Greetings from the Harold Hamm School of Geology and Geological Engineering. It has been a while since we last sent out a printed newsletter, so we have some catching up to do.

Our name has changed since our last newsletter because Harold Hamm and Continental Resources made a major financial contribution to our Department at a ceremony in September 2012. So, we changed our name in the Fall 2012 and are now a School instead of a Department. This means that Jaakko is now a Director, instead of a Chair.

Mr. Hamm’s generous support was matched, in part, by the North Dakota Industrial Commission. Hamm’s gift included two endowed professorships (one in Geology and one in Petroleum Engineering). The endowed geology chair is occupied by Steve Nordeng. We are very lucky to have him because Rich LeFever retired last year - Steve fills some of the void created by Rich’s departure. Some of the donated funds, too, allowed us to beef up our laboratories and to redesign and reconstruct many of our first floor museum displays. The money also allowed us to purchase some vital cutting-edge research equipment, and allowed us to create a very important Student Experience Fund. More information about the Experience Fund can be found later in this newsletter.

Another recent change is that all of our programs are now in the College of Engineering and Mines. One consequence is that our Geology BA degree has been renamed and is now called a BS in Earth Science. The College of Engineering, which also had a name change (from School to College) has been growing significantly recently - adding a Petroleum Engineering Department two years ago and, more recently, acquiring UND’s Department of Computer Science.

Our enrollments boom when the oil industry booms. As the numbers given in the table on this page demonstrate, we have a healthy number of students. Enrollment peaked in 2014-15 and has declined slightly since then, paralleling the price of crude. Overall, however, today we have 2½ times more students than we had in 2006.

We have also begun to offer more classes on-line and may soon have an on-line Geological Engineering Degree program.

Faculty (year joined our faculty)
- Dr. Nels Forsman (1987)
- Dr. Philip Gerla (1988)
- Dr. William Gosnold (1982)
- Dr. Joseph Hartman (2000)
- Dr. I-Hsuan Ho (2014)
- Dr. Ronald Matheney (1989)
- Dr. Taufique Mahmood (2015)
- Dr. Stephan Nordeng (2014)
- Dr. Dexter Perkins (1981)
- Dr. Jaakko Putkonen, Director (2008)
- Dr. Dongmei Wang (2014)

Our staff are Jessica Cadreau (Admin. Asst) and Darin Buri (Librarian).

<table>
<thead>
<tr>
<th>Fall 2017 Enrollments</th>
<th># students</th>
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<tbody>
<tr>
<td>BS Geology</td>
<td>16</td>
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<tr>
<td>BS Environmental Geoscience</td>
<td>15</td>
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<tr>
<td>BS Earth Science</td>
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<td>Ph.D Geological Engineering</td>
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Faculty and Graduate Student Activities

Taufique Mahmood and his graduate students are studying the impacts of climate and land cover changes on cold region hydrology and nutrient cycles. Study sites for on-going research include Devils Lake basin (ND), Reynolds Creek Watershed (ID), Tobacco Creek Watershed (MB), and a ponderosa pine hillslope in New Mexico. Taufique, in collaboration with Jaakko Putkonen is also investigating a high mountain watershed (Khudi River basin) in Nepal. Taufique currently has three graduate students. Diane Van Hoy is investigating the “impacts of recent climatic changes on cold region processes in a terminal lake basin using physically based simulations.” Tyson Jeannotte’s project is “phosphorous export model development using stream flow and concentration observations in a terminal lake basin.” Alexis Archambault is studying “spatiotemporal dynamics of wetlands” using remotely sensed data in the Devils Lake basin.

Jaakko Putkonen is now starting his third year as the Director of the Harold Hamm School of Geology and Geological Engineering. The Directorship still leaves him time to take students on field trips and teach courses. The most exciting thing this year is his upcoming expedition to Antarctica, where he will be leading a large field team from three institutions, including a film crew from London. The team will be studying the landscape evolution and drilling an ice core for further analyses. The work will take place in a small valley in the Transantarctic Mountains. He is looking forward to the sunny nights as the sun never sets during Antarctic summers.

Will Gosnold continues his research on terrestrial heat flow, geothermal energy, and climate change. The climate research spans time periods from 10s to 10,000s of years. Research on radioactive heat production in
Kelsey Forward, one of Phil’s graduate students is using drone imaging to study groundwater springs and seepage. Will and his students are also investigating the feasibility of creating a network of geothermal energy generating plants along the Missouri River in North Dakota and Montana and Will is directing a pilot program, involving many partners in Bowman County, ND, where hot water from the Lodgepole Fm. is being used to generate electricity. Graduate Student Dylan Young is studying the geoneutrino background at the former Homestake Mine in Lead, SD. The outcome of Dylan’s research has relevance for the Deep Underground Neutrino Experiment (DUNE) http://www.dunescience.org/ an international mega-science project. Burke Brunson is completing his Master’s thesis on the thermal history of the Williston Basin and its impact on thermal maturity of kerogen bearing formations.

