

Department of Earth and Environmental Sciences Newsletter

Message from the DEO

The EES Department continues to be a stimulating and vibrant member of the College of Liberal Arts and Sciences at the University of Iowa! This spring we have a total of 223 students enrolled in our degree programs: 142 Environmental Science majors, 53 Geoscience majors and 28 graduate students. Both of our undergraduate programs have remained stable over the last 5 years (+/- 5% annually) while our graduate population has decreased about 10%, primarily because we have focused on shortening the time to finish a graduate degree by improving monitoring of graduate student progress.



The Department's impact on the educational mission of the College and University has increased substantially over the last 5 years. In 2014-15 ~2300 students were enrolled in EES courses; ~3350 students enrolled in courses taught by the Department in 2018-19, an increase of 46%! To help us accommodate this increase we have added Lecturers Mary Kosloski & Kate Tierney, Visiting Assistant Professor Ben Swanson, and Adjunct Professor Neil Bernstein, who are doing a tremendous job showing undergraduates how exciting study of the Earth and its environment can be. Other changes in faculty over the last five years include the retirements of Professors Art Bettis, Nancy Budd and You-Kuan Zhang while Assistant Professors Bill Barnhart (Geophysics) and Jessica Meyer (Hydrogeology) joined our ranks and are building top-notch research and teaching programs in their fields.

An important recent improvement in our curriculum has been the number of field courses we are now able to offer. The Field Methods and Field Analysis courses are taught in Dillon Montana by Jeff Dorale, Emily Finzel, Jane Gilotti and Bill McClelland, replacing the Park City field camp course with a more flexible two year course sequence taught in late May/early June. Kate Tierney has taken over the Spring Field trip course and also begun offering a sequence of three NSF supported annual field trips for sophomore, junior, and senior Geoscience majors. Emily Finzel and Bill McClelland offer a weeklong field trip every year in the Tectonics or Mineral and Petroleum Exploration courses they teach in alternate years. Last but not least, Neil Bernstein has allowed us to make progress in offering field courses for biology-track Environmental Science students; he teaches Field Ecology in the Fall Semester and Winter Ecology plus Introduction to Bird Study in the Spring Semester.

On the Alumni front, the Department's Alumni Advisory board has been very active over the last year accomplishing a number of important objectives described on page 3 of this newsletter. I greatly appreciate the time and effort the 10 board members have devoted to revitalizing this important organization.

This is my last semester as Department Chair; I will be passing the DEO baton to Professor David Peate on July 1, 2019. It has been a pleasure to be Chair of a Department with faculty, staff, students and alumni who are a very dedicated team that has worked hard to allow the Department to excel.

Faculty Profile

Mark Reagan, Professor

Although it seems like I was hired yesterday, I am about to finish my 32nd year at the University of Iowa. I also just recently realized that my first research field excursion as a fledgling master's student to the Mariana Islands was 40 years ago this summer. Little did I know that that trip would begin a lifelong study of subduction-related volcanism, and in particular, the volcanism related to subduction initiation. The invitation to go on this trip was the first of many opportunities that came my way over the years, which, uncharacteristically, I had the good sense to accept.



Those early field trips to the western Pacific islands of Guam, Saipan, and Palau (below left), led to early papers on the peculiar sequence of lavas that erupted shortly after subduction of the Pacific Plate began beneath the Mariana volcanic arc. This was the beginning of the Dr. Jeckyll part of my career. My Mr. Hyde research started while I was pursuing my PhD studying active volcanism, particularly looking at concentrations of short-lived radioisotopes, such as the notorious ^{210}Po in lavas, to understand the processes that lead to volcanic eruptions. Although I regularly revert to Mr. Hyde, sanity has largely prevailed, and for the past about 15 years I have spent much of my time back at the Izu-Bonin-Mariana (IBM for short) arc system investigating subduction initiation.



Part of the reason for this return was another golden opportunity, this one from NSF, when that organization decided to focus resources on the IBM arc in their MARGINS program. Japan's JAMSTEC followed suit, and within short order I found myself on the ocean floor in the deep-diving submersible, the Shinkai 6500, during 5 cruises of the Japanese research vessel Yokosuka (below right). The data collected during these cruises led me and my colleagues to discover that basalts and related intrusive rocks underlie vast stretches of the trench slope, which meant that the entire sequence of rocks found in ophiolites (slices of oceanic crust on continents) was present on that trench slope, including peridotites at depth, then gabbroic rocks, dikes, and basalts progressively upslope. Above it all was an odd high-Si and high-Mg volcanic rock called boninite, whose type section is on the island of Chichijima in the Bonin forearc. This work cemented the idea that most ophiolites are not slices of normal oceanic crust, but are obducted forearcs that were produced during large-scale subduction initiation events.

Success commonly breeds success, and we were funded by the International Ocean Discovery Program (IODP) to drill the forearc near Chichijima during Expedition 352 in 2014. We, the shipboard scientists (23 in all) are in the process of publishing our results. One of our recent discoveries is that the sequence of basalt to boninite volcanism was produced by seafloor spreading near the trench over the first approximately 1 million years after subduction initiation, which is a time frame consistent with the times-scales of volcanism in ophiolites. I just returned from presenting an overview of this research in a keynote talk at the GeoPRISMS Synthesis & Integration Theoretical and Experimental Institute. Preparing that talk was what brought me to the realization that I had worked in the IBM subduction system for 40 years. What really struck me at this meeting, though, were the phenomenal presentations on a wide array of topics by the new generation of researchers, showing that geoscience research was in very capable hands and moving forward at an ever-increasing pace. Also heartening has been the increasing numbers of hard-working and intellectually gifted students coming through Mineralogy on their way to degrees in Geoscience at Iowa.



