program Coordinator.

IGWS website: <https://igws.indiana.edu/index.cfm>



Jose Luis Antinao



Alyssa Bancroft



Shalom Drummond



Lee Florea



Eric Gamble



Megan Harris



Jenna Lanman



Clayton McGuire



Gary Motz



Brandon Phillips



Don Tripp

These disciplines investigate the interactions between life and environments throughout Earth's history. Principles of paleontology form the foundation that bridges geologic, biologic, chemical, and anthropologic sciences.

Geobiology relies on analysis of fossils in their geologic, and thus historical and environmental contexts to test hypotheses about the history of life.

Geoarchaeology and geoanthropology focus on the spatial, temporal, and environmental context of humans in the most recent phases of Earth history.

The IU Paleontology Collection, which contains more than 1.3 million fossil specimens, offers special opportunities for specimen-based research, teaching, and outreach.



GEOBIOLOGY, GEOARCHAEOLOGY, PALEONTOLOGY

Ed Herrmann, Claudia Johnson, Jackson Njau, David Polly

ED HERRMANN Research Scientist | Geoarchaeology

Ed's geoarchaeological research is naturally interdisciplinary. Although his work is focused on archaeological questions, he incorporates datasets from a number of geologic fields such as geomorphology, sedimentology, pedology, cartography, paleontology, geophysics, and river basin research. These fields are important components of understanding the chronology and preservation potential for archaeological sites at various time scales. Geoarchaeology is a rapidly growing subfield of geological and archaeological sciences. The multidisciplinary field addresses archaeological questions by incorporating geological principles and methods into research design. Geoarchaeologists study sediments, soils, geophysical techniques, stone tools and lithic sources, paleoenvironments, and archaeological site taphonomy. In the past year, Ed has worked to decipher the stratigraphy and chronology of archaeological sites in Montana, Ohio, Illinois, Indiana, and in the cradle of humanity: Olduvai Gorge, Tanzania.

Geoarchaeological work at Olduvai Gorge, Tanzania

Along with Jackson Njau and EAS research affiliates Nick Toth and Kathy Schick of the Stone Age Institute, Ed is working on the Olduvai Project which studies millions of years of stratigraphy using deep coring methods that provide data related to the paleoenvironments within which some of our oldest ancestors lived. These data can also provide an understanding of lake levels and positions, volcanic activity, and local and regional geomorphology. Geoarchaeological methods are also being used at Olduvai to understand the distribution and sources of stone raw material used by our earliest human ancestors, and where yet undiscovered sites may be hidden. Many EAS faculty members and students are actively participating in the Olduvai Project and field school.



Left: Field school with Crow students under the recently discovered Grapevine Creek Buffalo Jump. Note colluvium beneath cliff.

Middle: Bison bone bed preserved under colluvium at Grapevine Creek Buffalo Jump on the Crow Reservation.

Right: Ed (far right) lectures to workshop visitors at the HEB site, Olduvai Gorge, Tanzania.



CLAUDIA C. JOHNSON Associate Professor of Geological Sciences | Geobiology



Claudia's research in evolutionary paleoecology takes her and students to the Caribbean where they investigate the composition of ancient reefs and the health of corals' modern counterparts. Data on coral species, disease, depth, temperature and geographic location are folded into a database investigated first for associations, and then for causal relationships emerging from data-driven hypotheses. Rudist bivalves, the Cretaceous reef builders of the Caribbean, are back in the forefront of research with new methods of addressing classification and phylogeny.

On the other side of the world and far up from the Cretaceous in the geologic column are investigations into Tanzania's Pleistocene fossils that disclose their riverine affinities, and rocks that reveal their fluvial and volcanic histories from exposures and cores extracted from Olduvai Gorge.

Closer to home and back down the geologic column are class field trips for students to learn field methods of measuring stratigraphic sections, and collecting fossils for laboratory processing of fossil identifications and paleoecologic analyses.



Claudia's Geology of Invertebrates Lab website: <http://earth.indiana.edu/claudia/invertebrates/index.html>



Above: Students in the G411 Invertebrate Paleontology class measure section and collect fossils at the Upper Dillsboro Formation, Upper Ordovician, Madison, Indiana in September 2017.



Above and opposite: Student divers learning to take compass orientations and written notations on coral species, all while maintaining neutral buoyancy.

Students are members of the K492 and K550 Research in Underwater Science course led by Professor Charles Beeker, with guest participation by Claudia who teaches coral identifications and coral reef ecology.

Photos of cannon and anchor are from the 1724 Guadalupe Underwater Archaeological Preserve in the Dominican Republic.



JACKSON K. NJAU Assistant Professor | Paleoanthropology

Research Associate, The Stone Age Institute and the Center for Research into the Anthropological Foundations of Technology (CRAFT), Bloomington, Indiana.

Adjunct Professor, Department of Anthropology, Indiana University

FROM CORE TO OUTCROP: TANZANIA PROJECT

The drilling program for scientific research that was carried out at Olduvai archaeological site in Tanzania by the Olduvai Gorge Coring Project (OGCP) has yielded about 600 m of continuous core obtained from ancient lakebeds. The core constitutes approximately 30 % of all cores from East African paleolake and hominin sites (including Kenya and Ethiopia). OGCP was developed in 2013 by Jackson Njau, Kathy Schick and Nick Toth (Earth and Atmospheric Sciences and The Stone Age Institute) with the goal of obtaining high-quality cores, which are vital for the investigation of past climates and environments in which early humans evolved. Along with parallel active and passive seismic studies conducted in the area in collaboration with the King Abdullah University for Science and Technology (KAUST) scientists,

we have built a strong interdisciplinary research program bridging paleoanthropology and Earth sciences, making OGCP one of the top drilling projects in Eastern Africa hominin sites. To date, twenty-seven scientists from eight different countries and 14 labs (including IU) have been working on the project, focusing on different aspects of the overall research including: sedimentology, X-Ray Fluorescence (XRF), argon-argon and paleomagnetic dating, tephrostratigraphy, soil carbonate isotope ratios, phytoliths, pollen, diatoms, ostracods, organic geochemistry, paleontology, archaeology, geophysics, and seismology.

We are beginning to get exciting results from core analyses revealing an unprecedented record of past environments that might have influenced human evolution in the East African rift valley. Although the link between environmental changes and human evolution faces many challenges, this research is changing longstanding views of early hominin paleoenvironments at Olduvai, and offers new perspectives for reconstructing paleolandscapes and a holistic understanding of hominin land use behaviors, climate history and basin evolution. The core record, which shows the influxes of mudflows and volcanic materials (from the adjacent Ngorongoro volcanoes) and the unparalleled large, deep and long-lived lake, suggests that both climate modulated environmental change and tectonic activities altered the lake configuration and shaped paleogeography and hominin adaptations through time. This ground-breaking research is providing modern methods that address our species' humble beginnings, and help us answer questions about our origins.



FIELDWORK IN OLDUVAI GORGE

After successful completion of the project's phase I drilling (2014), phase II seismic experiments (2015-2017), and phase III, core sampling at the NSF-funded National Lacustrine Core facility at the University of Minnesota (2015-2017), OGCP is now in phase IV of its research program. Our goal here is to tie the core stratigraphy to outcrop in order to examine whether times of significant environmental change correspond to times of significant technological or biological change (observed in outcrop-derived fossils and artifacts) during Bed I (~2 Ma), Lower Bed II–Upper Bed II transition (~1.7 Ma), Bed III during the Pleistocene Revolution (~1 Ma), and Masek Beds (~0.4 Ma). We began this exercise by correlating the volcanic ash layers and paleoenvironmental proxies archived in cores to the archaeological-bearing units in the outcrop. To this end, a series of excavations was initiated at Olduvai Gorge in the summers of 2016 and 2017 in order to expose fresh sections and recover more fossils and stone artifact data. The excavations targeted geological intervals and sites that document key evolutionary landmarks in the history of our ancestors such as the transition from *Homo habilis* to *H. erectus* and subsequently to anatomically modern *H. sapiens*, the extinction of early *Homo* and Australopithecine hominins, and the first human migration out of Africa.



DAVID POLLY Professor, Geological Sciences

Adjunct Professor, Departments of Biology and Anthropology | Director, Center for Biological Research Collections

Research Curator, IU Paleontology Collection | Affiliate Member, Integrated Program in the Environment

Research Associate, Department of Zoology, The Field Museum, Chicago | Shrock Professor of Sedimentary Geology



There has been a productive turnover in David Polly's group in 2017. Wesley Vermillion finished his Master's thesis on the effects of glacial-interglacial cycles on evolutionary differentiation and geographic distributions of painted turtles. Michael Smith finished his Ph.D. on the effects of physiography on the distributions of mammals in North America, demonstrating that topographic and geological features contribute to continuity in faunas despite turnover between glacial and interglacial communities. And Blaire Hensley-Marschand completed her Ph.D. on the Early Pleistocene mammalian faunas of the Nihewan Basin in China, disproving the idea that climates in north eastern Eurasia were harsher than in Africa because of global cooling during the Quaternary. Ely Ricardo, who

worked on dinosaur faunas from Antarctica for his undergraduate thesis at Eastern Washington University, and Anne Longar, who measured post-glacial differentiation in rodents using 3D microCT scan data at University of Minnesota, both joined our graduate program in the fall of 2017.

David himself is working on faunal changes and adaptation of mammalian communities during the Neogene to derive new proxies for paleoenvironments and to develop new ways of measuring rates of adaptation, community restructuring, and extinction relative to global-scale changes in climate and environment. The focus of this research has been Miocene Great Plains environments as they transformed from forested riparian landscapes to open grasslands as a result of global changes in atmospheric circulation and regional changes driven by tectonic uplift in western North America. This research is closely linked to IU's new Prepared for Environmental Change Grand Challenge initiative, which will create two new faculty positions and several postdoctoral opportunities in the Department of Earth and Atmospheric Sciences. David is serving as Associate Director of this initiative.



Lower jaw of Aelurodon mcgrewi, an extinct member of the dog family from the early Miocene of Nebraska.



Polly Lab website:
<http://mypage.iu.edu/~pdpolly/>

In August 2017, David was invited to speak about the mathematical and conceptual challenges of quantifying evolutionary change at a commemorative conference at the Siberian Branch of the Russian Academy of Sciences in Novosibirsk on the long-term genetic experiment conducted there on domestication of foxes, which uncovered a suite of unexpected correlations between behavior and morphology.

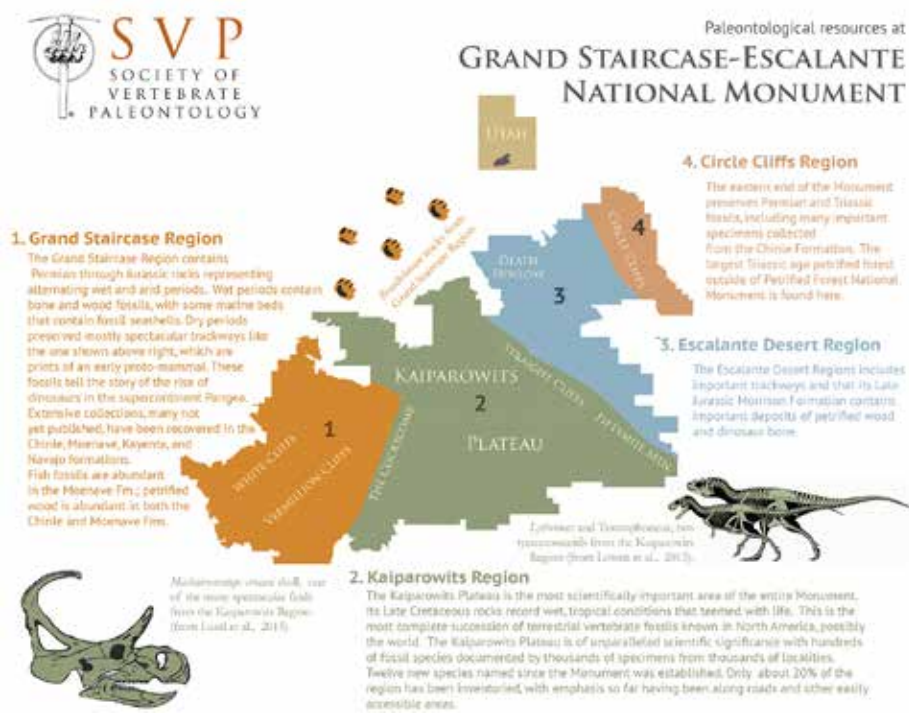
David is also serving as the current President of the Society of Vertebrate Paleontology, which is concerned among other things with the protection of vertebrate paleontological resources.

With the Society, David helped advocated successfully for the establishment of Bears Ears National Monument in southeastern Utah in December, 2016. Bears Ears became one of several national monuments that protect vertebrate fossil sites and provide funding for field research. One of the most important of the paleontology-focused monuments is Grand Staircase-Escalante, also in southern Utah, which has produced an incredible range of Mesozoic research since it was created in 1996 that has revolutionized our understanding of Late Cretaceous ecosystems. Two major monographs on Grand Staircase paleontology have been published by IU Press.

In December 2017, the White House announced that it would reduce the boundaries of both monuments, thus removing literally hundreds of scientifically important paleo localities from the protection and the funding associated with monument status. The Society, along with partner organizations, has filed lawsuits to reverse this decision because of its impact on science.