I-Hsuan Ho focuses his research on computational geomechanics, experiments and numerical modeling of unsaturated soil mechanics, geothermal deicing pavements, slope stabilization using piles, and rock mechanics. I-Hsuan is also collaborating the research in computational rock mechanics with Iraj Mamaghani in the department of Civil Engineering. I-Hsuan currently is advising two graduate students. Mark Dickson is finishing his MS thesis and his research focuses on the assessment of a snow-melting pavement, using energy from a shallow geothermal resource, in Eastern North Dakota area. Sidike Abudureyimu is a new graduate student from China and his research will take off where Mark’s ends. He will focus, too, on pavement deicing system development using renewable energy, and especially will focus on airport runway deicing system development in North Dakota.

Phil Gerla continues his investigations of surface and shallow groundwater hydrology and has several students working on projects in Minnesota and North Dakota. In spring, 2017, Ben York completed a thesis on the “Effect of Glacial Isostatic Adjustment on Rivers and Drainage Basins in the Red River Valley.” Kelsey Forward is finishing up a study that used drone-acquired thermal images to map groundwater seepage and springs to lakes. Ogochukwu Ozotto is attempting to map discharge zones in a large groundwater-fed wetland at Camp Grafton South, North Dakota, using on-the-ground thermal imaging, shallow temperature profiles, and nests of closely spaced ceramic-cup piezeometers. Justin Marks is working with the U.S. Fish and Wildlife Service and Agassiz National Wildlife Refuge, to help the agency restore a six-mile meandering reach of the Mud River in the eastern side of the refuge. Danielle Gorder is beginning MS thesis research that will focus on ways to design more sustainable, resilient, and effective agricultural surface drains. Both Justin and Danielle are in the College of Engineering and Mine’s Environmental Engineering graduate program.

Dongmei Wang continues investigating ways to improve oil recovery from tight formations. Due to ultra-low permeability and oil-wet conditions, using existing methods, the primary oil recovery from naturally fractured shale reservoirs has only been a few percent of original oil in place. Dongmei thinks this might be improved to more than 7% - perhaps as much as 25%. She is particularly focused on the potential of using chemicals to lower surface tensions as a means to improve oil recovery from the Bakken shale. She is also investigating oil extraction from oil sludge, and is developing methods to treat oil-contaminated soil. Dongmei has three graduate students. PhD students Jin Zhang and Kayode Olatunji are both working on enhanced oil recovery, and MS student Steve Detwiler is focused on modeling of the effects of surfactant used in Bakken oil recovery.

Joseph Hartman was on developmental leave last year, but is now back to his standard 60 hours a week in Leonard Hall. While on leave, he spent time working with a team of paleontologists, conducting studies at several places in southern Wyoming. The team included faculty from the University of Wyoming and other universities, and USGS geologists. Several UND students and researchers, including Ray Butler and Don McCollor, were also involved in the studies. Joseph is also working with several collaborators and UND students on museum paleontological studies. They are mining museum collects for important and significant paleontological specimens as the basis for several different research projects. Last May, MS student Matt Illies completed his
thesis - an investigation of the Judith River Formation in Montana. Another student, Matt Weiler is finishing his dissertation, but is being distracted (making a living) by his job as an Assistant Professor of Geology at Victoria College, Texas (heavily impacted by Hurricane Harvey). Joseph has a new research toy. He reports that “one of the most important events that happened [recently] was his discovery of the Keyence VHX-5000 digital microscope.” He first used one when visiting the University of Wyoming and found that the VHX-5000 was a “game changer.” It permits Joseph to shoot 2-D and 3-D images of fossils that otherwise would be impossible to photograph to his standards. He was so excited by the possibilities that he purchased a VHX-5000 for our school.

Dexter Perkins and Nels Forsman are spending most of their time teaching and writing. Dexter is working on an Earth Materials textbook. He says that a book of this scope has never been written before. Coauthors include one of Dexter’s former PhD students, Kevin Henke, who is a researcher at the University of Kentucky, and Adam Simon, a faculty member at the University of Michigan. Nels is currently working on a petrologic atlas of all of North Dakota’s volcanic tuffs. “This is important to get out to the scientific community because we have some of the oldest, yes fresh appearing, ashes in the world. He says that he will soon retire, but plans “to continue translating James Hutton’s manuscript into modern English - something more understandable than the original.” Both Dexter and Nels are busy directing undergraduates doing senior thesis projects.