Earth and Environmental Sciences Department Alumni Advisory Board

by Amy Sullivan, EESB Chair

Your Alumni Advisory Board (EESB) was “refreshed” in the fall of 2018. The Board consists of 10 members representing both the earth and the environmental science strengths within our department. We have members in all time zones! Several Board members live in Iowa City and are frequently on site at Trowbridge. The Department Chair, Tom Foster, and Faculty Liaison, Brad Cramer, keep us in close contact with the faculty. All alumni are welcomed to join our meetings. Please contact any of us with your questions or proposal for topics.

As stated in our bylaws our objectives are 1) facilitate communication among alumni of The Earth and Environmental Sciences Department (EESD) (including all past department names) and between alumni and the EESD; 2) participate in fund raising campaigns to enhance EESD research, teaching, and outreach; 3) provide information and mentoring on professional opportunities to EESD students and alumni; and 4) contribute to external advocacy for the EESD to University administration, Iowa Regents, and the Iowa Legislature.

We have just begun planning the October 18, 2019 meeting, to be held in Iowa City in conjunction with Homecoming. Please consider joining us, students and faculty for activities that will likely be over Oct. 17 and 18 (schedule under development). Our 2018-2019 accomplishments include forming Alumni Outreach, Mentoring and Fundraising Committees. We have also selected John Eiler, the Robert P. Sharp Professor of Geology and Geochemistry, Geological and Planetary Sciences, California Polytechnical Institute, for the Distinguished Alumni Award. John will also be receiving the CLAS Alumni Fellow Award.

A 2020 triennial meeting will include an Alumni Day. Every three years the EESB, in conjunction with the EESD (the department), intends to have a more robust opportunity for Alumni engagement and interaction with students. We welcome your input to develop these special engagements.

Our contact information is at: <https://clas.uiowa.edu/ees/alumni-and-friends/ees-alumni-board>



Amy Sullivan
Chair
B.S. 83, M.S. 86



Mike Burkart
Secretary
Ph.D. 76



Leon Aden
B.S. 80, M.S. 82



Richard Denne
B.S. 85



Liz Maas
B.S. 98, M.S. 04



Lee Phillips
Ph.D. 04



Todd Ririe
M.S. 76, Ph.D. 81



Steve Schutter
M.S. 78, Ph.D. 83



Grant Smith
B.S. 87, M.S. 90



Jennifer Wade
B.S. 03

Environmental Sciences Program

by Andrew Forbes, Director



The Environmental Sciences (ENVS) Program at the University of Iowa has, in many ways, been an unlikely success story. In the late 1990's, a group of faculty from the Departments of Geology, Geography, and Biology made the considered assessment that a global "environmental industry" was growing, and that students with specific training in an interdisciplinary blend of environmental sciences would be well equipped for this new landscape. The resulting program was one of the first among what would become many Environmental Sciences Programs across the nation.

Surprising some on campus, ENVS grew quickly to a core of 60-80 students enrolled each year. The addition of the BA degree in 2008 – allowing a broader but no less rigorous option – raised enrollments higher still. Today, the major has between 150-180 students at any given time and is one of the largest interdisciplinary majors in the College of Liberal Arts and Sciences. ENVS students can choose to seek the BA degree, or one of four BS "tracks", with upper-level classes variously focusing on biology (green track), chemistry (yellow track), hydrosience (blue track), or geoscience (brown track). In another change from the early years of the program, today's students receive expert advising on choice of major and classes from professional advisor Hannah Whitcomb-DeHague.

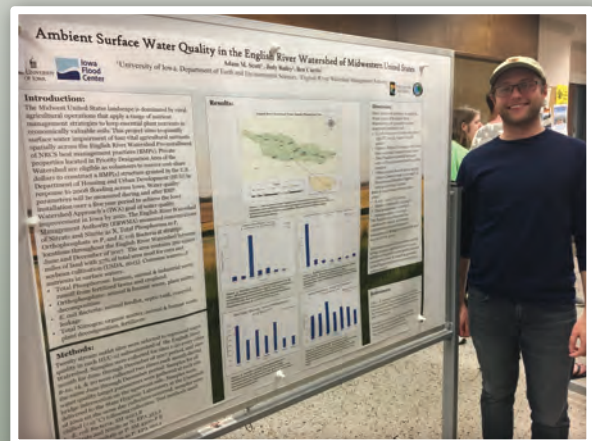


Now in its 20th year, ENVS has changed in several ways, but has also retained characters that distinguish it from other Environmental Science programs. From the beginning, one advantage has been that ENVS is a collaborative major, owned by several departments at once, with the Department of Earth and Environmental Sciences as its administrative home. The shared governance structure for curricular planning has resulted in a major that has maintained a broad footing across the natural sciences, while also allowing opportunities for students to specialize in a field of interest. This diverges strongly from programs elsewhere, which almost universally emphasize one aspect of environmental science at the expense of others. We are proud that we offer a broad foundation (courses in biology, chemistry, geography, and geology) to all of our students, such that no matter what field they emphasize in their advanced studies they

graduate prepared to tackle a great range of careers.