David Polly holding a domesticated fox at the Institute of Cytology and Genetics in Novosibirsk. The fox domestication experiment showed that features like behavior, tail shape, ear shape, and coat color are genetically linked and occur in parallel with the suite of features that distinguish domestic dogs from their wolf ancestors, a finding that is consistent with correlated patterns evolution observed in the fossil record.



Map of Grand Staircase-Escalante National Monument in southern Utah summarizing its vertebrate paleontological resources. The Kaiparowits Plateau region contains one of the most scientifically important records of the Late Cretaceous in the world.



[Read a recent article in Science about these lawsuits](#)

MARINE ANIMALS



Line = 1 centimeter

The 1.3 million fossils in the Indiana University Paleontology Collection are once again part of the department's research activity after a seven-year program to reorganize, inventory, and rehouse them. The Collection is a public trust research repository operated by the department that documents past research projects and serves as a resource for new synthetic research on stratigraphy, paleoecology, evolution, and the biotic component of Earth system change.

The IU Paleontology Collection

Following a successful unveiling of the IU Paleontology Collections during our Open House on April 30, 2016, physical improvements to our collections space and movement toward 3-D digitization of fossils continued under the curatorial expertise of our former Collections Manager, Gary Motz. Numerous undergraduate and graduate students from several disciplines gained academic and managerial experience under Gary's tutelage. Recently, Gary accepted a position as Chief Information Officer and Assistant Director for Information Services in the Indiana Geological and Water Survey, and fortunately we will continue to collaborate with Gary in his new position. We thank Gary heartily for bringing our collections into the forefront of the 21st century through his continued focus and dedication toward the goal of research access to fossil specimens.

President McRobbie visited our newly renovated IU Paleontology Collections space in April of 2017, and was hosted to a viewing and discussion of our research-focused repository of fossil specimens from Indiana and around the world. Our IU Paleontology Collections were founded in 1903 by IU geologist E.R. Cumings, and now contain more than 1.3 million fossils that document life on Earth for more than 500 million years. Soon after visiting our Collections, President McRobbie initiated a Collections Summit during which he shared his remarks about IU's material object collections across all campuses, hosted an open discussion regarding policy issues inclusive of mission, digitization, exhibition, accession, deaccession and staffing, and welcomed invited participants' responses to develop a collective vision for IU's material object collections as part of IU's Bicentennial activities and celebrations. We can gently boast that our IU Paleontology Collections are ahead of the curve relative to other IU collections holdings, and we look forward to in-depth participation in this collaborative Bicentennial effort.

We in Geobiology mourn the loss of our close colleagues, Professor Emeritus Donald Hattin and Professor Emeritus Erle G. Kauffman, both of whom added immeasurable pearls of wisdom to our professional lives. Stories of field collections and early international travels were conveyed to us with great exuberance, and certainly were embellished - at least a tad - each time they were told to enhance color and effect.

Our IU Paleontology Collections were enhanced recently by the addition of shallow-water coral and mollusc specimens from the Stoter Collection, formerly in off-site storage but now a central, visible part of the beauty of our fossils. Students in the G341 Natural History of Coral Reefs course participated enthusiastically in the unpacking of these treasures.



“ Soon after visiting our Collections, President McRobbie initiated a Collections Summit during which he shared his remarks about IU’s material object collections across all campuses, hosted an open discussion regarding policy issues inclusive of mission, digitization, exhibition, accession, deaccession and staffing, and welcomed invited participants’ responses to develop a collective vision for IU’s material object collections as part of IU’s Bicentennial activities and celebrations.

Probing questions about our daily research and teaching activities were always welcome. We now treasure these “good ol’ days” of interactions and hope we are developing our own stories, to be passed along to future generations with fossil specimens in our Collections.

The N. Gary Lane Paleontology Collection Fund campaign, launched at the inaugural Open House, provides the financial resources needed to manage, curate, and preserve the IU Paleontology Collections in perpetuity. We invite you to contribute to this fund, and to visit our Collections, either in person, or virtually through accessing this website, the Paleocollection Visualization Lab: https://my.matterport.com/show/?m=4FXijnxBcJ_



Collection Personnel

Claudia Johnson

(Faculty Research Curator) phone: 812-855-0646

e-mail: claudia@indiana.edu

David Polly

(Faculty Research Curator) phone: 812-855-7994

e-mail: dpolly@indiana.edu

Jackson Njau

(Faculty Research Curator) phone: 812-856-3170

email: jknjau@indiana.edu

Collection Location

Department of Earth and Atmospheric Sciences

Indiana University

1001 E. 10th St. Room GY518

Bloomington, IN 47405

IU Paleontology Collection website: <http://go.iu.edu/1cHc>

Solid Earth Dynamics

Critical to our understanding the Earth is knowledge of the physical processes that shape the Earth's formation, evolution, and present-day dynamics. The combination of state-of-the-art geophysical instrumentation and advanced computational capabilities makes it possible to observe and quantitatively model complex geological systems in ways that were previously unimaginable. Research applications of these geophysical methods include global tectonics, earthquake seismology, volcanology, structural geology, tectonic geomorphology, and environmental and exploration geophysics. Advances in quantitative geochronology, thermochronology, and petrology have expanded the scope for interdisciplinary investigation of deep Earth and surface processes involved in crustal deformation, sedimentary basin formation, magmatism, landscape evolution, and natural hazard mitigation.



GEOPHYSICS, STRUCTURAL GEOLOGY, TECTONICS

Bruce Douglas, Michael Hamburger, Kaj Johnson, Gary Pavlis, Bob Wintsch, Brian Yanites

MICHAEL HAMBURGER Professor of Geological Sciences | Geophysics, Seismology, and Tectonics

EAS faculty member Michael Hamburger collaborates with artist James Nakagawa for a prestigious art exhibit.

Here's an honor that you might not expect for an IU geologist: invited participation in an international art exhibition. As part of an unusual collaboration between artists and scientists, EAS Professor Michael Hamburger collaborated with IU Professor of Fine Arts Osamu James Nakagawa to document the devastating impact of a major natural disaster — the magnitude 9.0 Tohoku (Japan) earthquake and tsunami. Their artistic collaboration, which they refer to as "Seismophotography," was part of the IU's Grunwald Gallery exhibition, "Imag(in)ing Science," in 2013. Several pieces from that exhibition were accepted for a prestigious international photographic exhibition. The Noorderlicht Photofestival, based in Groningen, Netherlands opened in October of 2017, and featured six of the pieces created by Nakagawa and Hamburger for the exhibition.

Photographer Osamu James Nakagawa returned to his native Japan in the aftermath of the "3.11 disaster" and collected striking images of damage incurred by the earthquake and tsunami. Nakagawa turned his camera to the sea, a place where tragedy now found itself embedded in the silent landscape marred with debris, a bridge between life and death. In these images, his intention was not to merely document

the devastation but to contemplate the lives of those who vanished on that day in March. However, he found himself unsure of what to do with the photographs he had taken.

As part of this unique collaboration between artist and Earth scientist, Michael Hamburger modified the photographs using a number of traditional recording techniques that have been used by seismologists for over a century: smoke-paper and ink-pen recording of current seismic activity on rotating seismograph drums. They also experimented with manual tracing of specialized engineering recordings from "strong-motion seismographs" positioned close to the location of the photographic images. These techniques produced a new medium, "seismophotography": images that bring together photographic and seismological impressions of dynamic Earth activity. The combination of seismographic data and photographic images produce a mysterious, evocative, and sometimes powerful impression of the impacts of Earth activity on human agency and the ways in which we strive to understand and respond to them.

The images were on display at the Noorderlicht Photofestival in November 2017.



Left: collaborative seismophotographic imagery from geophysicist Michael Hamburger and artist James Nakagawa for an exhibition in the Netherlands.

EAS Research Contributes to USGS Earthquake Information System

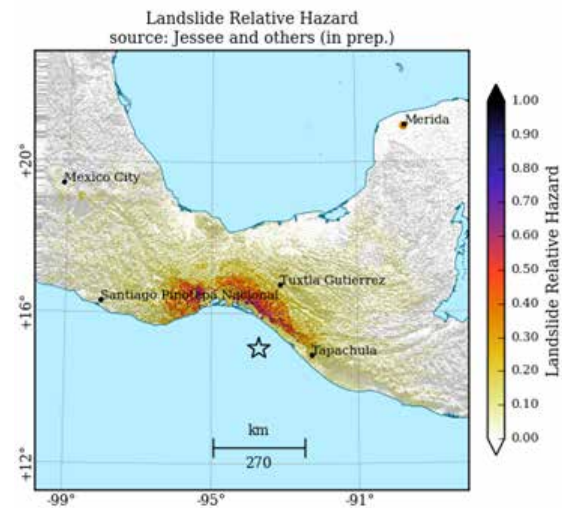
One of the most challenging aspects of earthquake hazard mitigation is predicting the nature and distribution of the complex array of secondary effects triggered by major earthquakes.

To address that research gap, Michael Hamburger and his students are collaborating with scientists from the US Geological Survey's National Earthquake Information Center in Golden, Colorado on a study of a particularly deadly secondary effect of earthquakes: landslides. The collaborative research promises to provide useful information on landslides triggered by earthquakes within minutes of the occurrence of a major temblor.

The collaborative research program grew out of EAS grad student Anna Jessee's summer internship with the USGS five years ago. Since her internship with the USGS, Anna has focused much of her Ph.D. research on development of a new global model to assess the likelihood of landslides in the aftermath of a significant earthquake. Anna's global landslide model offers the USGS — for the first time — the ability to predict whether, and where, landslides are likely to occur in the aftermath of significant earthquakes. Anna's model, now being implemented and displayed on the USGS earthquake website, will provide near-real time information to government officials, emergency responders, plan-

ners, and concerned citizens. The model should contribute to mitigation of the deadly effects of earthquake-triggered landslides. Eventually, the collaborators plan to develop a "stoplight" system that will provide preliminary indications of the likelihood of fatalities and economic impacts of earthquake-induced landslides within minutes after an earthquake.

M8.1 Sep 08 2017 v6 - OFFSHORE CHIAPAS, MEXICO
Jessee and others (in prep.)



Anna Jessee defended her Ph.D. dissertation in September 2017, and will remain at IU for the next year as a post-doctoral research associate, where she will continue to collaborate with USGS on further development of the model.

Thirteen IU Bloomington students spent the spring 2017 semester learning all they could about the production and consumption of energy in Vietnam in an innovative new Earth and Atmospheric Sciences course titled “Environmental and Energy Diplomacy.” The course was more than an academic exercise for the graduate and undergraduate students attending the class.

EAS Students Advise the Ambassador to Vietnam on Energy Policy

Part of IU’s contribution to the U.S. State Department’s “Diplomacy Lab” program, the course enabled students to analyze energy-related issues and produce a report on policy challenges and opportunities for the U.S. Embassy in Hanoi. Students capped the semester by briefing Ted Osius, the U.S. ambassador to Vietnam, on their findings.

Diplomacy Lab is a new outreach program, developed by former Secretary of State John Kerry, in which the State Department can “course-source” research and innovation related to global policy challenges. EAS Professor Michael Hamburger learned about the newly developing program when he spent the 2015-16 academic year working with the State Department as a Jefferson Science Fellow and helped initiate the program on the IU-Bloomington campus. The course was one of 11 IUB courses developed as part of the new program.

Universities “bid” on topics posted by the department, which selects the best proposals. IU Bloomington was awarded the Vietnam energy policy course in the fall of 2016. Hamburger collaborated with John Rupp, Indiana Geological and Water Survey senior research scientist, to teach the course with help from other IU faculty experts, including our own Professor Chanh Kieu, who originally hails from Vietnam.

Energy production and consumption are critical issues in Vietnam. The country’s economy is growing rapidly, creating increased demand for energy. Policymakers face decisions about whether to expand the country’s fossil-fuel and hydroelectric resources or to import more energy.

Vietnam ratified the Paris Agreement on climate change, creating an incentive to reduce emissions and move away from relying on coal. The country’s tense relations with China and other neighbors and its partial transition from a state-controlled to a market economy create further complications.

The IU class, which included seven graduate students and six undergraduates — about half of whom were EAS students — examined the issues from economic, geopolitical, and public health and environmental perspectives and produced a 25-page report of analysis and policy recommendations.

The report pointed to opportunities for U.S. and Vietnamese cooperation in economic development and highlighted risks if Vietnam increases its reliance on fossil fuels. In addition to public health problems associated with burning coal, Vietnam’s long and low-lying coastline makes it one of the most vulnerable nations to climate change and sea-level rise. In addition, students identified development opportunities in both the fossil-fuel and renewable energy sectors. Students helped develop and present a key recommendation, involving incentives to help U.S. companies develop solar energy for use in the important Vietnamese textile and garment industries.

The course also required some flexibility, because transition in the U.S. government suggested changes in emphasis. Embassy employees had been working on the assumption the U.S. would be part of the Trans Pacific Partnership, for example, but President Donald Trump jettisoned the deal.

During the semester, students and instructors kept in touch with embassy staff through email and video conversations. When the report was done, Heather Rogers, deputy counselor for economic affairs at the Embassy, arranged for students to brief the ambassador on their findings. The briefing took place via video bridge from the Gill Conference Room in IU’s Multidisciplinary Science Building II.

