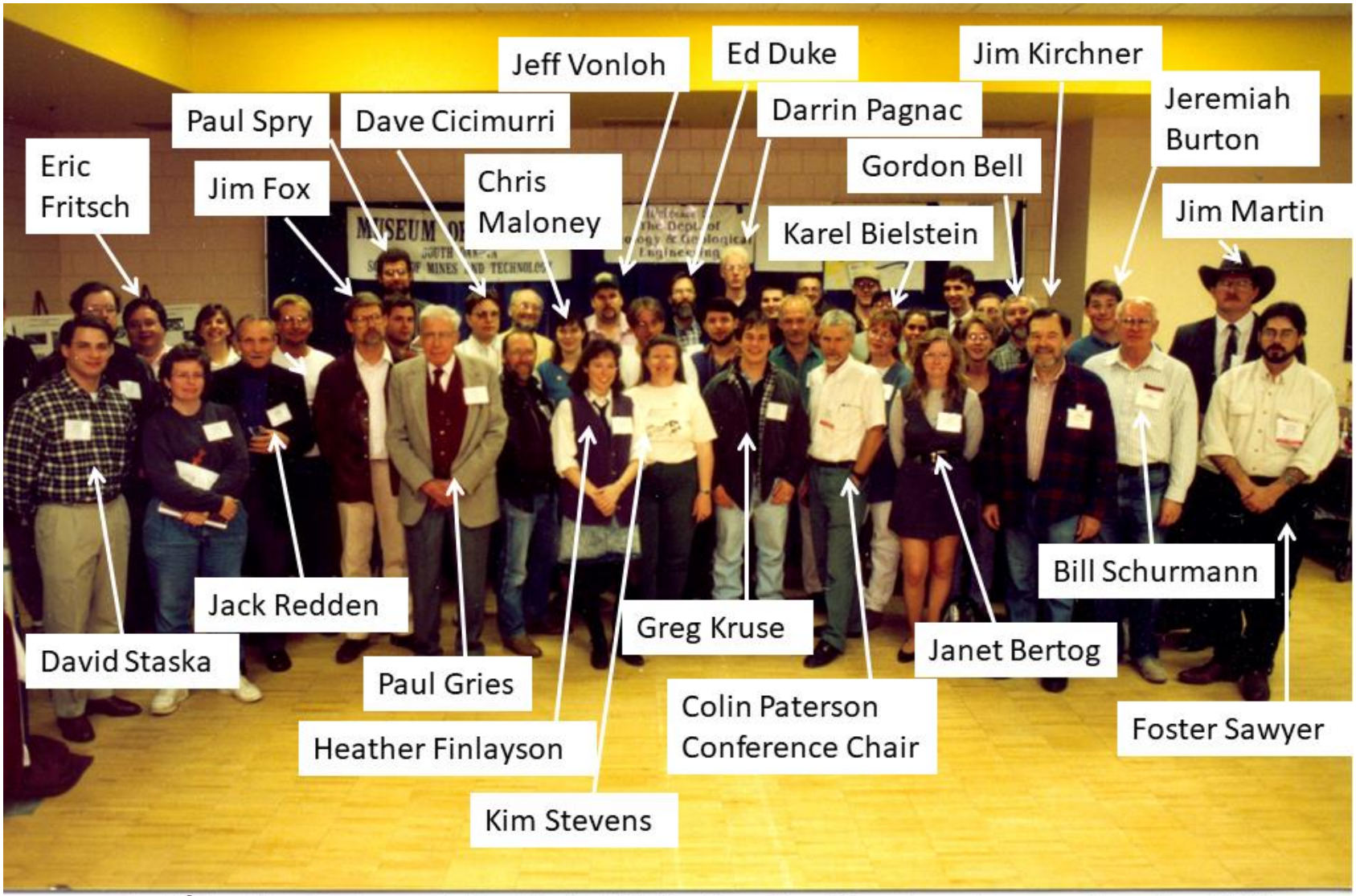
SOUTH DAKOTA MINES

Department of Geology and Geological Engineering

2020 Alumni Newsletter

Faculty and Staff in Geology and Geological Engineering – 2020
Row 1: Laurie Anderson, Cleo Heenan, and Christopher Pellowski
Row 2: Ed Duke, Kurt Katzenstein, Sarah Keenan, and Liangping Li
Row 3: Tim Masterlark, Roger Nielsen, Darrin Pagnac, and Curtis Price
Row 4: Foster Sawyer, Gokce Ustunisik, Nuri Uzunlar, and Kevin Ward
Missing: Zeynep Baran, Bill Roggenthen, Larry Stetler, Arden Davis, Jim Fox, Colin Paterson, and Perry Rahn