As the program moves into its third decade, it does so with a renewed emphasis on student research, hands-on learning, career planning, and community-building. In Fall 2019, the program's long-standing seminar course will officially split into two courses, the first geared towards breaking down barriers to student research. First and second year students will be introduced to research-active faculty around campus, and the importance of approaching and talking with faculty about their research will be emphasized. The second seminar course will focus on presenting results of independent research, as well as on preparing for careers in environmental science. A highlight of this second course is the semester-end poster session, where students present results of their independent research to faculty and peers. Goals are to approach 90% student engagement with one or more semesters of independent research and to have >90% of graduates employed within six months of graduation.

The program is building community in a number of ways. First, in collaboration with several other undergraduate and graduate programs across campus, we have worked to make environment and sustainability areas for which the University of Iowa is known. Because ENVS is today just one of the many terrific



environmentally-focused programs on campus, we work closely with these other programs to promote one-another, including by encouraging ENVS students to consider UI graduate programs in Environmental Water Sustainability, Public Health, Urban and Regional Planning, and Science Education. The program also works closely with the Office of Sustainability and Environment and with the undergraduate Certificate in Sustainability to promote student events, internships, and student organizations related to the environmental sciences.

A program is not successful without great students, and we have the best on campus. Environmental Sciences majors are creative, innovative, passionate, and dedicated in ways that make teaching and researching with them a delight. Our faculty regularly share stories of graduates who have gone on to varied and exciting careers, and who have returned to share stories – often specific and detailed – about how this or that experience in the ENVS program gave them the leg up they needed to succeed. We are proud of our graduates, motivated by the promise we see in our current students, and excited about what the future holds for the next ten years of this program.



Undergraduate Student Profile

Hannah Shea

Advisor: Bill Barnhart

Research: I have been working with Dr. Barnhart for my research. I produced 2-meter resolution DEMs using high-resolution satellite optical imagery to create a time series of the 2013 Mw 7.7 earthquake in Southern Pakistan. This work was used in a manuscript in review at the Journal of Geophysical Research: Solid Earth. I am currently working on an InSAR time series of the Mw 7.3 Darbandikhan Iran/Iraq earthquake which occurred in 2017.

Experience I value at UI: I have countless amazing memories within the Earth and Environmental Science Department at Iowa. From spending a week with peers in Texas camping in Guadalupe Mountains National Park and Big Bend National Park to mapping for weeks in Montana, these experiences have helped me to grow as a student. The community at Iowa has made it that much more enjoyable; the smaller class sizes allow for us students to get to know each other better. The courses and my research experience at Iowa were significant in finding my passion within the geosciences and it has made the last four years in this major unforgettable.

Future Plans: I have recently been accepted into graduate school at Iowa and I will continue to conduct research with Dr. Barnhart. I ultimately hope to research earthquakes through USGS or work for a geophysical software company.

Congratulations - Tiffany Adrain

Tiffany Adrain, Special Collections Manager, was selected as the 2019 Honorary Award recipient from the Midwest Federation of Mineralogical and Geological Societies for the American Federation of Mineralogical Societies Scholarship Foundation. With this Honorary Award goes the privilege of selecting a school, or schools, and assisting in the selection of two students to receive scholarship grants from our Foundation to help them achieve their educational goals. Each grant will be for the school Fall Semester 2019 and is for \$4,000 for each student.

The first Honorary Award was given in 1965. At this time rockhounds from all over the U.S. have paid out over \$1.5 million dollars to graduate students in Earth Sciences through this Foundation.



Spring Break Field Trip - San Salvador, Bahamas



On the climb out of Owl's Hole Cave with Kate Tierney, Stephan Oborny, Cailee Jo Sprecher, and Raechel Moulton



(Above) Diving for Conchs along North Point

(Below) Watling's Quarry



Ashley Morris and Shelby Humes look at a thrombolite from hypersaline Storr's Lake



Stephan Oborny, diving for a good look down the drop off

Spring Break Field Trip - San Salvador, Bahamas



Day one at North Point



Donald Hill at the top of Dixon Hill Lighthouse



(above) Owen Baldwin, Liz Flanagan and Kate Tierney looking at a seastar



Flamingo Tongue (*Cyphoma gibbosum*) grazing on a gorgonian soft coral



Postdoctoral Research Scholar Profile

Karolina Kosminska

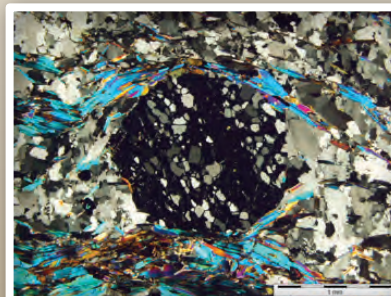
My research is focused on metamorphic petrology. I am particularly interested in deciphering the pressure-temperature-time (P-T-t) evolution of high-grade metamorphic terranes using multidisciplinary approaches which can be used to unravel tectonometamorphic events. I completed my Ph.D. last fall at the AGH University of Science and Technology in Krakow, Poland. The overall goal of my PhD was to establish the P-T-t path for medium- to high-grade metamorphic rocks cropping out along the SW coast of Svalbard, Arctic.