Energy issues played a prominent role at the 2017 Asia-Pacific Economic Council (APEC). Participants in the class got a real sense that the U.S. Embassy is seriously interested in taking our proposals and actually trying to turn them into policy. Either way, the class offered IU students an extraordinary opportunity to take their academic learning and turn it into practical, real-world policy initiatives.



Students in the EAS “Environmental and Energy Diplomacy” course brief Ted Osius, the U.S. ambassador to Vietnam, on energy policy.

KAJ JOHNSON Associate Professor of Geological Sciences



Kaj is a geophysicist who works primarily with geodetic data and numerical and analytical modeling to investigate active deformation of the lithosphere. In particular, he studies how deformation within plate boundary zones is accommodated by faulting and folding in the crust and viscous flow in the lower crust and upper mantle.

BRUCE DOUGLAS Senior Lecturer | Structural Geology
Director, IU Judson Mead Geologic Field Station

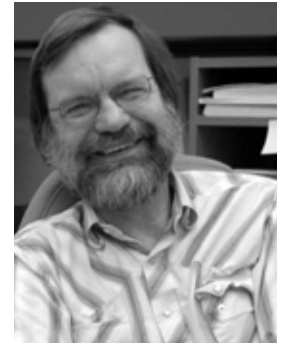


Bruce Douglas continues to work with colleagues from UNAVCO and other academic institutions including Mt. San Antonio College and Idaho State University to develop teaching resources that involve various types of geodetic data (e.g. airborne and terrestrial LiDAR, InSAR, GRACE gravity, GPS). These resources will ultimately be added to the Geodesy Tools for Societal Issues (GETSI) teaching resources package

supported by three NSF grants and hosted by the SERC website. The GETSI collaboration was an outgrowth of the incorporation of Terrestrial Laser Scanning (TLS) into the concentration week within course G429g.

The UNAVCO connection also has led to the use of Post-Processing Kinematic (PPK) GPS data collection and analysis for two M.S. projects undertaken in SW Montana under Bruce's supervision. Donald Tripp and Kirstyn Cataldo are both working on M.S. degrees that address the displacement history for active normal faults that are found in the region north of the Field Station. A third M.S. student, Ciara Mills recently completed her degree analyzing the mechanics of the Carmichael Fault that runs just south of the Field Station.

GARY PAVLIS Professor of Geological Sciences |
Geophysics, Seismology, and Tectonics



Although Gary Pavlis is planning to retire from teaching in summer 2018, he continues an active research program. Over the past 20 years Pavlis and students have been working on elements of the technology for seismic imaging of the deep interior. They have developed a novel form

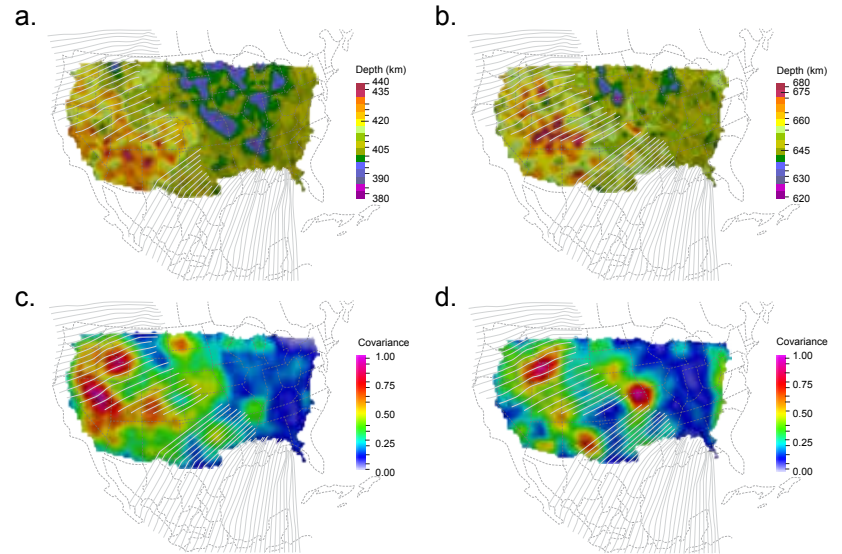
of imaging adapted from 3D migration methods used in the petroleum industry. The method migrates scattered P to S conversions produced by teleseismic P waves to produce an image of P to S scattering strength in true geometry and with true relative amplitudes. The result is a 3D volume that is handled much like modern 3D seismic reflection data. In fact, their most recent work has made extensive use of the seismic interpretation elements the Petrel package made possible through a recent software grant from Schlumberger.

Profoundly new results have proven possible due to deployment of large array experiments like the Earthscope Transportable Array (TA) and the OIINK project.

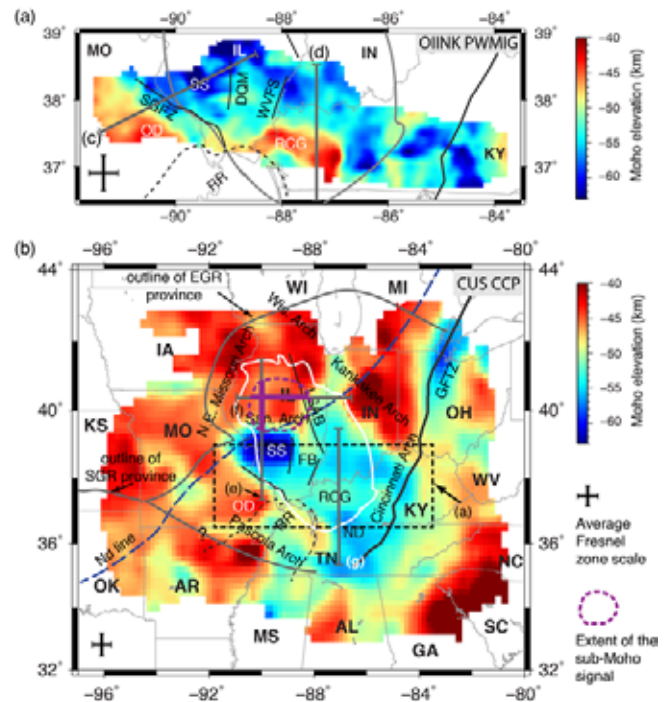
Recent work by Ph.D. student Yinzhi (Ian) Wang using data from the TA has produced images of the transition zone he showed in a recent paper are diffraction limited, which means they are the highest resolution possible from these data. His work promises to greatly change understanding of the area of the mantle called the transition zone. His Ph.D. work revealed two new insights on the transition zone.

First, he found seismic discontinuities that bound the transition zone, commonly attributed to phase changes of olivine at depths of around 410 and 660 km, are rough at every scale we can resolve. The figure to the right from his paper shows this graphically. The second figure, from a paper in review, argues that the transition zone is full of small-scale, low-velocity heterogeneities attributed to hydrous phases trapped in the transition zone. This has broad implications for Earth's history and the origin of water on the planet.

A second important recent result with this technology was published recently by Ph.D. student Xiaotao Yang who completed his Ph.D. in fall 2016. He used the plane wave migration method to image the Moho under the area covered by the OIINK experiment (see 2016 HGR section by Hamburger). A major discovery from Yang's paper was the inference of surprisingly thick crust under central Illinois and a remarkable step in the Moho along a trend parallel to the Mississippi River south of St. Louis. The existence of mountainless roots under the Illinois Basin is a puzzle we will be working on for years to come.



Inferred roughness of the mantle 410 and 660 discontinuities. (a) and (b) show picked depth to 410 and 660 discontinuities respectively. (c) and (d) are related maps showing a measure of roughness defined in the paper by Wang and Pavlis (2016).



Moho geometry inferred from P to S conversion imaging in the central US by Yang et al. (2017). (a) was produced from the OIINK data and (b) was produced from the Earthscope Transportable Array (TA) data. The dashed box in (b) is the map area of (a). (a) is a higher resolution image made possible by the higher station density of the OIINK experiment compared to the TA.

Judson Mead Geologic Field Station

The Judson Mead Geologic Field Station continues to thrive with increasing diversity of students, faculty involvement and national recognition.

COURSES AND FACULTY

The past year has seen a number of small but important changes in the curriculum offered at the Judson Mead Geologic Field Station. In efforts to keep the G429 program at the leading edge of field programs, a number of additions and revisions to the different exercises that comprise the curriculum have taken place. The concentration options have been expanded to include crystalline rocks and economic geology, geophysics and neotectonics, hydrology and environmental geology, and sedimentology and sequence stratigraphy. Each concentration has been augmented with new data sets and equipment, including chemical and isotopic analyses, use of petrographic observations, and paleontologic data. The subsurface correlation exercise was extensively revised based on the feedback we received after its introduction in 2016; in 2017 the exercise went smoothly, and successfully allowed the students to recognize patterns in the subsurface that matched those they had observed in their field observations with respect to the history of Belt Island. A new graduate field seminar was offered in summer 2017, G700 3-D Structural Analysis. The seminar is open to students from across the country and combines field work with the development of a digital 3-D model of the J-Fold, a long-standing field area for G429.

A stable and highly functional faculty has emerged that includes Drs. Bruce Douglas (IU), Erika Elswick (IU), Jim Handschy (IU), Candace Karies-Beaty (Winona State), Page Quinton (SUNY Potsdam), and Mike Rygel (SUNY Potsdam). We have also had the good fortune to have Dr. Jess King (Hong Kong University) join the crystalline concentration to provide her expertise to the teaching efforts.

OTHER ACADEMIC USERS

Other academic users of the Field Station include Hong Kong University who returned for a third year and agreed to continue the arrangement for the indefinite future. The course is

taught by Jess King and a former G429 student who returns to the IUGFS to co-teach this course. In 2017 we had Andy Barth from IUPUI, following his alternate-year scheduling pattern of teaching a small group of students from the IUPUI program.

The Field Station also hosted an advanced graduate seminar for the second time. Students were brought in from across the country to take part in the The Paleontological Society Field Course on Stratigraphic Paleobiology led by Dr. Mark Patzkowsky (Penn State University) and Dr. Steve Holland (University of Georgia). They returned to continue their studies of the Mississippian carbonate sequences found in Miligan Canyon, the same location that the G429s concentration has been working. The two efforts have been complementary and are producing exciting results.



Watch a video “Extraordinary Moments: From Bloomington to Big Sky Country,” filmed at the IU Geologic Field Station this summer by Venture Production Group for the College of Arts + Sciences Magazine.

<https://magazine.college.indiana.edu/issues/fall-2017/articles/stone-fixed-moment.html>

RESEARCH

In addition to serving as a base for teaching, the Field Station continues to act as a base and logistical hub for research. One M.S. thesis has been completed, and three other projects are ongoing all within the past three years. Field work was undertaken by Kirstyn Cataldo (M.S., adv. B. Douglas) and Matt Wanker (M.S., adv. D. Edmonds) during the summer of 2017. IU faculty member Dr. Brian Yanites also made a visit to the Field Station to conduct a preliminary assessment of the South Boulder River as a potential site for future research.

SCHOLARSHIPS

It is exciting to be able to report that we have continued to add to our scholarship base with the addition of three new scholarships over the past three years. These generous donations from alumni are making it possible for the Field Station to award scholarships to 70 % of the students enrolled in G429 with the average amount of funding awarded during this time being \$52,000.

FACILITIES

Efforts have been underway for several years to systematically upgrade the student dormitories. The goal is to have all of the dorms on the upper campus renovated over the next 5 years. A less obvious change but of high importance was the replacement of a number of kitchen appliances, the most important of which may have been the replacement of the coffee maker which was the same one that existed when Bruce Douglas started teaching over 30 years ago. Progress has also been made on the design and plans for a new student bathhouse to be constructed on the upper campus. The project is in the final stages of design and cost analysis. We are cautiously optimistic that construction will begin in the not too distant future.

IUGFS Website:
<http://www.indiana.edu/~iugfs/>



Olduvai Gorge Summer Field Study

The summer field course in Field Geology and Paleoanthropology at Olduvai Gorge in Tanzania, Africa (EAS-X377) was held for the fourth consecutive year in summer 2017. We had a total of 10 students hailing from IU-Bloomington, IUPUI, University of Nevada, Addis Abbaba University (Kenya) and the University of Witwatersrand (South Africa). As with last year, the faculty were Jackson Njau and Jim Brophy, both of Earth and Atmospheric Sciences.

For those EAS (formerly Geological Sciences) alums who have taken the course, you will be interested to know that we had to relocate our camping and dining site to the west of the Old Leakey Compound. The Tanzanian government has decided to turn the original compound into a Leakey museum site and they did not want scruffy faculty and students running around. As part of this project, the small museum along the rim of Olduvai Gorge has been replaced with a modern 3-building museum that was dedicated in summer 2017.



The website address for the Tanzanian field course is <http://www.indiana.edu/~olduvai/>

support the

Olduvai Gorge Summer Field Study Program

For the past 4 years, Indiana University has offered a unique five-week Geology and Paleoanthropology Field School taught in the Olduvai Gorge region (<http://www.indiana.edu/~olduvai>). The course has been a truly valuable and sometimes life-changing experience for students. The Stone Age Institute (<http://stoneageinstitute.org>) has provided generous support from the beginning.

For many students, however, participation is still beyond their reach. An additional goal of the Earth and Atmospheric Sciences Alumni College is to raise funds for the Olduvai Field School Scholarship Fund. If you are interested in helping, a donation can be arranged at the time of registration or any time thereafter.