Geol/GeoE volunteers at the Rocky Mt Section Geol Soc America meeting, Rapid City, May 1996

Missing: Drs. Arden Davis, Alvis Lisenbee, Bill Roggenthen, and Perry Rahn

From the newsletter coordinator – Christopher Pellowski

Greetings alumni and friends! Please enjoy reading the 2020 edition of the alumni newsletter.

This newsletter is also accessible on the department's alumni newsletter webpage:

https://www.sdsmt.edu/Academics/Departments/Geology-and-Geological-Engineering/Activities-and-Organizations/Alumni-Newsletters/

Status of the Department

Alumni and friends, 2020 has been an extraordinary year. I hope you all are healthy and safe. We have had both ups and downs in the Department of Geology and Geological Engineering (GGE) this year and although responses to the COVID-19 pandemic have been a challenge for all of us, there are also some silver linings.

We would like to acknowledge the gifts we received for the Department or the Museum of Geology. In Fiscal Year 2020 we received, $198,623 in unendowed gifts to support department initiatives and $76,244 to support the Museum of Geology. Gifts to the department supported the Energy Research Initiative (ERI), students, scholarships, the geospatial lab, student clubs, and the department in general. In FY21, we discontinued the ERI Director position, although energy research and education efforts continue within the department. Most gifts for the Museum were provided by alumna Dr. Rachel Benton (MS PALE 91) to support National Park Service Collections. We are very excited to have the opportunity to rehouse, care for, and catalog these important collections and also train students in current collections care practices.

We thank all friends, alumni, and corporate partners for your generous support of our students and programs. **I hope you will think of us as part of your charitable giving plan now and in future years**. I would be happy to chat with you about the department's needs and goals at any time.

Finally, all the best to you for the New Year.

Department of Geology and Geological Engineering Update

As you may know, we had to move all courses online in March 2020 and finished up spring semester remotely. Faculty had to transition courses online on very short notice, which was an especially challenging task for our many hands-on labs and field exercises. Faculty and students did an outstanding job finishing out spring semester.

Summer courses were also disrupted, and we had to cancel several of our field courses. Others were moved online. However, we did successfully teach a portion of the geology field camp and both sessions of the paleontology field camp in person without any COVID cases resulting from field activities.

Fall semester was on campus but with some courses, or portions of courses, online and with social distancing and masking requirements in place. As a result, we had to expand the number of lab sections to accommodate reduced room capacity. All in all, however, we were able to successfully complete fall semester.

The changes brought on by SD Mine's response to COVID have had some positive outcomes. We learned a lot about delivering educational content online, and successfully teaching in person classes without increasing infection risk. As a result, the Field Station has developed an online field methods course and some virtual field camps that will become a regular part of course offerings. In addition, our experience has led us to explore options for online graduate course and program offerings. More on this in the future.

We have two faculty searches active in the department. We are searching for assistant professors in geology, particularly structural geology and tectonics, and in geological engineering. These positions anchor the curriculum for all of our educational programs, and we are excited to welcome new faculty to the department in the fall.

We also will see the retirements of Drs. Foster Sawyer and Bill Roggenthen this year. Both have made significant contributions to our teaching and research over the years, and although we will miss their day-to-day involvement in the department we expect to have them continue to be active as emeritus faculty for years to come.

The number of undergraduate majors declined slightly in 2020-1, although the number of B.S. degrees awarded remains strong (35 graduated in 2019-20). We currently have 110 GEOL and GEOE majors. In our graduate programs, enrollment overall is down slightly (currently 32). Career placement of our undergraduates is strengthening. In 2018-19 (the latest numbers available), GEOE had 100% placement and GEOL had 86% placement.

We are working to increase the visibility of our excellent programs and students. If you are on Facebook, please check out the series "This Week in Lab" that highlights what our students do in our classes as well as "GGE Research Highlights" that features research of our faculty and students.