My current research is focused on the Pearya terrane, northern Canadian Arctic. I am working under the supervision of Prof. Jane Gilotti and Prof. Bill McClelland on the NSF funded project: "Collaborative Research: Displacement history of the Pearya terrane, Ellesmere Island – evaluating a strike-slip origin for the Canadian Arctic margin". We had a field season together in 2017. My task is to perform petrochronological studies on the Petersen Bay shear zone to explain the metamorphic evolution of this unit and in a broader perspective, the timing and character of the juxtaposition of the Pearya terrane with northern Laurentian margin. This research is conducted in collaboration with Dr. Justin Strauss and Ph.D. candidate Karol Faehnrich from Dartmouth College.

When my time at the University of Iowa is complete, I will start a research associate position at the AGH University of Science and Technology in Krakow, Poland. I will continue my Arctic research, but my position will also incorporate teaching undergraduate and graduate courses, mostly mineralogy, petrology and geochemistry.



(above left) Sampling the amphibolite-facies units within the SW Svalbard; (above right) Fieldwork on Prins Karls Forland, Svalbard; (left) The high-pressure Richarddalen Complex, Svalbard; (below) Garnet-bearing amphibolite facies schist of the Isbjørnhamna Group, SW Svalbard



Alumni Profile

Timothy O. Nesheim, M.S. 2009

My career began following graduation from the University of Iowa (UI) in 2009, on the heels of the Great Recession. My wife still had a semester of classes and an internship to finish her respective degree. During those early months, I made pizzas for minimum wage and often recalled Dr. Tom Foster once telling me that some geology graduates get geology jobs while others pump gas. Within 6 months, I started a temporary, full-time research assistant position at Washington State University (WSU) through connections of my UI advisors, Dr. Jane Gilotti and Dr. Bill McClelland. For this opportunity I am still very grateful! While I worked

at WSU and my wife completed her internship hours, I applied for several geology jobs and Ph.D. programs across the United States. I was offered a couple Ph.D. fellowships, but job opportunities were very limited. Even finding geology related job openings during that time was challenging. I recall receiving a rejection email once from a company before I had even finished and submitted the online job application. That was a low point.

While visiting family in Bismarck, North Dakota, I came across a “subsurface geologist” job posting through the North Dakota Geological Survey (NDGS). Even though I lacked the required work experience listed, the NDGS office was located just across town. So I called and asked if I could stop by to discuss the job opening. An older UI geology alum once told me that meeting potential employers face-to-face vastly increases your potential for landing a job. After reviewing information on the NDGS, I met with my eventual boss, the North Dakota State Geologist, Ed Murphy. Despite being under qualified, I must have made a positive impression on Mr. Murphy because a few months later he offered me the job.

My UI graduate work dealt with deformed metamorphic rocks. My NDGS work primarily focuses on sedimentology/stratigraphy, petroleum source beds, sedimentary basin analysis, and generally nothing directly related to my graduate thesis. However, despite a huge learning curve, my UI experience prepared me to be an independent student and researcher. During those early years at the NDGS, I spent hundreds of hours reading literature on everything from North Dakota’s Precambrian crystalline basement up through the 40+ overlying carbonate and siliciclastic sedimentary formations. I also attended dozens of conferences, hundreds of presentations, and signed up for every relevant short course and field trip offered along the way.



All that time invested in continued education has continued to pay off. In 2012, I received a best paper award on an AAPG-Rocky Mountain Sectional meeting presentation and was later invited to publish that work through a special volume symposium. More recently, I have begun publishing papers on my NDGS work through peer-reviewed journals. Two years ago, I was promoted to Head of the Subsurface Section and transferred to the Wilson M. Laird Core and Sample Library, located on the University of North Dakota (UND) campus. This new location allows me to meet numerous geologists and engineers from both industry and academia that visit our core library each year, as well as to informally mentor and advise students from UND’s geology department. I’ve turned down various job opportunities over the past 7 years largely because I enjoy my time at the NDGS, both the work and the people. One of the informal job offers even came from a company that had turned me down close to a decade ago. I do find myself regularly pumping gas and reflecting back on my time at UI and all that’s happened since.

Congratulations to Kenny Horkley on the arrival of his new daughter. Alice Anne was born April 15 at 9:15 pm!

Mineral & Petroleum Exploration Field Trip - Arizona



Discussing Cu porphyry systems at the Ray Mine



Using iPads and FieldMove to map igneous intrusions



Chiricahua National Monument



At the Lavender Pit in Bisbee, Arizona



Discussing low-angle faults at Tanque Verde



Perched atop Mt. Lemmon outside of Tucson



Graduate Student Profile

Reuben Ng – MS student

Advisor: Jonathan Adrain

Research: My research centers on a genus of late Cambrian – Early Ordovician trilobites called *Clelandia*. This group is a constituent of Laurentian trilobite faunas that spanned an interesting interval of time when a number of closely-spaced mass extinctions, ones we are only just now beginning to fully understand, seem to have seriously affected biodiversity on Earth. Members of the genus have been described throughout Laurentia in shallow water rocks for over a century, but the group is still poorly understood. There is no species level phylogeny, nor has there been a satisfactory family assignment for the genus. These issues aren't helped by images in the literature that are small and of low resolution. New material from our fieldwork in the Great Basin of the western United States indicates about 4 additional species. My project involves imaging these new species, reimaging the described ones, and revising the systematics of the group. I will also be putting together a phylogenetic analysis for genus.