There are three donation levels:

Silver benefactors (\$100-\$1,000)

Gold benefactors (\$1,000-\$2,000)

Platinum benefactors (\$2,000 and above)



For information on donating to the

EAS Alumni College scholarship fund, please visit

<http://www.indiana.edu/~olduvai/alumni/index.html>



EAS Alumni College at Olduvai-Serengeti

In last year's HGR it was announced that an Olduvai-Serengeti Alumni College was "in the works." We are very pleased to announce that we plan to offer it for the first time this coming summer (2018). This Alumni College offers an exciting ten-day educational experience in and around Olduvai Gorge, Tanzania. Olduvai is located in the Ngorongoro-Serengeti ecosystem where people and their early ancestors have coexisted with

wildlife for nearly four million years.

It is a world heritage archeological site made famous by Dr. Louis Leakey and his wife Mary for their ground-

breaking discovers of early human fossils documenting the evolutionary history of our species, culture and technology.

The College will be led by IU professors Jackson Njau and Jim Brophy, along with one or more experienced Tanzanian safari tour guides. Together, Njau and Brophy represent over a decade of teaching and research in the Olduvai region while the safari guides bring their vast knowledge of the flora and fauna of the Serengeti.

We are very pleased to announce that we plan to offer it for the first time this coming summer (2018)

The College will begin in the city of Arusha, which is close to Mt. Kilimanjaro. As you leave Arusha you will see and learn about the East Africa Rift Zone, arguably the single most famous geologic feature in the world.

You will spend several days in the Olduvai region working side by side with students currently enrolled in a 5-week Geology and Paleoanthropology field school based out of the original Leakey research camp at Olduvai.

You will participate in lectures.

You will hike into the gorge.

You will get your hands dirty in the field.

You may even make your own stone tool and skin a goat (if you are up to it!).

You will experience first hand the local Masaai culture as you interact with them at both the Leakey camp and at their own primitive bomas.

After leaving the Olduvai region you will travel for three days in the nearby Serengeti plain where you will experience African wildlife at its best. From there, you will return to Arusha and home.

All vehicle travel is in comfortable, robust safari vehicles. All accommodations are in first class hotels or safari lodges. In short, you will be comfortable from beginning to end.

apply for the

EAS Alumni College Program at Olduvai - Serengeti

For information on applying for the EAS Alumni Field School in Olduvai, please visit

<http://www.indiana.edu/~olduvai/alumni/index.html>



The following sections contain news and information about our graduate students and faculty members, construction and upgrade projects in the department, news from Emeriti and Alumni, and a list of our esteemed benefactors.

Our best undergraduates are sought by the top graduate programs in the U.S. We place three or four students per year in the most highly competitive programs and about 10 additional students in moderately competitive programs. Our M.S. students are recruited by the top Ph.D. programs in the U.S. Conversely, we are able to draw students from top programs into both our M.S. and Ph.D. programs. Our graduate students are annually recruited by two major and several mid-sized oil companies. Service companies also conduct on-campus interviews each year.



Blaire Hensley-Marchand
Ph.D. 2017
faculty position at Fairfield College Fairfield, CT and research associate at Yale University New Haven, CT.



Michael Smith
Ph.D. 2017
full-time position with Cloud Imperium Games Austin, Texas.



Katarina Topalov
Ph.D. 2016
work as an adjunct at two universities in Chicago and volunteers her time to a conservation organization and a land trust.



Kevin Webster
Ph.D. 2017
post-doc at the University of Arizona.



Lin Wei
Ph.D. 2016
full-time research geochemist at Petrochina (governmental oil company) Beijing, PR China.

external fellowships and honors

- REBECCA CALDWELL
SEPM Outstanding Oral Presentation Award | Outstanding student presentation AAPG – Honorable Mention
- MATT WANKER
GSA Student Research Grant | Grant from Tobacco Root Geological Society
- ERIN BENSON
2017 GSA Student Grant
- KIRSTYN CATALDO
Vitaliano Grant in Aid of Research
- SCOTT DAVID
GSA - John T. & Carol G. McGill Research Award
- GRAHAM JOHNSON
Society of Sedimentary Geology, Student Research Grant | AAPG, Alexander & Geraldine Wanek Memorial Grant
- JOHN KEARNEY
GSA Graduate Student Research Grant | Stone Age Institute Graduate Fellowship
- JAMES ATTERHOLT
Mineralogical Society of America Undergraduate Award
- PATRICK GRIFFIN
Award for best student presentation at the 12th International Symposium on Applied Isotope Geochemistry (AIG-12)

graduate awards

- ALEX ZIMMERMAN
Estwing Academic Achievement Award
- JOHN KEARNEY
John and Mary Droste Award
- ANNA JESSE AND YINZHI WANG
Departmental Citizenship Award
- JEFFREY VALENZA
Chevron Oil Company Fellowship
- SILVIA ASCARI
Galloway Perry Horowitz Fellowship
- ZHIYANG LI AND BRIAN THORNTON
Edward J. Grassman Fellowship
- KUSHAL RAVIPRAKASH
Atmospheric Sciences Fellowship
- CARRIE BURKE
Tudor Fellowship
- BEI LIU
John Barratt Patton Award

2017 Crossroads Conference

- GRACE CARLSON
Undergraduate Poster
- ALEX ZIMMERMAN
PH.D. Poster
- BRITT ROSSMAN
M.S. Oral Presentation
- REBECCA CALDWELL
PH.D. Oral Presentation

faculty news

DAVID POLLY

EAS Professor David Polly is Associate Director of a successful IU Grand Challenge initiative.

The Department of Earth and Atmospheric Sciences will play a central role in the multi-milliondollar IU Grand Challenges initiative called *Prepared for Environmental Change* directed by Ellen Ketterson of the Biology Department.

The initiative aims to improve forecasts of climatic, hydrographic, and biotic change (including disease vectors); assess public perception of risk and improve methods for communicating the implications of environmental change; reconfigure strategies for conserving natural resources and designing resilient human communities; and develop strategies for governments and businesses to invest productively in the face of large-scale environmental change. Sixteen new faculty positions will be created to support this work, including two in EAS in the area of climate modeling.

Several EAS faculty are involved, including David Polly who is the Associate Director of the initiative, Chanh Kieu, Paul Staten, Doug Edmonds, Arndt Schimmelmman, Peter Sauer, Edward Herrmann, Brian Yanites, Claudia Johnson, and Chen Zhu. The initiative will bring several postdoctoral fellows and graduate students to the department, upgrade our stable isotope facilities, and add LiDAR technology.



Watch a video from the IU Grand Challenges initiative to get more information about the Prepared for Environmental Change grant, as well as other efforts that were funded by the IU Grand Challenges Initiative.

<https://grandchallenges.iu.edu/>

MICHAEL HAMBURGER

Midcontinent EarthScope Workshop for Teachers

The Department of Earth and Atmospheric Sciences hosted 20 middle- and high-school Earth science teachers for “Midcontinent EarthScope Workshop” connected with its NSF-funded research project on Structure and Dynamics of the North American Craton. The three-day workshop included lectures, demonstrations, exercises, discussions, and two field trips to learn about structures associated with earthquakes in the Midcontinent.



department news

ACTIVE FELLOWSHIPS AND SCHOLARSHIPS

Don and Margie Hattin Special Field Course Fund

This Fund is intended to support IU geology undergraduate students planning to participate in high-quality, rigorous field camp programs such as the Olduvai Gorge field course or the Geology Regional field course.

George M. Nevers Memorial Field Station Scholarship

The George M. Nevers Memorial Field Station Scholarship was established by William R. Kersten and Timothy K. Driggers to honor the memory of their dear friend Dr. George M. Nevers and his love of the Judson Mead Geologic Field Station. Dr. Nevers earned his M.A. at Indiana University in 1957, attended field camp in 1956 and is remembered as “being a great leader, wonderful person and even better friend.” Recipients are not required to be students at Indiana University, but must be accepted and enrolled for summer field courses at the field station. Preference will be given to those students who are degree-seeking at IU.

Class of 2013 Katharine E. Compton Memorial Field Station Scholarship

The IUGFS Class of 2013 and Compton family established an endowment in memory of Katharine E. Compton, an enthusiastic young woman with a profound interest in field geology. This scholarship will be used to support students who have been accepted and enrolled for summer field courses at the field station. Recipients are not required to be full-time IU students. Preference is given to students who best exhibit the potential to perform exceptionally well in a rigorous field geology course.

Margaret C. and Anne Marie Kuzmitz Scholarship/Fellowship

Anne Marie Kuzmitz has irrevocably given to the department a gift to be used to support scholarships and fellowships for undergraduate and graduate students in need of financial assistance who are pursuing a degree in Geological Sciences. Preference will be given to a female student. Margaret Clare Kuzmitz received her B.A. from the department in 1938.

Mary Iverson Graduate Fellowship

This fellowship was established to support graduate fellowships for students who are pursuing an M.S. or Ph.D. in Geological Sciences and need an additional semester of support to finish writing their thesis or dissertation.

Peter S. and Susan M. Dahl Graduate Fellowship

This gift is used to support graduate fellowships in the Department of Earth and Atmospheric Sciences.

Frank D. and Shirley A. Pruett Undergraduate Scholarship

This gift is used to support undergraduate scholarships for students majoring in Geological Sciences and who hold an academic standing of junior or senior status and a grade point average of 3.0 and above.

James Rockford Orgill Endowment

Income from this gift is used to support undergraduate scholarships and/or graduate fellowships in the Department of Earth and Atmospheric Sciences. Recipients of the scholarships and fellowships may include full-time IU students attending the IU Judson Mead Geologic Field Station in Montana. Preference will be given to students with demonstrated financial need.

Parke Graduate Fellowship in Geological Sciences

The income from this gift is used to support fellowships for graduate students in the Department of Earth and Atmospheric Sciences within the College of Arts and Sciences who are entering their final year of study. The fellowships should be awarded to students who are no longer eligible for regular department support but who, in the estimation of the Fellowship Committee, have demonstrated good progress toward degree completion. The fellowship is not renewable.

Norman R. King Graduate Field Research Fellowship

The income from this gift is used to support fellowships for M.S. or Ph.D. students in the Department of Earth and Atmospheric Sciences who are conducting field studies in the area of soft-rock geology including stratigraphy, sedimentology, and paleontology. The fellowship may be renewable at the discretion of the Chair of the department.

Sheldon Turner Geological Science Scholarship

Income from this gift is used to support scholarships for undergraduate students in the Department of Earth and Atmospheric Sciences. The scholarship may be renewable.

John and A-Lan Reynolds Undergraduate Research Travel Award

The income from this gift is used to support travel awards for undergraduate students to conduct field-based research. Recipients of these awards shall include, but not be limited to, students planning to conduct their research at the Judson Mead Geologic Field Station. The award shall be given to undergraduate students pursuing a major in Earth and Atmospheric Sciences with records of academic excellence as demonstrated by a minimum GPA of 3.0.

Van Benschoten-Rapoport Scholarship

Income from this gift is used to support undergraduate and graduate scholarships for field study at the Judson Mead Geologic Field Station. The recipients shall be registered at Indiana University and enrolled in field courses offered through the Indiana University Department of Geological Sciences. Preference will be given to students from the State University of New York College at Oneonta who meet the academic guidelines and admission criteria for field study at the Judson Mead Geological Field Station, as defined by the Scholarship Committee. Preference will be given to students who express financial need.

Geological Sciences Senior Student Support Scholarship

The gifts in this fund will be used to support an annual \$2,000 scholarship for one student beginning their senior year in the department and has a strong research plan/proposal.

Edward J. Grassmann Fellowship

Income from this gift will be used to support fellowships for students with a special interest in clay mineralogy or clay mineral application.

Gallaway/Perry/Horowitz Memorial Fund

Income from this gift will be used to support the research and educational needs of graduate students studying paleontology, stratigraphy and/or paleoecology, including field research transportation, subsistence, and supplies.

Daniel S. Tudor Fellowship

The gifts in this fund will be used to support fellowships in geophysics or a closely related field.

Charles J. Vitaliano Grant-in-Aid

Income from these gifts will support a summer grant-in-aid for student(s) research on the geology and geophysics of western Montana and adjacent areas being conducted at the IU Judson Mead Geologic Field Station.

Bill and Jan Cordua Scholarship

The income from this gift is used to support \$500 scholarships to junior or senior students majoring in geological sciences with a 3.0 GPA or higher.

Maynard and Winifred Collier Scholarship

Income from this gift is used to support \$500 scholarships to junior or senior students majoring in geological sciences with a 3.0 GPA or higher.

Scott and Allyson Tinker Scholarship

This gift is used to support undergraduate scholarships of \$1,000 annually for field study at the Judson Mead Geologic Field Station. Recipients must be registered at IU, enrolled in field courses through the department, with preference given to students from Trinity University.

Leon – IUGFS Excellence in Field Geology Scholarship

The income from this gift will be used to support scholarships for students who have been accepted and enrolled in the summer field courses at the IU Judson Mead Geologic Field Station. Recipients are not required to be full-time IU students. Preference is given to students who best exhibit the potential to perform exceptionally well in a rigorous field geology course.

Coller Family Graduate Scholarship

The income from this gift will be used to support graduate students pursuing their M.S. or Ph.D. in geological sciences within the Department of Earth and Atmospheric Sciences.