Ron Matheney is working with Ph.D. student Fazilatun Mahmood to understand oxygen-isotope fractionation mechanisms in diatoms (siliceous algae). They hope to explain why different researchers have produced conflicting temperature calibration curves for various fossil and living diatoms, and to determine whether it may ever be feasible to use the oxygen isotope composition of biogenic silica for paleotemperature reconstructions of marine and lacustrine environments.

Steve Nordeng’s research is currently focused on a debate over the application of experimentally derived kinetic properties of source rocks to the problem of defining the thermal threshold for oil generation. The debate boils down to whether the pre-exponential or frequency factor in the Arrhenius equation is a fixed or nearly fixed value. Data obtained from the Bakken Formation appear consistent with a constant frequency factor. His graduate students are busy too. Sreeram Jambulapati is studying modern dolomite precipitation. Emily Sundell spent the summer mapping cliff faces of the Shannon Sandstone in the Wind River Basin of Wyoming using photos taken by a drone aircraft (photo on next page). Dilyn Stevenson and Michael Farazaneh are working on the subsurface sequence stratigraphy and examining source rocks of the Tyler Formation (Pennsylvanian). Chioma Onwamelu is studying the kinetics of maturation in the two source beds in the Bakken Formation. Her primary goal is to establish whether there is a significant difference in modern and past reaction rates. Adedoyin Adeyilola is working on a project to measure the distribution of pore-sizes using Nuclear Magnetic Resonance within the Upper Three Forks Formation in Divide County, ND. Tyler Lindsey has started a project to determine the feasibility of using machine vision methods to recognize crinoid fragments in core and to use this approach to log core on the basis of crinoid content. His project is expected to provide a test the applicability of these emerging technologies to common problems in collecting geologic data from core.

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FIELD NOTES

Geomorphology Trip Fall, Sept 8-10, 2017 (information provided by students Danielle Zinsmaster and Grace DeVault)

The drive to Chippewa National Forest on Friday was long, but I didn’t mind. Before we even reached camp, I had laughed until I cried, made some cheesy geology puns, and we had bounced research ideas off each other. After arriving to camp, we were briefed in how to properly navigate, using a compass and map or a GPS. Up next was the night hike. For those of you who don’t know, the “night hike” is a little game Jaakko made up to test our navigation skills when we are in an intense situation. He drives us to a pull off, on the side of a remote road, in the dark. He then tells us there are four people hiding deep in the woods. Their locations are marked on a map he hands out to all of us. Our challenge is to find them, using the GPS or compass. For some, this is an easy, fun challenge. For others, this is terrifying because they have little experience with the navigation equipment or they fear the dark. Overall, everyone completed and enjoyed the challenge.

Saturday was the busiest day of the trip. To start off, we visited some ridges in the woods. On the first ridge, we dug a variety of pits in the ground, and examined the soil layers and made drawings of soil profiles. With this information, we concluded the ridge was an esker. After refilling the pits, we moved to a different ridge to measure slope. The ridge was incredibly steep; we were almost sliding down it while we measured! We assessed the slope with a tape measure and an eye level, so it was a fairly simple, though exhaustive, method. After this, we headed for a nearby bog. Rain boots were the most popular footwear, but some chose to go with tennis shoes, sandals, or even barefoot. This was the first time I had ever seen a peat bog, and I found it fascinating. A peat bog is an ancient lake that has been covered with a giant mat of sphagnum moss. This makes walking around on it similar to walking in a bouncy house. Our feet sunk into the ground with each step, drawing water. We also saw pitcher plants and a garter snake in the bog. We took core samples, and saw how the moss became more and more decomposed the further down we dug. Then we returned to the car and dried off before driving to our final stop for the day, an abandoned gravel pit. Here, we calculated how close the bottom of the gravel pit was to the water table in the area. We found that the bottom was only a few meters above the water table. We also calculated the volume of material removed from the gravel pit, and how much money it was worth: $20,000,000. By the time we returned to the campsite, everyone was exhausted. However, after a nice fire and warm meal, we were all in good spirits, and enjoying the trip.

Sunday morning, we learned how to core trees and how to use dendrochronology in research, before departing for home. We will use the cores we took for projects later this semester. Looking back on this trip, I realize that we really learned a lot in a very short time. The trip was basically like going to field camp for only a few days. Having hands-on experiences like this really made us feel more prepared for working as a geologist in the future.