Experience I value at UI: I've had a great deal of valuable experiences at the University of Iowa. My research project afforded me the opportunity to do fieldwork at a number of extraordinary localities in Idaho and Utah in late 2017 and 2018. I have also had the opportunity to present my work at the annual Geological Society of America conference where I was immersed in the fascinating and inspiring work going on around the world in a huge number of fields. My skills as a scientist and communicator have been greatly improved through studies, coursework, and public talks. I've also had the pleasure of meeting wonderful people and making excellent friends with the many colleagues I am working and teaching with.

Future Plans: This coming fall (2019) I plan to pursue a doctoral program with the goal of an academic, research-driven career.



Undergraduate Student Profile

Ellie Biebesheimer – BS anticipated Spring 2020

Advisor: Brad Cramer

Research: I currently do research under Dr. Cramer on organic carbon isotope chemostratigraphy of the Mulde Excursion from the Altajme Core, Gotland, Sweden. The goal of this research project is to determine the synchronicity of the organic and carbonate carbon isotope excursions that occur during the Mulde Excursion as well as to provide an extremely high resolution organic carbon isotope curve. To do this, samples were drilled and then decarbonized by washing the samples in multiple rounds of HCl and water. The samples were then dried in an oven for a period of days before the remaining amount was crushed using a mortar and pestle and placed in a new sample tube. They were then sent to a lab for further testing where the amount of organic carbon present in the rock was determined. This data will then be paired with previously found carbonate carbon isotope data to provide a paired organic and carbonate carbon chemostratigraphy of the Mulde Excursion, and to determine the synchronicity of the organic and carbonate carbon isotope excursions.

Experience I value at UI: The amount of opportunity available within the Earth and Environmental Sciences department is amazing. I have learned so much from the various field trips I have taken that I wouldn't have otherwise had the chance to. Going out into the field has been critical to helping my understanding of geology grow. I didn't know there were classes that would take me to places like Montana, Kentucky, and the Bahamas at Iowa, and the knowledge and experiences I gained on these trips has been invaluable to furthering my geoscience education.

Future Plans: I plan on graduating in Spring of 2020 with a BS in Geoscience and a minor in Environmental Science. After that, I plan on attending graduate school to obtain my master's degree.

In Remembrance



Paul E. Van Dorpe, 70, of Iowa City, died Wednesday, March 13, 2019. Paul was born in Detroit, Michigan on April 17, 1948 to Roger and Betty Van Dorpe. As he grew up, he was active in bowling, card playing, building model ships, and learning about U.S government through the Children of the American Revolution organization. After Catholic Central High School, he received a Bachelors and Masters degree in Geology from Wayne State University. By this time his family had moved to Farmington, Michigan, where he met Jill Kramar in church choir. They married on July 4, 1975 and moved to Ottumwa, Iowa so Paul could explore coal reserves for the Iowa Geological Survey. During this time Paul and Jill were very active in religious education at St. Mary's Church, and Jill finished her college degree.

When the coal project ended, Paul moved to Iowa City, continuing to work for the Survey until retiring in 2014. Over the years he was involved in well forecasting, subsidence, water contamination, well drilling concerns, and organizing water festivals to educate children. He was active in professional geological organizations and served as treasurer of the Iowa Groundwater Association for many years.

Paul played piano as a child, followed by clarinet in high school (marching band) and bassoon in college (symphony). He had traveled on several geological field trips (both domestic and foreign) while in college. So he continued these interests with his family after his children were born. Since Alexander, Rex, and Darlene Angelique were all musical like their parents, the family traveled to various conferences and performances together, both in the U.S. and overseas. The highlight of their family travels was a month-long trip in 1997 to Germany, Austria, and Switzerland.

For many years Paul's photography business --- Your Best Image --- captured memories for people at weddings, religious services, parties, theater events, and recitals. As public interest in videography grew, Paul offered that as well, including recording for the Cedar Rapids Opera Theater.

Paul enjoyed theater and dance, especially when watching his family perform! He read constantly, including mystery, biography, history, historical fiction, action novels ... and shipwrecks! His last model was of his favorite, the Titanic, suspended in a sheet of plexiglass so it was truly sinking. His largest model was the U.S.S. Constitution, complete with sails, lifeboats, and sailors.

In Iowa City Paul was active in St. Mary and St. Wenceslaus churches, the Sacred Heart homeschool group, and the Knights of Columbus. He truly loved serving the public throughout his geologic career, making contributions as long as he was able. Although afflicted with Parkinson's Disease for so many years, he sets an example to continue living life as fully as possible.

Acquisition of an X-ray Fluorescence Spectrometer

Four members of the department were recently awarded grant funding from the Roy J. Carver Charitable Trust to purchase a new X-ray Fluorescence Spectrometer. Emily Finzel, David Peate, Brad Cramer, and Kenny Horkley recieved \$341,000 to purchase a research grade WD-XRF instrument and sample preparation equipment, including a vibratory disc mill and ceramic grinding dish system, a dedicated digital balance, and an automated glass fusion disk maker.

An X-ray Fluorescence Spectrometer is a non-destructive analytical instrument that allows inorganic analysis of the elemental composition of a wide range of environmental materials (e.g. rocks, soils, metals, glass, air filters, building materials). The relatively simple and inexpensive nature of sample preparation, and the stability and ease of use of x-ray spectrometers, make this one of the most widely used geochemical methods for analysis of major and trace elements. The instrument will provide key support for undergraduate and graduate student research and teaching across a wide spectrum of disciplines in Earth & Environmental Sciences and on a variety of specific projects that include sedimentary environments, chemostratigraphy for global environmental change, studies of volcanoes, Mars-analog planetary studies, mineral exploration research, the nature of Iowa soils, and understanding controls on groundwater chemistry. Currently, there is no such piece of equipment on the University of Iowa campus.