Charles Deiss Memorial Scholarship

The income from this gift will be used to support two summer scholarships for students enrolled in field courses at the IU Judson Mead Geologic Field Station.

If you would like to donate to any of the funds that support the department, please visit <https://www.myiou.org/one-time-gift> and select your preference from the drop-down list.

Since late 2011 we have repurposed, remodeled, or renovated a multitude of spaces in the Geology building.

building updates

Most efforts were isolated endeavors, one commonality being that each was made more complicated by issues related to the building's aging infrastructure. As such, we are quite excited with the news that IU has received funding for a future infrastructure-focused building renovation.

Although unrelated to the renovation effort, we did experience a major central infrastructure upgrade in 2017. The internal chillers and their associated hardware were removed and the building was connected to the IU Bloomington central chilled water system. Aside from the benefit of having the utility in place before renovation efforts begin, the upgrade also included remote monitoring and control systems. Those systems are already improving functionality of our existing air handling units. The air handling units are now capable, if necessary, of receiving chilled water supply year round, whereas the HVAC side of the previous arrangement had to be winterized each winter to avoid damage. Ultimately, while still utilizing original systems it is not that noticeable an improvement, but it is a noteworthy first step.

In addition to those major improvements, in mid-2017 we finished the final phase of the Paleo Collection renovation, installing card readers, and creating a new display case that viewers can study from the outside hallway. The display case will not only hold specimens but incorporate a monitor and displays with augmented reality functions.

The Geology building has become an invaluable resource to a variety of groups from across campus, these groups were displaced from their buildings due to renovation efforts but are now utilizing temporary space in the Geology building so that they can continue their operations until their building renovations are finished.

And some units have moved in permanently.

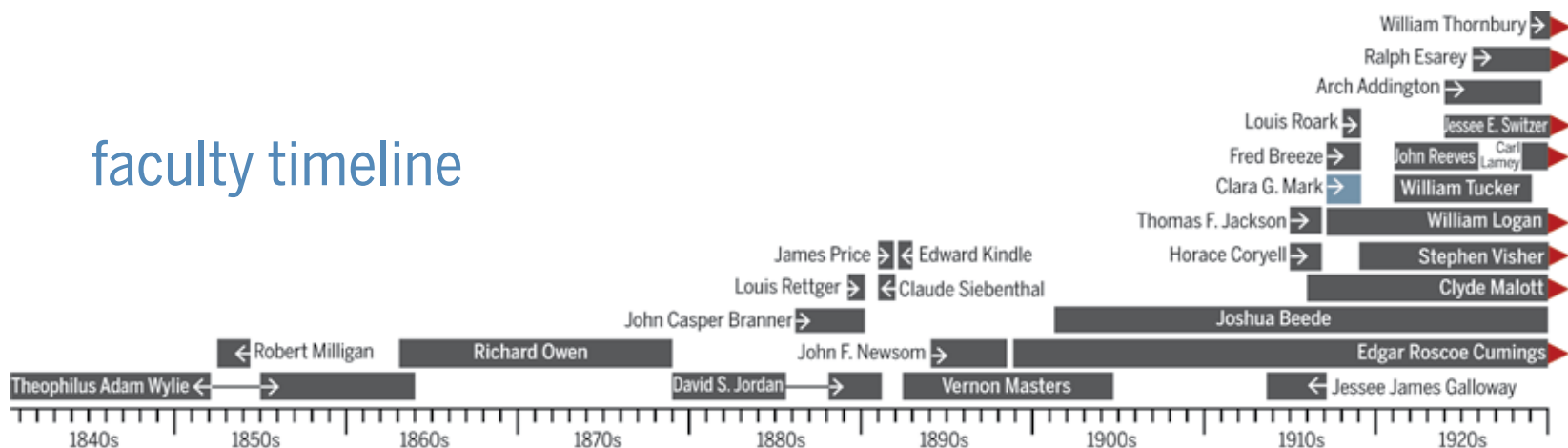
Our neighbor to the west, the School of Informatics, Computing, and Engineering, is occupying a renovated classroom on the 4th floor of Geology. They have a new building, Luddy Hall, under construction (see image right), but they will also use the Geology building classroom for the foreseeable future.



View of Luddy Hall under construction, looking west from the roof of the Geology building.

Our neighbor to the east, Psychology and Brain Science, has moved some of their research facilities into a beautifully-renovated suite of offices on the 6th floor,

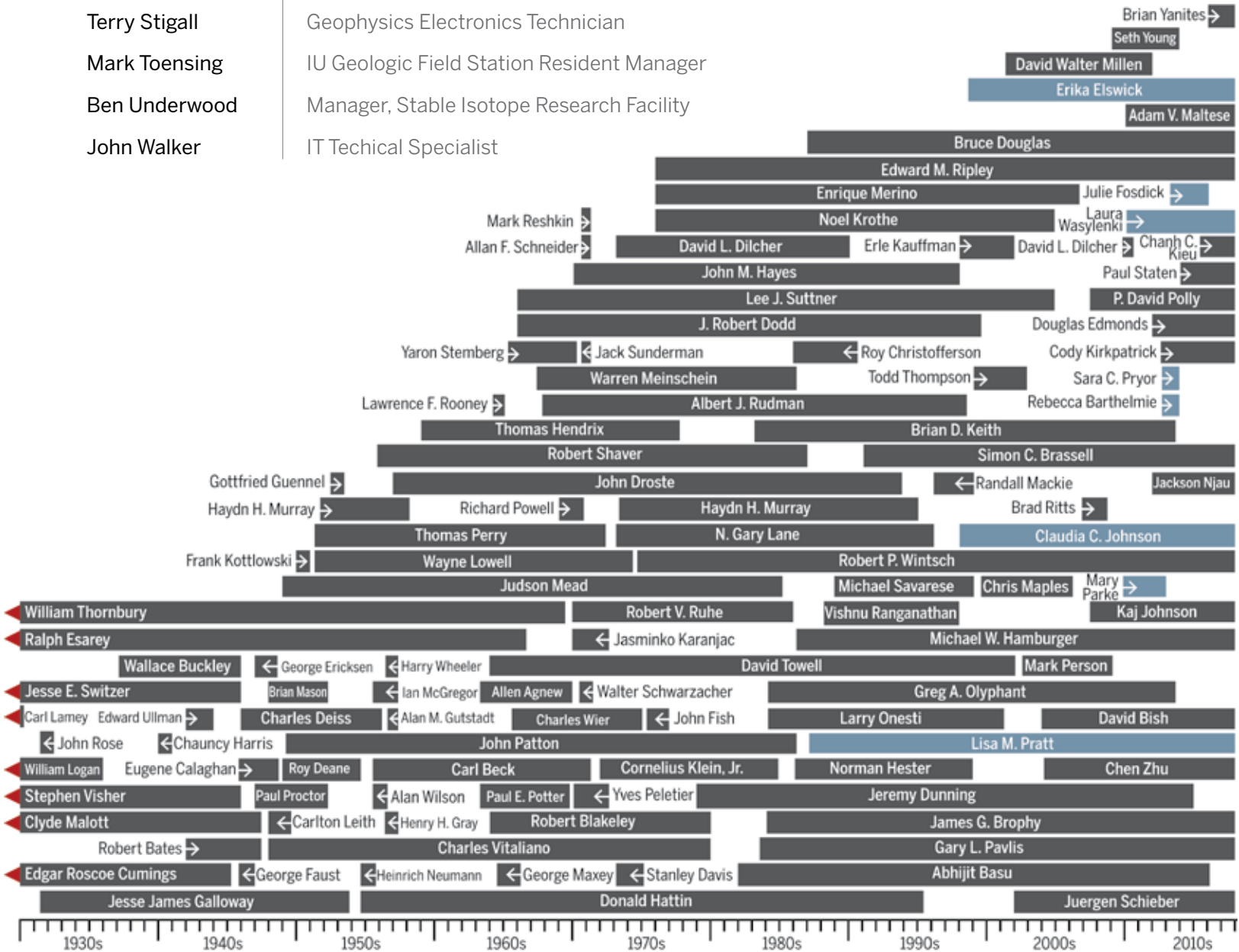
faculty timeline

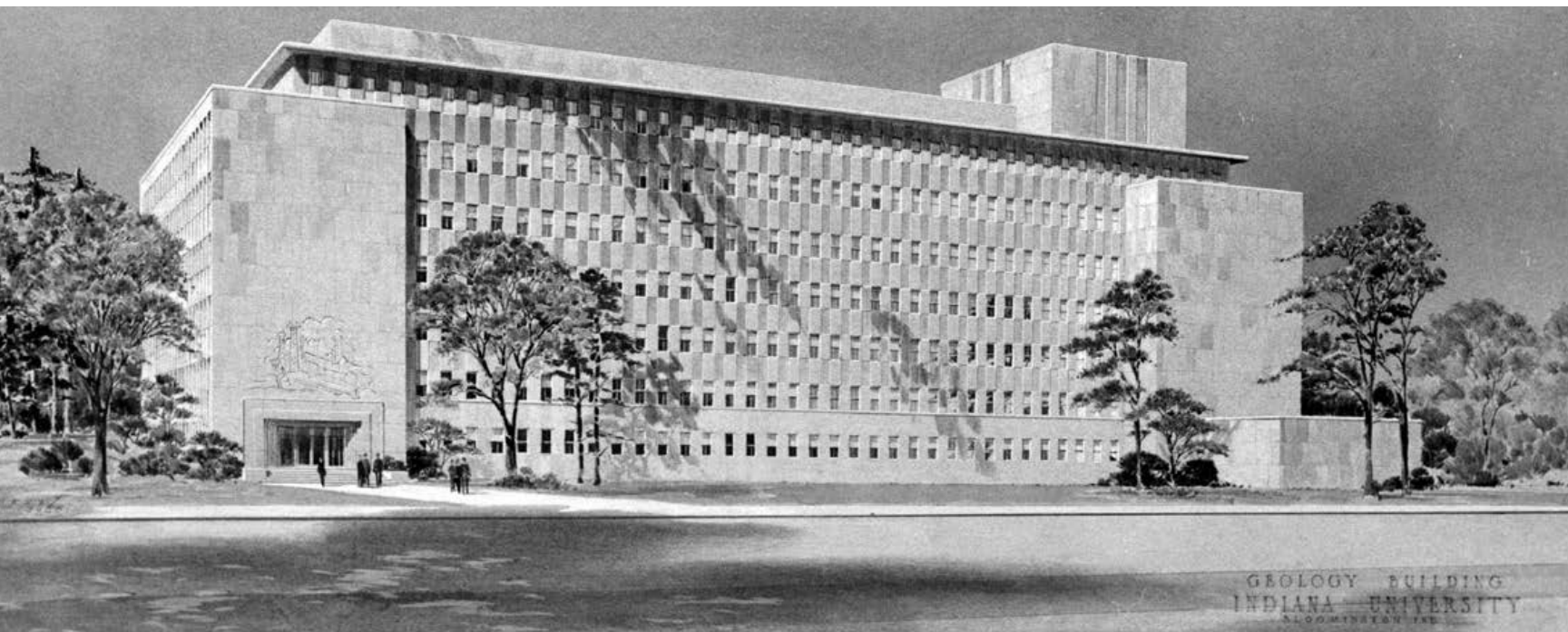


| | |
|--------------------|---|
| Michael Bennett | Manager of Information Technology |
| Pam Christenberry | Administrative and Fiscal Officer |
| Amanda Coats | IUGFS Accounting Associate |
| Megan Divine | Contracts and Grant Accounting Associate |
| Ruth Droppo | Graphic and web design and development |
| Dianne Dupree | Administrative Secretary, Chair's Assistant |
| 'Chelle Filippelli | Graduate Services Coordinator |
| John Hettle | Facilities Administrator, Geology Building |
| Not Listed | Purchasing and Travel Representative |
| Jian Liu | Geosciences Librarian |
| Terry Stigall | Geophysics Electronics Technician |
| Mark Toensing | IU Geologic Field Station Resident Manager |
| Ben Underwood | Manager, Stable Isotope Research Facility |
| John Walker | IT Technical Specialist |

department staff

Staff members work in a variety of occupations to enhance the presence and function of the department on campus.





Architect's rendering of the Geology building, which was constructed from 1957 to 1962. Note that in this model, there are seven floors and a low-relief sculpture above the front entrance.

tracks and trails

from deep (sort of) time

News items from historic issues of the Departmental Newsletter and the Hoosier Geologic Record

Lee J. Suttner

The following material is mostly quoted verbatim; all past issues of the departmental newsletter and the Hoosier Geologic Record are currently being scanned and will become available on-line on our departmental website.

June, 1952 (Inaugural Issue)

FACULTY

C.F. Deiss (Chair), J.J. Galloway, R.E. Esarey, B.H. Mason, W.D. Thornbury, C.J. Vitaliano, J.B. Patton, J.W. Mead, R.E. Dean, W.R. Lowell, P.D. Proctor, T.G. Perry, H.H. Murray.

ENROLLMENTS

University (14,360), College of Arts and Sciences (2590), Undergraduate Geology Majors (63), Graduate Geology Majors (43). Factors contributing to decreased enrollment are expiration of veterans' benefits, increasing cost of education, the call of the armed services and the siren call of high salaries paid by industry.

STORIES

John Patton, R.E. Deane and Wayne Lowell taught the eight-week summer field course at the Indiana University Geologic Field Station in Jefferson Island, Montana. Forty-five students were enrolled.