Last year the geology faculty began a significant curriculum review in preparation for seeking ABET accreditation. During the course of the 2019-20 academic year, we revised the geology curriculum to align with published Applied and Natural Science Programs (ANSAC) Student Outcomes (SOs) and Geology Program Criteria. As part of this revision, we have added an introductory field methods course, a geochemistry course, another geophysics option, and a required resource geology elective to the program. We developed an assessment plan for SOs and Program Performance Indicators (PPIs), mapped the new curriculum to ANSAC Geology Program Criteria, developed an assessment schedule, developed assessment tools for each SO and PPI, composed a statement of Educational Objectives, determined our constituencies, and developed surveys for these constituencies as well as other critical stakeholders. Our efforts were positively reviewed by the GGE Advisory Board in Spring 2020.

We also are working with the President's Office and the SD Mines Center for Alumni Relations and Advancement (CARA) on securing state support and donor contributions to construct a new MI building. In addition, we are working with the Departments of Mining Engineering and Management and Materials and Metallurgical Engineering on building an applied research and educational program centered around advancing mining technology and related fields. The first component of that initiative is the CAT Lab (see: https://www.sdsmt.edu/News/Caterpillar-Inc--Funds-Major-New-Initiative-at-Mines/#.X9OjLthKguU) and we have received significant positive feedback from other industry partners with interests in being involved in similar efforts.

We also are working on building a new field camp facility in the northern Black Hills. **We welcome any assistance that alumni and industry partners can provide in promoting SD Mines, GGE, and our students!**

We continue to strive to build our research programs in the department. Research awards help support both undergraduate and graduate students and provide them opportunities for research experiences in the field and laboratory. Please check out faculty entries to see the great things they and their students are up to.

Museum of Geology Updates

Because of campus closure in response to the COVID-19 pandemic, the Museum was closed from mid-March to July 5. Our visitation and revenues have suffered as a result, but we have expanded our online content, particularly through social media. We are open and you should come visit us when you can!

The Museum of Geology underwent accreditation review last year and we learned in the spring that we received accreditation from the American Alliance of Museums. We are one of four South Dakota museums with this designation. The others are The Mammoth Site of Hot Springs, the Washington Pavilion of Arts and Sciences, and the South Dakota Art Museum.

We hired a new Associate Director in the Museum of Geology this year. Nathanial Fox joined the Museum this fall. He recently completed his Ph.D. from UC Merced and has an expertise in Quaternary small mammals. Nate has previous experience in mitigation paleontology and has hit the ground running with his work in the Museum's collections. We have also been working on expanding volunteer opportunities, policies, and training. If you are interested in volunteering with the Museum, let us know!

The Museum, its staff, GGE faculty, and alumni were prominently featured on the PBS series Prehistoric Road Trip, hosted by Rapid City native Emily Graslie. It was a great series on the geology and paleontology of the northern Great Plains. You can find more information here: https://www.pbs.org/show/prehistoric-road-trip/ I am happy to announce that we are focusing more attention on improving our Mineral collections in the Museum. Largely built through the efforts of Willard Roberts between 1963 and 1987, mineralogy and petrology holdings in the Museum include the South Dakota Collection, which contains many remarkable samples of the large diversity of minerals found in the state (particularly in the Black Hills), a worldwide systematic collection, and hundreds of display quality specimens. In addition, drill cuttings and cores, well logs, and other data from throughout South Dakota, as well as mineral ore samples, have been transferred from the Department of Geology & Geological Engineering (GGE) to the Museum in recent years.

Unfortunately, since the death of Willard Roberts in 1987, the Mineralogy Collection has not received consistent oversight or the level of curation needed to become a resource for faculty, students, staff, and visiting researchers. Although now stored in a stable facility within the Paleontology Research Laboratory, the specimens that are the core of the collection need to be rehoused, curated, and digitally cataloged. Our goal is to seek major grant funding to support collections improvement. Before that can be done, however, an accurate inventory of the collections is needed to accurately estimate supply and cabinetry needs, labor needed to complete curation, and data to construct an effective database schema.

In October, alumnus Martin Jensen helped develop a rough collections map and he observed the following:

> - this collection is the most comprehensive record of Black Hills minerals from most of the mines, most of which are now exhausted, inaccessible, and/or reclaimed.

- there are many above average specimens from well known, classic, Black Hills occurrences.

- selected samples were actually field collected by eminent mineralogists.

- most of the pieces are historic now and are the only remaining examples in existence from once important and productive deposits.