Yes, there ARE igneous rocks in Iowa!!!

by Ryan Clark & David Peate

Back in 1975, Ken Kittleson completed his Masters thesis in the department with Prof. Kenneth Clark. His project focused on gravity modeling of the "Osborne magnetic anomaly" in Clayton County in NE Iowa. Fortuitously, this anomaly had been drilled in 1963 by New Jersey Zinc Company for iron exploration (aka the Osborne core), recovering more than 700 feet of Precambrian ultramafic olivine-plagioclase cumulate. Ken conducted a reconnaissance petrographic study of the core and used measurements of physical parameters on the core to show that the gravity and magnetic data are consistent with a NE-trending inclined ultramafic dike (Fig. 1). For the next 40 years, little attention was given to these rare Iowa igneous rock samples that had been archived at the Iowa Geological Survey's (IGS) Rock Library on the UI's Oakdale Research Campus. That all changed in 2011 when IGS geologists David Pals and Ray Anderson gave a presentation at a Geological Society of America meeting on "Reassembling Iowa: spatial and temporal evaluation of the mineral potential of the Iowa segment of the Midcontinent Rift and related plutons", which highlighted the Osborne core. Thanks in part to that presentation, the U.S. Geological Survey (USGS) became interested in the mineral potential of the Midcontinent Rift-related plutons in NE Iowa, given the significant known resources of copper, nickel, and platinum group metals associated with gabbroic intrusions of the Duluth Complex in northern Minnesota.

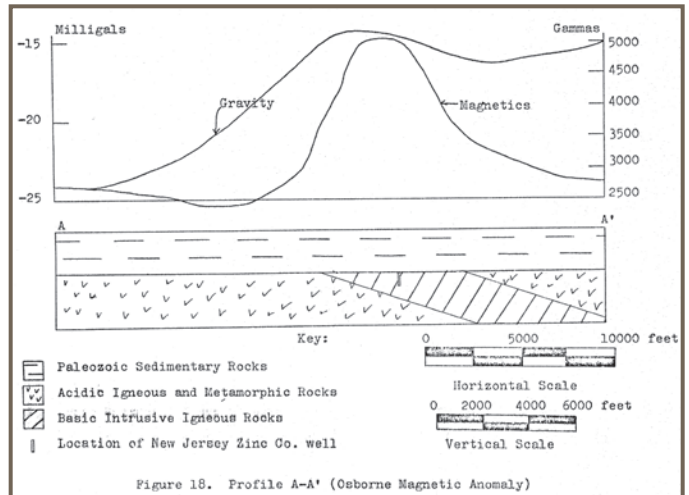


Figure 1. Kittleson thesis figure

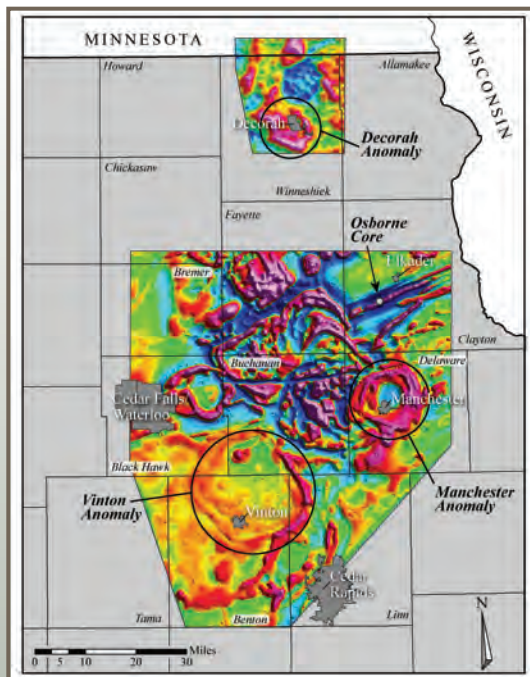


Figure 2. Aeromagnetics map

In 2012, the USGS began the process of characterizing the subsurface geology of the Northeast Iowa Intrusive Complex (NEIIC) using geophysical techniques over a relatively small survey area encompassing Decorah, Iowa and expanding into Minnesota (Fig. 2). The Decorah Survey included high-resolution aeromagnetic and airborne gravity gradient surveys. Aeromagnetic surveys generally detect variations in iron content in the rocks whereas gravity surveys detect subtle differences in rock densities. The results of the survey improved our understanding of the Precambrian geology and identified the Decorah Anomaly (Fig. 2), which appears quite similar to geophysical anomalies known to produce economic mineral deposits elsewhere in the world. Based on the success of the Decorah Survey, a second survey was completed over a larger area of the NEIIC called the Manchester Survey (Fig. 2). This survey further resolved the character of the Manchester and Vinton anomalies which has generated substantial interest within the USGS-Mineral Resources Program to investigate further. The USGS have approved the concept of drilling a new research core into one of the anomalies, but their budget lacks the necessary funding. The chances of getting funding approved for drilling will be greatly enhanced if there was more definitive evidence of the relationship of the NEIIC to the ~1.1 Ga Midcontinent Rift system.