Professor Thornbury spent the summer at Pomona College in Claremont, California writing the first draft of his Principles of Geomorphology textbook.

Visiting lecturers included Walter Voskuil, Illinois Geological Survey ("Minerals on the Russian Border and What They Mean"), G.W. Tyrell, England ("Geochemistry

of Sediments"), Kenneth Caster, University of Cincinnati ("A Geologist Looks at Brazil"), Harlow Shapley, Harvard University ("Astronomical Dating of the Earth's Crust"), R.P. Goldthwait, Ohio State University ("Baffinland Expedition").

The Oil and Gas Division of the Indiana Department of Conservation, which was created and moved to the Indiana University campus in 1947, was officially changed to Geological Survey, Indiana Department of Conservation. Ten fellowships and assistantships were made available by the Survey for graduate students in the Department.

May, 1956

FACULTY

C.W. Beck, C.F. Deiss (Chair), R.E. Esarey, H.H. Gray, A.M. Gutstat, W.R. Lowell, J.W. Mead, H.H. Murray, J.B. Patton, T.G. Perry, W.D. Thornbury, C.J. Vitaliano.

STORIES

Just one year after joining the faculty, Professor Hattin was called for two years of military service with the Air Force. Professor Harry Wheeler of the University of Washington was appointed as Distinguished Visiting Professor of Stratigraphy to teach Dr. Hattin's courses in 1956-57.

The geology faculty voted to change the requirements for the A.M. degree by adopting a Graduate School option which states "Either a thesis or a reading knowledge of German or French is required".

The recipient of the Faculty Scholarship Brunton Award for 1954-55 was James Robert Dodd. James plans to obtain a Ph.D. in paleontology, and then either teach in a university or do paleontology research for the U.S.G.S. or a state survey.

It appears that some part of the geology facilities will be on wheels most of the time between March and October, and anyone who hopes to do business with us would be well advised to bring a bicycle. The large Quonset hut occupied by geology at the east end of the Union will be removed to make room for the eastward extension of the Union Building, which will triple the size of that building.

Up to fourteen companies have visited the department and about every student that resembled a geologist has had some sort of offer.

Twenty-four students were enrolled in the Montana summer field course taught by professors Esarey, Perry, and Lowell. No unusual events occurred—no accidents, no romances.

Moving part of the Geological Survey into their new quarters in Wylie Hall was delayed several months while Dr. Kinsey's new quarters in Jordan Hall were sound-proofed to prevent the escape of any sex secrets before publication.

Professor and Mrs. Judson Mead toured the west during the past summer and visited the I.U. Camp, Black Hills, Glacier Park, etc. Jud liked the camp so much that he is going back as a member of the summer staff.

May, 1966

FACULTY

A.F. Agnew, C.W. Beck, J.B. Droste, R.E. Esarey, D.E. Hattin, T.E. Hendrix, W.R. Lowell, J.W. Mead, W.G. Meinschein, J.B. Patton (Chair), T.G. Perry, P.E. Potter, A.J. Rudman, R.H. Shaver, Y.M. Sternberg, W.D. Thornbury, C.J. Vitaliano, C.E. Wier.

STORIES

The addition of three new faculty in 1966, Rudman, Sternberg, and Meinschein, raised the total number of faculty to its highest level (18) in the history of the Department.

The Department was “deluged” (because the program Director, Professor Agnew, is a hydrogeologist) by 20 high school earth science teachers from across the country, selected from over 300 applicants, for the Academic Year Institute sponsored by NSF. The participants are in residence for two semesters to obtain the M.A. for Teachers degree.

Recruiters from 20 industries interviewed students in the Department. The Department received notices for 47 teaching positions available mostly at U.S. colleges and universities.

The Department/Survey hosted five meetings with regional, national, and international participation, adding spice to the lives of the inhabitants of the Geology Building.

SGE's social calendar was a rousing success. Fall Frolic attendance was 55; 115 people attended the Christmas Party and 185 participated in the spring picnic. The second winner of the Annual Screwball Award, Professor Mead, was introduced by the inaugural winner of the award in 1965, Professor Hattin.

[illegible]

GEOLOGY SENIOIRS, GRADUATE STUDENTS, AND FACULTY September 30, 1968



BACK ROW - Robert D. Blakely, Michael E. Johns, Vernon D. Swenson, Keith H. Adkins, Michael S. Chisholm, Joseph A. Olson, Michael J. Tabor, Carolyn D. Olson, Robert F. Blakely, Connelley Kibby, David J. Borge, Judith Mead, John T. Bishop, Myron H. Murray, Wayne R. Lawell, Donald E. Hatten, Nelson R. Shaffer, John G. Fenn, and Thomas J. Patton
 THIRD ROW - David M. Fails, Bruce A. Tansut, Kathleen K. Fowler, Michael L. Lister, Harry Demétrio, Ralph W. Knapp, Karen S. Drusman, C. Denise Lawrence, Mark S. Dunlap, John W. Dunlap, Daniel L. Penland, William J. Gibbons, Christopher J. Condon, Bruce B. Wright, Kurt W. Mink, Myron H. Webb, Thomas S. Zeller, Janet L. Bergstrom, James R. Webb, David G. Towell, William H. Adams, and Michael J. Graham
 SECOND ROW - Mary A. Jauden, Thomas S. Fyfe, David C. Oliver, William I. Asch, Al Clark James, David W. Hosen, Gregory H. Mack, Madelyn A. McMillan, Marla A. Engle, Ellen A. Lake, James G. Ford, Steven J. Lind, Clyde A. Gads, Thomas B. Komar, Lee J. Dumas, Thomas E. Janney, Norman P. Bennett, M. Timothy Rios, Robert P. Wilson, and Kenneth G. Boudary
 FRONT ROW - J. Robert Dodd, John H. Thorne, William L. Wilson, John J. Davidson, Joseph P. Zurewinski, Susan M. Chis, Lyndene M. Fries, Raymond M. Hordis, Mark T. Chalpin, C. Michael Lecher, Susan J. Kruhn, John B. Greene, Myron G. Meltemi, John Flett, Mark C. Tavena, Charles J. Violette, Peter G. Dahn, and Robert H. Shaver

GEOLOGY SENIORS, GRADUATE STUDENTS, AND FACULTY September 29, 1975

December, 1977

FACULTY

R.F. Blakely, D.L. Dilcher, J.R. Dodd, J.B. Droste, D.E. Hatten, J.M. Hayes, T.E. Hendrix, C. Klein, N.C. Krothe, N.G. Lane, J.W. Mead, W.G. Meinschein, E. Merino, H.H. Murray (Chair), J.B. Patton, E.M. Ripley, A.J. Rudman, R.V. Ruhe, R.H. Shaver, L.J. Suttner, D.G. Towell, C.J. Vitaliano, R.P. Wintsch.

ENROLLMENTS

Undergraduate major enrollment reached a high of 150; 75 graduate students were enrolled. The Department's number of alumni passed 1000.

STORIES

The Department had six active NSF grants, five HEW fellowships on energy and mineral resources, three industrial fellowships, three industry-funded research projects, and six projects funded through the Water Resources Research Center.

A gas chromatograph-mass spectrometer designed and constructed in part by John Hayes performed flawlessly in analyses of the Mars atmosphere. Very, very much closer to home, Warren Meinschein and Robert Ruhe conducted a study of the organic pollutant content in Bloomington's storm-water runoff.

William Glover and Andrew Campbell received the prestigious Faculty Scholarship Brunton Compass Award reflecting their achievement of highest GPA in the 1976 and 1977 graduating class of undergraduates. W. Calvin James, Myron Webb, Connie Roberts, and Ellen Lake received Outstanding Associate Instructor Awards in recognition of their excellent undergraduate teaching.

With approximately only one out of three out-of-state student's applicants being accepted, the Montana program continued to operate at capacity with an enrollment of over 140 students.

December, 1987

FACULTY

A. Basu, J. Brophy, R. Christoffersen, D. Dilcher, J. Dodd (Chair), J. Droste, J. Dunning, M. Hamburger, D. Hatten, J. Hayes, N. Hestor, N. Krothe, G. Lane, E. Merino, H. Murray, G. Olyphant, L. Onesti, P. Ortoleva, G. Pavlis, L. Pratt, E. Ripley, A. Rudman, R. Shaver, L. Suttner, D. Towell, R. Wintsch.

ENROLLMENTS

Undergraduate major enrollment declined from a maximum of over 200 at the start of decade to about 60 in the past two years. Graduate enrollment declined from about 105 to 60.

STORIES

Within the last year, the Department celebrated its 100th birthday and the Indiana Geological Survey celebrated its 150th birthday.

A Richter-scale 5.0 earthquake centered near Vincennes on June 11 kept Professor Gary Pavlis busy with television, radio, and newspaper media. It was widely felt in southern Indiana and there was some local damage.

The Annual Fall Field Trip of the Great Lakes Section, SEPM was held at I.U. on October 9-11; it focused on the Mississippian carbonate stratigraphy of southern Indiana. Bob Dodd and Abhijit Basu organized the trip with students as part of a special graduate seminar in carbonate petrology.

Following the celebration of I.U.'s national championship basketball victory over Syracuse, Professor Droste summarized his memories of having stars Steve Alford, Keith Smart, and Dean Garrett in his introductory physical geology class. Following the victory in New Orleans, he was forced to postpone the start of his class until nearly the start of the next class to allow Keith Smart, whose last-second shot clinched the victory in the championship game, to sign autographs.

A new computer lab for student use has just been completed next to the geology library. Included in the hardware is a Macintosh SE microcomputer, and a laser printer, along with extensive software, including graphics packages. This will be especially useful for word processing and illustrations for theses, term papers, and other student projects.

December, 1997

FACULTY

A. Basu, S. Brassell, J. Brophy, J. Dodd, J. Dunning, M. Hamburger, N. Hestor, C. Johnson, E. Kauffman, N. Krothe, R. Mackie, E. Merino, G. Olyphant, L. Onesti, G. Pavlis, L. Pratt, E. Ripley, A. Rudman, M. Savarese, L. Suttner (Chair), D. Towell, R. Wintsch.

ENROLLMENTS

Undergraduate geology major enrollment experienced a modest increase to 40; graduate enrollment was 66 with a near equal number of Ph.D. and M.S. candidates. The Department's undergraduate enrollment climbed from sixth to fifth in the Big Ten; its graduate enrollment remained the second largest in this group of institutions.

STORIES

At its annual meeting in September, the Department's Advisory Board officially announced the kick-off of the largest endowment campaign in the history of the Department, if not the largest in the history of any department in the University — Geological Sciences at the Forefront: "\$5 million in five years."

Representatives from six different energy industries recruited in the Department in spring and fall.

As noted in the September issue of Geotimes, IU geophysicists have participated in the Princeton Geophysics Program, funded by NSF. This project links two objectives: to provide earth science and physics high school students with hands-on training in seismology, and to create a nationwide network of seismograph stations capable of providing useful data to researchers.

Fifteen alumni and friends participated in the sixth annual Alumni College at the Field Station led by Gary Lane and Tom Straw.

December, 2007

FACULTY

A. Basu, D. Bish, S. Brassell (Chair), J. Dunning, M. Hamburger, C. Johnson, K. Johnson, G. Olyphant, G. Pavlis, M. Person, P. Polly, L. Pratt, E. Ripley, B. Ritts, J. Schieber, R. Wintsch, C. Zhu.

STORIES

The Department's U.S. News national ranking, in the region of 75 in 1985, has risen to 34th, in 2006.

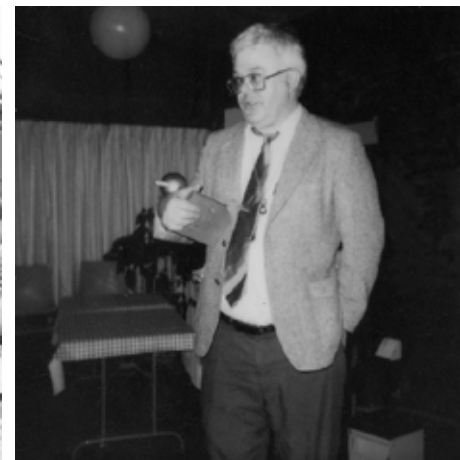
The groundbreaking for the second Multidisciplinary Science Building (MSB II) is expected soon, with an optimistic schedule for occupancy in early 2009. The state-of-the-art laboratory space will house the research programs of several of our faculty, notably those in biogeochemistry and those involved in environmental science research.

More than 80 people attended the 2006 Holiday party at The Fields in Bloomington. Undergraduates put on a "Project Runway" show in which students impersonated Departmental Professors. Professor Wintsch barely edged out Professor Bish for the high honor of the Screwball Award.

The Field Station hosted a forum "Does Need Exist for a National Center for Geoscience Education in the Field? If so, How do We Get There?" More than 50 participants from academia and industry attended. The University provided over \$115,000 to upgrade the lodge and make other facility improvements.

Faculty external research grants in the Department totaled 33. (The per faculty total of external funding was reported to be in the top fifth of the Big Ten.)

Sadly, two long-time Department faculty, N. Gary Lane and David Towell passed away in 2006-07.