The College of Engineering and Mines recently built a Collaborative Energy Complex where the parking lot west of Leonard was. This provides much needed office and laboratory space but, alas, cost us all the exterior windows on the west side of Leonard Hall.
Yellowstone Field Trip, Sept 14-17, 2017 (information provided by graduate student Marie Bergelin)

Despite snow, cold feet, and wet sleeping bags, the petrology field trip was one-of-a-kind fun. It was filled with humor, and positive spirit persisted despite inclement weather. We saw great geology and nobody seemed too upset about getting wet. Exploring the beautiful nature and geology of Yellowstone National Park was great. And our visit to the Stillwater Complex on Sunday was great because the geology and scenery were spectacular, the sun came out, and we had an extra professor (Dr. David Mogk from Montana State) to help us interpret what we were seeing.

The trip started with two short stops in North Dakota. Near Almont, we visited a fantastic exposure of Paleocene fossils in a mudstone. Ginko leaves were my favorite but other kinds of plant fossils and fish scales were also present. After fossilizing for a while, we drove to the Painted Canyon Overlook of Theodore Roosevelt National Park. More beautiful eye candy and a great sunny day. Shortly after leaving North Dakota, however, the rain began and rain and snow persisted until Sunday afternoon.

After a 12-hour drive and a good night sleep, we started the next day by driving over the Bridger Range, and then along the Madison River where we looked at 2 billion year old garnet-bearing metamorphic rocks, and then at gneisses in tall cliff outcrops that were intruded by large colorful dikes. We visited the Hebgen Lake fault site and, then, in the evening, we finally reached Yellowstone National Park. Even in the rain, it is a beautiful and breathtaking place. It is no wonder that the park attracts more than 4 million people each year. Before we set up camp, we walked through the colorful Norris Geyser Basin. Luck was with us, and the rain and snow stopped long enough for us to set up tents and cook and eat dinner.

The second day started with a few wet sleeping bags, cold feet and great spirit. We visited some way cool geological sites including a giant basalt flow, watched an eruption of Old Faithful geyser, took photos at Artist Point, got personal with an old petrified tree, hiked through colorful Mammoth Hot Spring, and saw lots of wildlife - including many bison and elk. We were supposed to drive over Beartooth Pass, but 2 feet of snow meant we had to drive the long way around to get to a campground near Nye, Montana. Sunday started with a great geology presentation by a geologist at the Stillwater Mine. The mine is one of the world’s leading producers of paladium, with lesser amounts of platinum. We then drove up the mountain and visited an abandoned mine site and looked at many different kinds of rocks in the Stillwater (mafic-ultramafic) Complex.

Although I am a graduate student, this was the first petrology trip that I have been on. It introduced me to a whole different world of geology and some great students who are now good friends. Most importantly, I learned an amazing amount about geology - in particular about hard-rock petrology. And of course, with camp fires, Dexter’s cooking, the tents collapsing under snow and then almost being blown away by heavy winds, and being 6 feet away from the butt of two bison’s - we had a lot of bonus fun.

Thanks a Lot!

We want to take this opportunity to thank Harold Hamm, Continental Resources, the NDIC, and the many others who have donated to our School. This support directly helps our students to have the experiences and opportunities that make the difference between education and the great education. Our wholehearted thank you from students, staff, and faculty.
Subsidizing Field Trips

Travel can be expensive - so expensive that many students could not afford to go on geology field trips if they had to pay all the costs. Yet, we want all students to participate.

For example: Last Spring Break (2017) Dexter led a group of 14 students on a trip to California. The total cost of the trip was about $16,000, but because of support from the Experience Fund, students only had to pay about $300 each.

The previous Spring Break (2016), Jaakko took 19 students to Hawaii. The entire trip cost in excess of $20,000 but students only paid about $300, plus a bit more for food, each.

This fall (2017), the Petrology class field trip went to Yellowstone and the Stillwater Complex for 4 days. The total cost of the trip was about $4,100, but we charged students only $20 to cover food.

During the past several decades, our departmental operating budget has barely kept up with inflation. At the same time, all of our costs have gone up (including having to pay for participation in our Black Hills field camp consortium). So, we have had to rely more and more on donations and grants to keep even routine activities functioning. Right now, our #1 funding priority is the Student Experience Fund.

If you can help by making a donation to the Experience Fund, or for any other purpose, we promise you that it will go to good use. Our contact information, including our mailing address, is on the following page.
We want to hear from you!
You can email us at und.gge@und.edu

• Please help us keep our contact information up to date. Tell us of better or preferred mailing addresses or email addresses.
• And please tell us what you are doing these days?
• Or tell us what other alums are up to.
• Or, just ask us questions that come to your mind.

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