Clearly, the next logical step is to answer "What is the age of the NEIIC?". At the moment, the Osborne core provides the only samples we have available to analyze for geochronology, but unfortunately, ultramafic rocks are not necessarily the easiest materials to date. They are unlikely to contain zircon ($ZrSiO_4$) crystals, often the mineral of choice for high quality U-Pb ages, but they can potentially contain trace amounts of baddeleyite (ZrO_2), a mineral that can also provide precise U-Pb ages. In Fall 2018, undergraduate student Allison Kusick was employed as an intern for the IGS as part of a NSF-IMPACT undergraduate education grant. She was tasked with helping us hunt for baddeleyite crystals in the Osborne core. To do this, she performed a systematic survey of compositional varia-

tions throughout the Precambrian section of the core, using a handheld X-ray Fluorescence instrument (Fig. 3). The focus of this effort was on finding any horizons particularly rich in the element zirconium (Zr) that should be hosted in baddeleyite crystals. These data largely confirmed the petrographic division into two dominant lithologies (an upper olivine-rich dunite and a lower plagioclase-rich troctolite). However, she did find a thin feldspar-rich vein (Fig. 4) that was significantly enriched in Zr (~500 ppm) compared to the rest of the core (~50 ppm) (Fig. 5): exactly what we were looking for. For the next step, Matt Wortel prepared a large (1" x 3") polished slab of this core piece, and then Kenny Horkley used the electron microprobe to map out how the concentration of Zr varied within the slab. This allowed Kenny and Allison to locate likely baddeleyite crystals that were then investigated under high magnification to determine their size and composition. To their surprise, they discovered that the main zirconium-rich accessory phase is actually a mineral called zirconolite ($\text{CaZrTi}_2\text{O}_7$) (not sure if Mark Reagan covers that one in Mineralogy!), with baddeleyite present but not as abundant (or as big). This might not be a problem, as zirconolite is also a suitable, although less-commonly-used, phase for U-Pb dating. We are currently evaluating the best method to use to date these tiny minerals [zirconolite is 50-500 μm (0.002"-0.020") and baddeleyite is 25-50 μm (0.001"-0.002")](Fig. 6), most likely using the SHRIMP ion microprobe at Stanford.

This project garnered a lot of local media interest earlier in the year following a write-up in the UI's IowaNow newsletter, with articles in the Iowa City



Figure 3. Allison using the pXRF

Press Citizen (Jan 7), the Cedar Rapids Gazette (Jan 12), and the Daily Iowan (Jan 16). Hopefully by the time you receive the next newsletter, we will know the age of the Osborne core. In doing so, we will be one step closer to knowing whether a wealth of mineral resources lie buried beneath northeast Iowa, which would be a valuable conclusion to the study originally started by Ken Kittleson over 40 years ago.