ABHIJIT BASU

The Student Years

He was naïve and believed everything the educational branch of the State Department told him about graduate schools in the US. Graduate courses are extremely hard. You are restarting as a student

after a hiatus of 10 years – begin with undergraduate courses. Only GPA is considered for the award and continuation of financial aid. Your fellow students would be far advanced in their knowledge of geology and world affairs. They will be extremely competitive and not likely to share their notes with you. The professors there do not care if you have time to study and complete projects assigned by others. He came to Indiana University with panic in his heart.

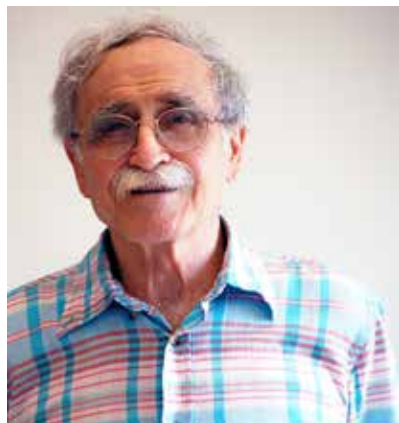
Within 20 minutes of his arrival in Bloomington on July 30, 1971, Fulbright counselors whisked him over to Nick's where the legendary Ruth served him a Stroh's. Finishing Ph.D. students Dick Alexander and Bob Schwartz treated him as an absolute equal in discussing science and the Ph.D. program in the Department. Larry Cook gave a typewriter to him to submit clean copies of assignment papers. Tom Kalan loaned his Bug for him to get a driver's license. Dave DesMarais and Bill Cordua put some Moon dust under a microscope for him to examine. Steve Young essentially adopted him as a brother, taking him to his parents' home to stay, and was as loud as he could be in arguing all the time in their shared office. The two were inseparable.

Emeriti notes

Well before classes started in late August, he became engaged in a verbal teasing-spar with Professor Robert Ruhe who treated him with great respect since then. Professor Charles Wier eased him into being a graduate student in a foreign country and gave him a summer job for support. Professor Charles Vitaliano saw to it that he would be placed in appropriate courses in geology and let him co-teach a course with Professor David Towell. Professor Thomas Hendricks unilaterally declared English as his foreign language. Professor John Hayes taught him to appreciate precision and accuracy in all analyses. Professor Warren Meinschein opened the vista of studying lunar regolith as samplers of solar particles. Professor Lee Suttner kindly accepted him as his Ph.D. student and inspired him to inquire about provenance *sensu latu* for the next 40+ years!

The ten-year gap (1961-1971) in studentship, however, took its toll. He had become used to living in a tent in deep forests, some nights with a loaded gun to fend off wild animals. He forgot his college physics and college chemistry. Plate tectonics bypassed him completely. Mathematical treatment and statistical analysis of geological data were beyond his grasp. He lacked scientific depth in his conversations and presentations.

The State Department was dead wrong about American students and American Professors, but perfect in assessing the mediocrity of a foreign student.



ENRIQUE MERINO

Last fall, I got a plaque at the WRI-15 meeting at Évora, Portugal, “in recognition of my contributions over the years” to the Water/Rock Interaction Group. At Évora I was invited to come to Japan, and that’s where I traveled in March, lecturing on the physics of mineral replacement at Tohoku University,

at Sendai. It was the fifth anniversary of the tsunami that devastated the coast in the vicinity of Sendai, and I visited three fishing villages that had been wiped out and that are under reconstruction. After Japan, my wife and I travelled to Spain every spring. While in Madrid we took part in the celebration of the 50th anniversary of IU’s Study Abroad Program, along with current and previous students and directors of the program, with the permanent Madrid staff, with quite a few IU alumni who live and work in Spain, and with deans Zaret and Sideli and IU president McRobbie who came from Bloomington for the party. Also in Madrid, and as I do every year, I checked the status of the beautiful,

five-story-high Jardín Vertical, see photo. At the end of my stay, in early July, I gave the keynote lecture at the annual meeting, in Oviedo, of the Spanish Society for Mineralogy. I had been asked to uncover the blind spot geochemists have – without knowing they have it – regarding the nature and mechanism of replacement. The meeting closed with a fieldtrip to the Respina Talc Mine in northern



León, where dolostones and patches of dolomitic zebra veins are replaced by talc.

DAVID DILCHER

Now engaged in research projects with colleagues in India, France, Spain and Germany. One project is to document the oldest record of the sweet potato family. With a colleague in India I am working on the origin of the morning glory family (Convolvulaceae) which is distributed

worldwide and has been a matter of debate. The fossil record from the late Eocene sediments of North America argues for a Laurasian origin that is in contrast to a molecular phylogenetic study that favors an East Gondwana origin. Here we report on fossil leaves of *Ipomoea* from the late Paleocene of India that support the current molecular phylogenetic conclusions of an East Gondwana origin for Convolvulaceae. This then puts the origin of a major branch of flowering plants (Convolvulales) in southeast Asia at about 75 million years BP rather than in the Americas at about 50 million years ago.

Also as part of my search for early flowering plants, I am working with a team of researchers from France, Spain and Germany on fossils collected in northeast Spain from Lower Cretaceous sediments. This is an aquatic plant and has two growth forms. It is complete with fruits (+seeds).

I am trying to rebuild again a teaching and research collection for Paleobotany. In 1990 much of the IU collection was moved to the Florida Museum of Natural History. Now I am looking for help to rebuild the IU Paleobotany Collection.



Earth and Atmospheric Sciences Alums

Glenn Bear M.S. (1992) Ph.D. (1997)

Home: Shenandoah TX Married to Laurie Bear

Career: ExxonMobil

Comments: "Glenn Bear (MS '92, PhD '97) and Lorie Bear (PhD '97) are living in Houston and both are working for ExxonMobil. Both continue to pursue their passions in geophysics. They met, were married, and had their first son while at IU. Both of their kids have now started college, but neither could be convinced to study geosciences, nor to attend IU."

Haleigh Howe M.S. (2014)

Home: Tulsa OK Married to Gabrielle Reed.

Career: Chesapeake Energy

Scott Warner M.S. (1986)

Home: Novato, CA

Career: Principal Hydrogeologist, Ramboll

Comments: "Lots of changes since my last update - I am working as a Principal Hydrogeologist with the global firm Ramboll (Headquartered in Copenhagen but my office still in the SF Bay area) on lots of water resources, environmental restoration, climate change and litigation work. And on the family side, older daughter Shayna is just about to graduate with her BA from UCLA (my undergrad alma mater), and younger daughter Sara is a new undergrad at IU(!) (with the vocal program at the Jacobs School of Music!). It has been fun getting back to campus with Sara and checking out all the old digs - and running into friends from ways back like Todd Thompson, the State Geologist with the IGS! Both my wife Susan and I are also now part of the IU Parents Advisory Board - so that is another very cool connection with IU and B-town."

Scott Wendorf M.S.

Home: Zug, Switzerland. Married to Andrea Hamilton.

Career: Halliburton Worldwide GmbH: Managing Director of Halliburton Worldwide GmbH, in Zug, Switzerland.

IUGFS Alums

Mary Pikul Anderson G429 (1969)

Home: Madison WI

Career: Professor Emeritus of Hydrology at Department of Geoscience, University of Wisconsin at Madison

Comments: "Indiana's field camp was one of the most memorable times of my life - it was my first big adventure - my first time to see the Western USA and its incredible geology, my first encounter with so many people from such diverse backgrounds. It was important for me to have this field experience especially since my career has

news from alumni

focused on computer modeling with limited field adventures. After IU field camp, I graduated from the University at Buffalo, got a PhD in Hydrology from Stanford Univ, spent two years in Long Island, and in 2009 retired from a 34 year career as a professor of hydrogeology at the Univ of Wisconsin-Madison. I am so glad the IU field camp tradition continues."

Cat Beck G429

Home: Clinton NY

Career: Faculty member, Geosciences Department, Hamilton University

Chuck Berthoud IUGFS (1973 or 1974)

Home: PA

Ariana Boyd G433 (2015)

Home: Knoxville TN

Career: Attends University of Tennessee Knoxville

Glenn Bruck G429

Home: Moraga CA

Career: US EPA in San Francisco, CA

Kurt Byanski G429

Home: Anderson IN

Career: Geologic Arts, Inc.

Michele DeMartini (Mydris) G429 (1995)

Home: Santa Rosa CA

Roy H. Drew G429 (1969)

Home: Maple City MI

Career: Retired from the Bureau of Land Management

Comments: "Thank you very much for 'tracking me down' and contacting me! It was a pleasure to hear from you and reflect on my time at the Field Station. G429 was a much needed experience and education for me, and I benefited significantly from it. I went on to have a very rewarding and interesting career with the Bureau of Land Management as a Geologist/Mineral Examiner in Colorado. I was able to work in the field, over much of the West, but never in Montana. I took my wife to the Field Station sometime during the late 80's to show her around the campus, but unfortunately it was not during course time. It was nice to return! We did have a beer in Whitehall. Take care of yourselves, and G429. Thanks again! "

Stewart Farrell IUGFS (1966)

Home: Port Republic NJ

Comments: "Still fondly remember the agony of getting into field traversing shape, driving from Rapid City across the west and learning one huge amount about western stratigraphy, geologic history and field mapping that has always been in the background as we do similar types of tasks along the New Jersey oceanfront and bayshore coastlines."

Gary R. Gates IUGFS 1995

Home: Morro Bay CA

Comments: Married to Marilyn Gates

Finn V. (Vivian) Gratton G429 (1982)

Home: Santa Cruz CA

Career: Psychologist, Trainer, Consultant, Finn Vivian Gratton, LMFT

Russ Hartford IUGFS (1969-70)

Home: Kalispell MT

Comments: "I came to IU with a masters in chemistry and a lifelong interest in geology and geophysics. After attending IU for a year and the field station that summer I returned to Kalispell and teaching. The next year I added a course in geology in addition to the chemistry I was teaching. Each year we were able to go up to Grinnell Glacier and take a week long trip around Montana, Idaho, and Yellowstone National Park. During the 22 years we did this we had a least one student go on to study geology and/or geological engineering. I retired from teaching at Flathead High School in 1993. Just this last spring I retired again, this time from Flathead Valley Community College. Can't thank Judd Mead and the rest of the staff enough for a lifetime of pleasant memories."

Jon Hassinger G429

Home: Evergreen CO

Career: CI International, Inc.

Adam Heffeman G429 (1998)

Home: Houston TX

Career: Anadarko Petroleum Corporation

Dick (Harold) Holbo G429 (1960)

Home: Albany OR

Career: Retired from Comstock Instrument

Paul Kapp G429

Home: Tucson AZ

Career: Professor, Geology, Tectonics, Wind. Department of Geosciences, University of Arizona

Tim Ku G429

Home: Middletown CT

Career: Associate Professor of Department of Earth and Environmental Sciences, Wesleyan University

Robert N. Lambe G429 (1972)

Home: Topsfield MA

Career: GEI Consultants, Inc.

Comments: "Attending the IU field course and faculty inspired me to pursue my Ph.D.; my research area was the Boulder Batholith. While I intended to pursue a career in teaching, having been inspired and counseled by several of the IU faculty, I ended up working in the mining industry for Exxon Minerals and then Newmont Mining. As the U.S. mining industry declined, I ended up spending much of my subsequent years as a consultant with Arthur D. Little, pursuing mining and environmental projects throughout the world. I truly feel that the experience at the field station, including the opportunity to be an associate instructor in 1973, and the inspiration of the faculty was one of the most important and decisive events in my almost 40 year career."

Whitney Littleton G429 (2000)

Home: Centennial CO

Career: Gilbane Federal, Inc. Construction Engineering Company

Robert M. Mason G429

Home: Littleton CO

Comments: "Married to wife, Penny, 48 years. Three daughters: Shannon, Megan, Holly. Six grandkids. 42 years in oil and gas. Ex-Shell Oil, Southland Royalty, Meridian Oil. Retired as VP Exploration, Andex Resources. Still consulting. Just finished high potential oil prospect in northern Nevada and still sharing my love of geology with young grade school kids. Fondest Field Camp memory: I brought my bagpipes to field camp and piped my fellow students to the trucks most mornings. Also, living in Billings, MT, in 1988. Took Megan skiing at Bridger Bowl. While going up chairlift saw large overturned fold just north of ski area. Told Meg: "I mapped that outcrop as part of a field test back in 1965 at IU field camp when you were just a twinkle in my eye". In many ways G429 was an important building block for my career. All the best! "

Morgan McGee-Solomon G429

Home: Wilmington DE

Career: Delaware Department of Natural Resources in the Control Site Investigation and Restoration Section

Ryan McNulty G429 (1993)

Home: Lincoln RI

Michael Minner G429 (1994)

Home: Bakersfield CA

Career: Chevron, Inc.

Keri Murch (Chappell) 429e

Home: Petaluma CA

Career: works on major oil company environmental remediation projects in western US

Autumn Skye Murray IUGFS (2016)

Home: Lancaster KY

Career: Graduate student at Tulane University

Brian Noonan IUGFS (1995)

Home: Houston TX

Career: Anadarko Petroleum Corporation

Christopher Nowak G429 (1991)

Home: Bothell WA

Robert Gregory Nesselhauf G429 (1970)

Home: Fairbanks AK

Career: Retired from R.G. Nesselhauf, Consulting

Comments: "I was a TA for the G429 6-Credit Options for both the years 1971 and 1972. I look back to the three years that I was associated with the G429 - first year as a student and the following two years as a TA - as the happiest geologic experiences in my lifetime."