- a smaller portion of the collection also contains significant samples from other famous worldwide occurrences now considered classics.

- there is an excellent sub-collection of worldwide ore mineral specimens from the most famous ore deposits that is largely intact and a is very valuable teaching resource.

- the collection is easily significant enough that the outdated storage cabinets deserve to be upgraded.

I am thrilled to report that we have received pledges of $50,000 to support an initial inventory of existing mineral and rock collections and associated data. The funds will primarily support a graduate student to complete this inventory. Additional expenses will include various supplies that we will need for documentation and emergency rehousing needs. These efforts will put the Museum in a good position to submit larger proposals to fund new cabinetry, as well as labor for rehousing and curation. As we raise funds to upgrade housing and cataloging, we will seek President Rankin's approval to name the mineral collections facility in honor of Mr. Roberts.

Laurie Anderson News

I competed my term as Interim Head of Mining Engineering and Management (MEM) this year. The MEM department successfully hired a new Department Head, Dr. Robert Hall, who comes to us from the University of Alberta. I look forward to working with Rob on various educational and research initiatives that will strengthen both departments. I miss working closely with the MEM faculty and students, but they now have excellent permanent leadership.

I taught Senior Research I to a group of 16 geology students this fall, and it was exciting to see the wide variety of projects they are developing, from geophysics to petrology to geospatial analyses to paleontology projects. I also taught the interdisciplinary course Developing and Planning Research (GEOE/GEOL/MEM 700). I had a group of 13 graduate students from the geology, geological engineering, paleontology, and mining engineering programs. It was a great group with many lively discussions and I'm excited for the wide variety of research they will pursue while here at SD Mines.

I'm also working toward becoming an ABET program evaluator for geology. Training has been postponed due to COVID-19, but I hope to complete training and go on my first observer visit in 2021.

I am currently working with two graduate students: Brooke Long-Fox is completing her PhD lucinid bivalves and Peter Daly has begun an MS on foodweb modeling of Cretaceous methane seep faunas. With collaborators and students, I published two papers: one on the Eocene-Oligocene boundary transition in the southeastern US (based on work done when I was at LSU), another on endosymbiosis in lucinid bivalves (part of a collaborative Dimensions of Biodiversity grant from NSF). Another publication is in revision and four are nearing submission. We also closed-out our

collaborative collections grant to catalog Cretaceous Western Interior Seaway collections in the Museum of Geology. For this project, SDSMT digitized 58,731 specimen records (5,343 lots). In addition, 624 localities were georeferenced, with an additional 189 localities added but not georeferenced. The Museum has shared 12,927 Cretaceous records through iDigBio.org; about 41% of these were added as part of this grant. Finally, we developed two teaching modules for distribution on the Digital Atlas of Ancient Life https://www.digitalatlasofancientlife.org/teach/).

2020 GGE Department news:

January:

Ms. Corrine Cranor (BS GEOL) – Curation First Impressions
https://mogcollections.wordpress.com/2020/01/24/curation-first-impressions/

March:

Dr. Laurie Anderson - SD Mines Museum of Geology receives highest national recognition
https://www.sdsmt.edu/News/Museum-of-Geology-Gains-Accreditation/

Drs. Kurt Katzenstein and Christopher Pellowski – Women in Science Conference at the School of Mines
https://www.newscenter1.tv/women-in-science-conference-at-the-school-of-mines/

April:

Dr. Darrin Pagnac – Chatting with NDGS Paleo: Camels!
https://www.youtube.com/watch?v=g7bQwAnz7Ds

June:

Drs. Sarah Keenan and Darrin Pagnac – SDPB Prehistoric Road Trip
https://watch.sdpb.org/show/prehistoric-road-trip/

July:

Ms. Emily Berry – Asst. Dir., has the dirt on International Rock Day
https://www.blackhillsfox.com/2020/07/13/asst-dir-has-the-dirt-on-international-rock-day/

August:

Drs. Nuri Uzunlar and Christopher Pellowski - South Dakota Mines finds success in 2020 Earth Science field camps
https://www.sdsmt.edu/News/2020-Earth-Science-Field-Camps/

October:

Ms. Emily Berry – Museum of Geology: Happy National Fossil Day!
https://www.blackhillsfox.com/2020/10/14/museum-of-geology-happy-national-fossil-day/

November:

Ms. Kayleigh Johnson - T. Rex fossil getting facelift at South Dakota Mines
https://www.sdsmt.edu/Research/Research@Mines/T--Rex-Fossil--Getting-Facelift-at-South-Dakota-Mines/

https://rapidcityjournal.com/news/local/education/t-rex-fossil-discovered-near-mud-butte-being-restored-at-south-dakota-mines/article_656bf651-cece-5139-9dc7-9b5f559595b0.html

https://www.blackhillsfox.com/2020/11/11/south-dakota-mines-preserves-worlds-6th-ever-discovered-t-rex-fossil/

https://www.newscenter1.tv/t-rex-jaw-bone-being-preserved-at-sdsmt/

Dr. Nuri Uzunlar – Learn! Blog interview
https://www.aapg.org/publications/blogs/learn/article/ispreview/true/articleid/58759

https://www.aapg.org/publications/blogs/learn/article/ispreview/true/articleid/58764

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[OSHATOES safety (steel toe) overshoes]

The Newmont Mining Company donated $950 towards safety equipment for our department. We decided on safety (steel toe) overshoes from OSHATOES. We placed an order for 36 pairs that included buckets to use on future field trips to drilling/mining sites that require Personal Protective Equipment (PPE). We can't wait for the next field trip to try them out!

Cleo Heenan

Sending best wishes to everyone for a Happy New Year. This past year has been a learning process for everyone, and I definitely enjoyed more of the outdoors. The husband and I bought an older boat and spent many hours on the weekend being lazy on the water and of course enjoyed family as they like the new purchase. So thankful that I was able to continue to spend quality time with my friends and family and hopefully our new year brings another great year. Happy Holidays everyone and stay safe.

Christopher Pellowski

It was a slightly different year due to COVID-19 and a 15-day field camp being held on the SD Mines campus with field areas within a one-hour drive. We had three cohorts made up of 10 students and two instructors each that lived on three separate floors in Connolly Hall and operated on their own each day in the field and office. This certainly posed some unique challenges to daily operations that were far removed from our past days at Ranch A. In the end, it all worked out with satisfied students and no one became infected.

Drs. Jon Rotzien and Ryan Sincavage led the charge to engage the other instructors of this field camp to document our efforts in the form of a journal article that we could share with other field camp directors and faculty to assist them with the planning and logistics of their own future field camps during a pandemic. Be sure to read the article "Field-based Geoscience Education during the COVID-19 Pandemic: Planning, execution, outcomes, and forecasts" by Rotzien et al. in the March-April issue of GSA Today to learn more about how we made it all work.

I taught the Geol 451 Economic Geology class in the spring semester with five students enrolled. We had just finished up the first five labs when Spring Break arrived, and everything changed. Unfortunately, we were unable to have the Mineral Venture mineral exploration game due to the students not on campus and was further compounded by internet connections that weren't quite up to par. We finished out the semester with some extra guest lectures and a virtual reality field trip of Wharf Resources with the help of alums Ms. Lindsay Chasten (MS GEOL 09), Mr. Keenan Sarratt (BS GeolE 03), and Mr. Jacob Thaler (BS Geol 08). This year I am serving on six department committees and will be teaching Geol 351 Earth Resources and the Environment during the Spring 2021 semester with 17 students already signed up.

Be sure to visit and like us on Facebook and follow our posts.

https://www.facebook.com/SDSMTGeologyGeologicalEngineering

Bill Roggenthen

An Update on Recent Geothermal Energy Research at SURF

Geothermal investigations began in 2016 at the Sanford Underground Research Facility SURF) and were supported by the U.S. Dept. of Energy beginning in 2016. The kISMET project (Permeability [**k]** and **I**nduced **S**eismicity **M**anagement for **E**nergy **T**echnologies) was the first project and focused on the relationships between stress and fracture stimulation using detailed real time borehole monitoring. The work was done with the Lawrence Berkeley National Laboratory as the lead and with SDSMT among others as a participant in the project. Five closely spaced vertical bore holes (three meters separation) were drilled on the 4850 Level (Fig. 1) of SURF and instrumented with seismic and electrical resistivity monitoring equipment (Fig. 2). The central hole that was 100 m long was hydraulically fractured in several intervals, and the resulting effects on the seismic velocities and electrical resistivities were tomographically analyzed using data from the adjacent 50 m deep monitoring bore holes. This allowed characterization of relations between stress, induced fractures, and rock fabric.