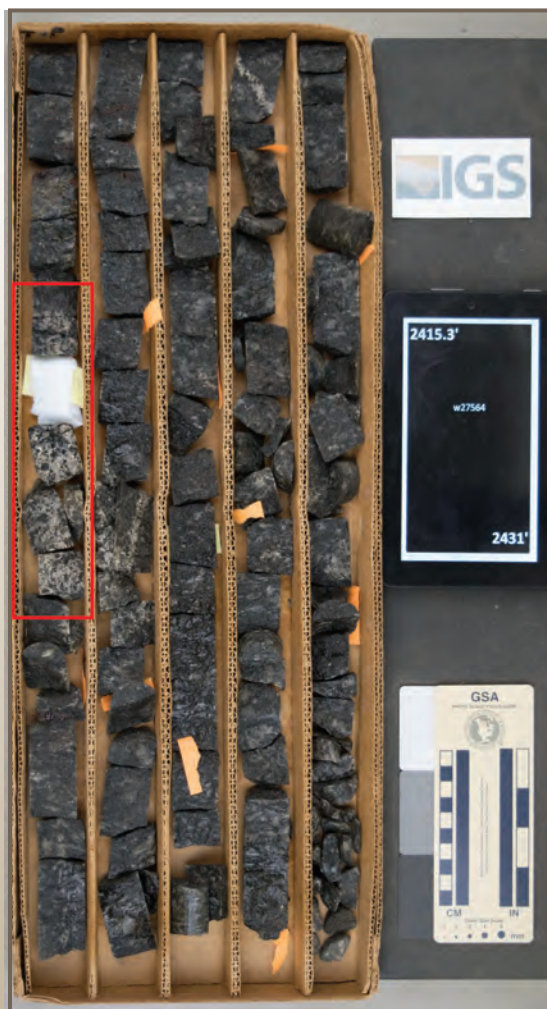


Figure 4. Corebox photo

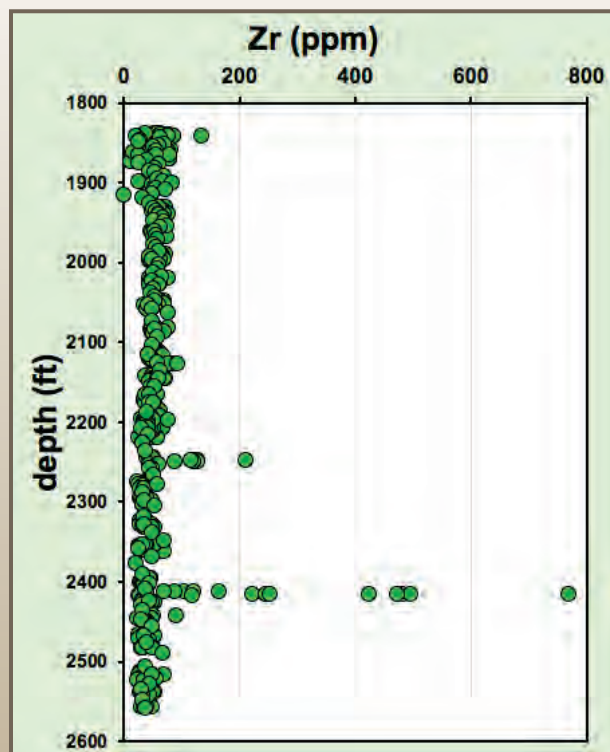
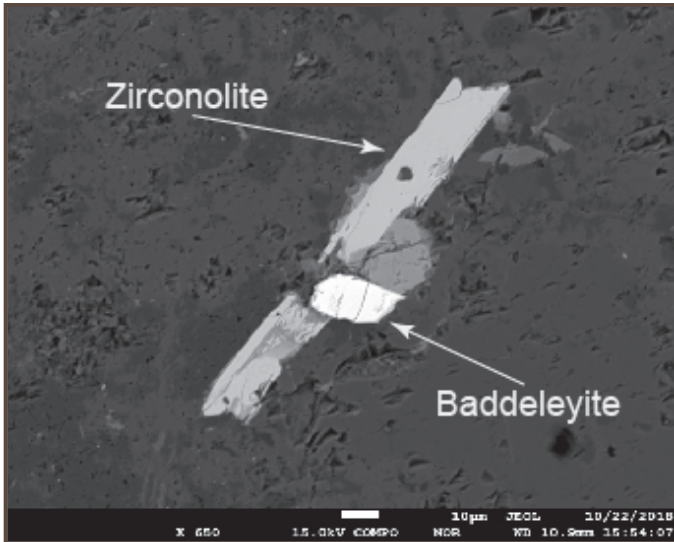


Figure 5 (left). pXRF Zr profile

Figure 6 (next page). Baddeleyite & zirconolite BSE image.

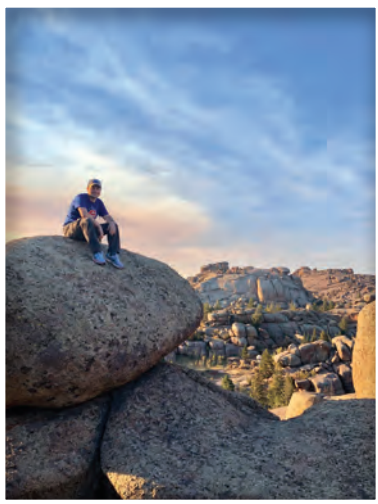


Ocean-A at the dock in Longyearbyen, Svalbard
(photo by J. Gilotti)

Eclogite Hunting on Svalbard

by Jane Gilotti

In July 2018, Professors Bill McClelland, Jane Gilotti and post-doc Karolina Kosminska visited the hard-to-reach high-pressure rocks at Biskhayerhalvøya on the NW coast of Spitsbergen, the largest island of the Svalbard archipelago. We joined a Polish expedition to try out a “new” logistics platform that follows the tradition of past Arctic exploration. Instead of putting out a helicopter-supported camp on the coast, we chartered a 24 m sailboat, the Ocean-A, to transport us to the field and provide living quarters while we worked. The idea was to avoid having to deal with polar bears in a coastal camp. The expedition proved successful: we sampled the eclogites and their host rocks. The crew was incredulous as we off-loaded our daily rock collection onto the boat, but they welcomed us back for future expeditions. In September, Ocean-A grabbed the record for the farthest north sail along the east coast of Greenland, reaching 79°40.16’.



Graduate Student Profile

Tanner Hartsock – MS student

Advisor: Ingrid Ukstins

Research: My Master’s research is concerned with understanding subsurface magmatic processes. I have been applying geochemical techniques to better understand the dynamics of a Yasur, a steady-state volcano in the Vanuatu archipelago that has been constantly erupting for 1,000 years. The persistent nature of Yasur volcanoes makes them a contributor to the sulfur atmospheric reservoir, which can directly affect global climate patterns. Yasur pumps out about 700 tons of SO₂ every day, and is one of the biggest point sources of sulfur on the planet. The goal of my Master’s thesis was to unravel degassing mechanisms and to calculate pressure-temperature conditions of crystallization within the magma chamber by analyzing bombs erupted from Yasur over a 75-day interval.

Experience I value at UI: I have been part of the Earth and Environmental Science Department for almost five years now. My time here has been both memorable and rewarding. I was given the opportunity to learn about geology in a variety of breathtaking locations and have made life-long connections along the way. I feel very confident moving forward into the next chapter of my life and career because of the skills I obtained during my time in this department. I owe thanks to a lot of good people and will never forget these experiences.

Future Plans: Upon graduating, I plan on pursuing a career in industry or consulting. I am ultimately interested in improving our relationship with the planet. I want to contribute in making the world a better place for future generations, and I believe this solution is rooted in developing a better understanding of the natural world.



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EARTH & ENVIRONMENTAL SCIENCES

SPRING 2019

Share your perspective

Please share the wisdom you've accrued throughout your career with our students by answering one or more of the questions below, or dispensing any other advice you may have. Your responses will be included in the Alumni Perspectives in the next newsletter. Send them to geology@uiowa.edu and indicate whether you would like it to be anonymous or attributed to you. Thanks for sharing!

What made you competitive in your field?

What were your lucky breaks?

What type of preparation would have made your career path easier?