Chris Paschke G429 (1992)

Home: Houston TX

Career: PHPBilliton Petroleum

Comments: "Thanks for this. I sent in the paper form, but I wanted to update my info on the website as well. I am sorry that I will miss the function in Houston in January."

Sarah Pearce (Newland) G429 (1999)

Home: Golden CO

Career: San Francisco Estuary Institute

Comments: "I have been in California since 2001 working as a geomorphologist, and am one of the leads of the California Rapid Assessment Method for wetlands (cramwetlands.org). But my family moved to Denver this summer for my husband's job with USACE. I still have many projects to complete with the San Francisco Estuary Institute, but ultimately want to transition to a Colorado firm or agency. I would be grateful to talk with field camp alum in Colorado to begin networking."

Jordan Pelfrey G429e (2015)

Home: Cumming GA

Career: Advanced Disposal

Scott Pflug G429 (1993)

Home: Grand Junction CO

Career: Co-Owner, Fresh Start Carpet Cleaning

John Quinn G429 (1986)

Home: Downers Grove IL

Career: Argonne National Laboratory

Kent Reser G429 (1978)

Home: Marietta GA

Career: Retired from IBM after a 38 year career

Comments: "It was a great once in a lifetime experience - getting there; the field camp; afterward and getting home. I would love to get the contact info for 3 of my classmates from G429 1978: Joseph Martin, Curtis Smith & Robert Goldstein."

Eric Riggs G429 (1995)

Home: Houston TX

Career: On faculty at Texas A&M University

Comments: "Hope all is well for you guys! Miss teaching up there!"

Lorri Ronis (Maloney) G429 (1984)

Home: Herndon VA

Lanya Ross IUGFS (1997)

Home: St. Paul MN

Career: Metropolitan Council

Frank Scavo G429 (1972)

Home: Irvine CA

Career: Strativa, Inc. Computer Economics, Inc.

Comments: "The field studies was a high point of my life. Although I never worked in a geology-related field, I treasured this experience. I enjoyed watching the videos of the students today. Thanks for reaching out."

Janet Schweitzer IUGFS (1981)

Home: Golden CO

Michael Sharwood (Schaiewitz), M.A.

Home: Australia. Married to Helen Sharwood, Retired

Brian Shaw G429 (1972)

Home: McLean VA

Career: National Intelligence University at the Pentagon
Comments: "Currently serving as Dean of the Oettinger School of Science and Technology Intelligence. The School is the focus of S&T degree-granting education across intelligence and national security communities. The National Intelligence University was chartered by the Department of Defense in 1962, and the University's degrees — the Master of Science and Technology Intelligence, the Master of Strategic Intelligence and the Bachelor of Science in Intelligence — are authorized by Congress."

- David C. Shelton IUGFS (1966)
 Home: Golden CO
 Career: Retired from Shelton Environmental LLC
 Comments: "Amazing that you found me after all these years. My last Clay in Calico coffee mug is now broken."
- Mark Stacy IUGFS (1991)
 Home: Fort Collins CO
 Career: Wenck Associates, Inc.
 Comments: "Great to hear that fieldcamp is still going strong! Need more well trained geologists. Are you offering a hydrogeologist's class?"
- Frederick (Fred) Stanin G429 (1978)
 Home: Lafayette CA
 Career: Arcadis Design and Consulting
- Edward M. Stolper G429 (1972)
 Home: Pasadena CA
 Career: Provost; William E. Leonhard Professor of Geology; Carl and Shirley Larson Provostial Chair, Division of Geological and Planetary Sciences, California Institute of Technology
- Robert Swartz G429 (1993)
 Home: Folsom CA
 Career: Regional Water Authority
- Jennifer N. Swift G429 (1984)
 Home: Los Angeles CA
 Career: Spatial Sciences Institute, USC
 Comments: "Dear James, What a wonderful letter! I will surely try to connect at a conference in the future. FYI, Don Hattin was my "Uncle Don", and very influential throughout my life. He and Aunt Margie grew up with my parents on the east coast. We will all miss him very much. He is the one who encouraged me to attend camp w/IU rather than the school I was attending. I could scan my photos from 1984 field camp if you'd like them for the website? I still have them in an album :) I look forward to hearing from you. Happy Holidays! All the best, Jen spatial.usc.edu "
- David Tett G429 (1990)
 Home: Cypress TX
 Career: Development Geophysicist <https://www.linkedin.com/in/dltett>
- Dan Thompson G429 (2001)
 Home: Andover MN
 Career: Dakota Technologies
- Dennis Tryon IUGFS (1962)
 Home: Tucson AZ
- Ching Tu G429/429e (2005)
 Home: Houston TX
 Career: Schlumberger-WesternGeco (Retired)
- Andrew Van Benschoten IUGFS (1965)
 Home: New Kingston NY
- R. Greg Vaughan G429 (1991)
 Home: Flagstaff AZ
 Career: US Geological Survey
- Marwan A. Wartes G429 (1996)
 Home: Fairbanks AK
 Career: Alaska Division of Geological and Geophysical Surveys
- Christine Weaver (Gordon) G429 (1994)
 Home: Sterling Forest NY
 Career: HDR Engineering, Mahwah, NJ
- Ronald Wilkins G429 (1986)
 Home: Carrollton TX
- Ben Witherell G429 (1987)
 Home: Flemington NJ
 Career: New Jersey Department of Environmental Protection
- Donald Wittemore G429 (1967)
 Home: Lawrence KS
 Career: Kansas Geological Survey
 Comments: "As an undergraduate chemistry major with several geology courses at the University of New Hampshire, and as a first-year graduate student in geochemistry at MIT, I did not have as much geologic field experience as most geology majors. MIT sent their students without a field course to the IU field program, which was very valuable training in the development of my geologic background. After the IU field program, I transferred to Penn State University because I wished to obtain a geosciences degree with more practical application to the environment. During the summer of 1968, I spent a summer of geologic mapping and prospecting for a mining services company in the Canadian arctic, for which the IU field training was especially valuable. I obtained a Ph.D. in geochemistry and mineralogy at Penn State and then started my career as an Assistant Professor in Geology at Kansas State University. At KSU I worked on groundwater and environmental geochemistry, earning tenure, before I decided to join the Kansas Geologic Survey at the University of Kansas in 1978, where I have conducted research in hydrogeochemistry. I am now in my last year of phased retirement as a Senior Scientific Fellow. "

Our 2011-2017 Benefactors

In October of 2016 we dedicated a Donor Wall to honor our benefactors. The modern wood and plexiglass structure is installed in the building lobby. It contains the names of people who have made substantial donations to the department and are listed in “Presidents Circle,” “Arbutus Society,” and “Major Gifts” by the University Development Office.

On a separate plaque is written: *Since 1886, the Department of Earth and Atmospheric Sciences has successfully carried out its mission of teaching, research and service to both the profession and the community. The continued generosity of our alumni and friends has made this possible.*

The donor wall recognizes those who have contributed significantly to the Department over the years. We are forever grateful for the legacy of philanthropic support from all of our benefactors.

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ERLE KAUFFMAN

Dr. Erle Kauffman

Born: February 9, 1933

Died: December 16, 2016

Erle Galen Kauffman, 83, Professor Emeritus, Earth and Atmospheric Sciences at Indiana University, died peacefully at home December 16, 2016 after a long illness.

Honored for his many contributions to the Geo-

logical and Paleontological sciences, Erle also was acknowledged as a master teacher, researcher and mentor, advancing the education of many through his passion for learning, rigorous science, and generosity of ideas. Erle held an academic position at IUB since 1996.

Born and raised in the Washington DC area, Erle received his undergraduate and graduate education at the University of Michigan, Ann Arbor, and was awarded a Doctorate in Geological Sciences in 1961. Subsequently, Erle built a 20 year career with the US National Museum, Smithsonian Institution, where he ultimately held the position of Full Curator, Department of Paleobiology. During that tenure, Erle also served as Adjunct Professor of Geology, George Washington University, Washington DC. From 1980 to 1996, Erle was Professor and later Chair (1980-1984), in the Department of Geological Sciences, University of Colorado, Boulder.

Erle received many honors, both as scientist and educator. He was recognized with an Honorary Master of Science from Oxford University, England (1970), where he was a Visiting Professor, and an Honorary Doctor of Natural Sciences in 1987 from Georg-August-Universität, Göttingen, Germany, and in 1986 as a Fulbright Visiting Scholar to Australia. In 1991 the Society for Sedimentary Geology awarded Erle the R.C. Moore Medal for Excellence in Paleontology, and in 1997 he was honored with the Gilbert Harris Award for Life-

time Excellence in Systematic Paleontology from the Paleontological Research Institution. Additionally, Erle was recognized with The Society for Sedimentary Geology's W.H. Twenhofel Medal for Outstanding Contributions and Sustained Excellence in Sedimentary Geology in 1998, and more recently with the Paleontological Society's Medal for Advancement in Knowledge in Paleontology in 2014. Erle was a Fellow of the Geological Society of America, the Paleontological Society, and the American Association for the Advancement of Science. He served in leadership roles in many of the professional organizations of which he was a member, notably as President of the Paleontological Society, and Vice President of the International Paleontological Association.

Erle lived life fully and with great heart, exploring, adventuring, playing as hard as he worked. His love of the Rocky Mountains drew him both professionally and personally. Erle was an experienced hiker, backpacker, climber, skier and an avid fly fisherman, and these adventures were an integral part of the family life he shared with his beloved wife and colleague Claudia Johnson, his former wife Carolyn Kauffman, and their children Donald, Robin and Erica. Erle was an accomplished banjo player, and was known, particularly by his students, for gatherings famous for good food, good wine, good music, good conversation and camaraderie.

Erle is survived by his wife of 27 years Claudia C. Johnson; his three children: Donald (Kathleen) of Sydney, Australia, Robin of Paonia, CO, and Erica (Jim) Lancaster of Atlanta, GA; six grandchildren: Shelley, Christopher, Anna, Tucker, Tate, and Reed; former wife Carolyn (Stinebower) Kauffman of Redstone, CO; and his sister Christina Kauffman of Boulder, CO. Erle was preceded in death by his parents: Erle B. Kauffman and Paula V. (Graff) Kauffman.

To honor Erle's legacy, please consider donating to the Erle G. Kauffman fund at the Paleontological Society, the Erle Kauffman Paleobiology Fund at the Department of Earth and Atmospheric Sciences, Indiana University, or to Indiana University Health Hospice.



JOHN HAYES

Dr. John Michael Hayes

Born: September 6, 1940

Died: February 3, 2017

John Michael Hayes passed away at his home in Berkeley, California, on February 3, 2017, of idiopathic pulmonary fibrosis. Hayes was a geochemist, receiving a B.S. from Iowa State University in 1962 and a Ph.D. from the Massachusetts Institute of Technology in 1966. He was a professor at Indiana University for 26 years and was named a Distinguished Professor. In 1996 he became director of the National Ocean Sciences Accelerator Mass Spectrometry facility at Woods Hole Oceanographic Institution, and also served as a professor at Harvard University. He has lived in Berkeley since 2007.

Born in Seattle, Washington, John Hayes grew up in Montana and Iowa, attending 13 schools before graduating from high school in Perry, Iowa, as his family moved regularly for his father's job with the Chicago, Milwaukee, St. Paul and Pacific Railroad. In 1962, he married Janice Maria (Boeke) Hayes of Hubbard, Iowa, whom he met at Iowa State University. They celebrated their 51st wedding anniversary before her death in 2013.

He is survived by his children James T. Hayes of Honolulu, Hawaii, Anne Hayes Hartman of Oakland, California, and Rachel M. Hayes of Nashville, Tennessee, and by his grandchildren Diego Enriquez, Johanna Hartman, Sarah Hartman, and Rylan Hayes. His children and grandchildren were all with him on the day he died.

As a scientist, Hayes' work on organic isotopes and reconstruction of ancient conditions provided evidence of the development of the carbon cycle over geologic time, the timing of evolutionary events such as the development of photosynthesis, and the development of the global environment. He performed field work around the globe, including on the R/V *Atlantis* and in the submersible *Alvin*, and in Western Australia, South Africa, and the Canadian Arctic. He was a member of the American Geophysical Union, the American Society for Mass Spectrometry, and the European Association of Organic Geochemists. He authored two textbooks, four book chapters, and nearly 200 papers, and mentored students and assisted colleagues in countless ways. Hayes was elected a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences in 1998, and a Foreign Member of the Royal Society in 2016. Hayes served as a Captain in the United States Army from 1967-1968, detailed to the NASA Ames Research Center in Mountain View, California.

John and Janice Hayes were enthusiastic travelers throughout their lives, always willing to detour for, or plan a trip around, good restaurants and fine wine. He was an experienced photographer, a flutist and lover of classical music, and a baker who made six loaves of bread nearly every weekend his children were growing up. In Berkeley, he was a member of the Epworth United Methodist Church and the Berkeley Camera Club. He had an unpretentious approach to life in and out of the laboratory; "look for the good in people" was his bedrock philosophy. As he rejoins the carbon cycle, he would like to remind us all to take action to combat global climate change.

hello alumni!

(we'd love to hear from you)

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<http://earth.indiana.edu/alumni/forms.html>



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2017-2018 Alumni Newsletter of the
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