In 2018 a much larger project, the EGS (Enhanced Geothermal Systems) Collab project, began work on the 4850 Level of SURF. The EGS Collab is a small-scale field site where concepts involving modeling can be exercised and validated in a heavily instrumented site, and it is focused rock fracturing and permeability enhancement in crystalline rocks. Test Bed 1 on the 4850 Level proved to be of particular interest with respect to the interplay between the induced fracturing and the natural fractures present in the qtz-carbonate-mica phyllite of the upper part of the Poorman Fm. Figure 3 shows the eight 60 m long sub-horizontal boreholes drilled in Test Bed 1 along with the areas chosen to be hydraulically fractured. The green hole was the injection hole, the red was the production hole that was designed to receive the fluids and the yellow was the monitoring boreholes. The direction of the injector and production holes was informed by the results of the kISMET experiment that demonstrated that the minimum compressive stress was to the north and was nearly horizontal. This allowed the fractures (light blue) to be designed to be perpendicular to injector/producer.

Activities have now shifted to the 4100 Level where EGS Collab Test Bed 2 is planned for construction in 2021 and will consist of nine boreholes as shown in Figure 4. It will consist of one injection borehole, three production bore holes, and five monitoring holes, and the monitoring hole will be instrumented similarly to those in Test Bed 1 on the 4850 level. The primary focus of this phase of the project will be on stimulating existing fractures.
To date at least a dozen undergraduate and graduate students have participated in the project. This includes the work of Colton Medler (MS 2019) who used the Continuous Active Source Seismic Monitoring (CASSM) data acquired during the kISMET project to monitor the inflation/deflation of induced fractures. In addition, Carson Reimers expects to complete his M.S. during 2021 and has been developing a system for three-dimension archiving and analysis of drill core acquired during the various projects.

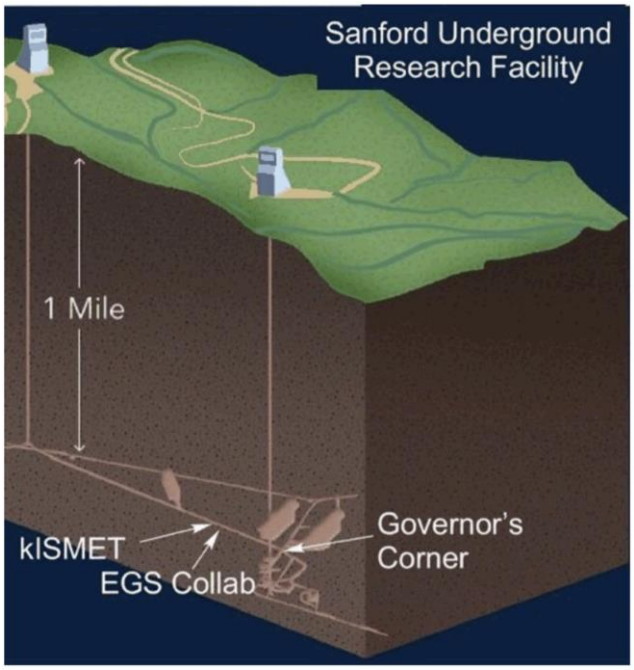


Figure 1. Location of the kISMET and EGS Collab (Test Bed 1) on the 4850 Level of SURF. The excavations in brown near Governor's Corner are the location of the large neutrino detectors that are scheduled to begin being constructed in 2021.

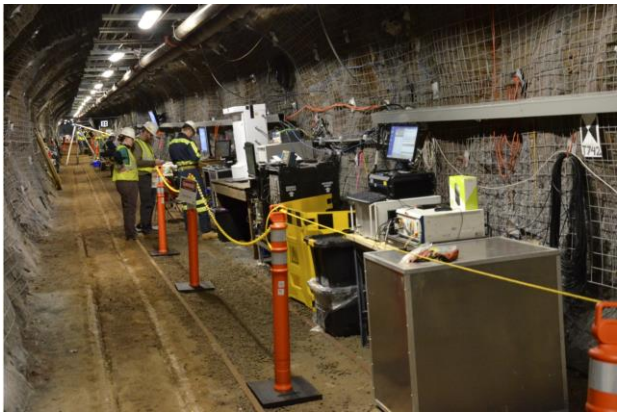
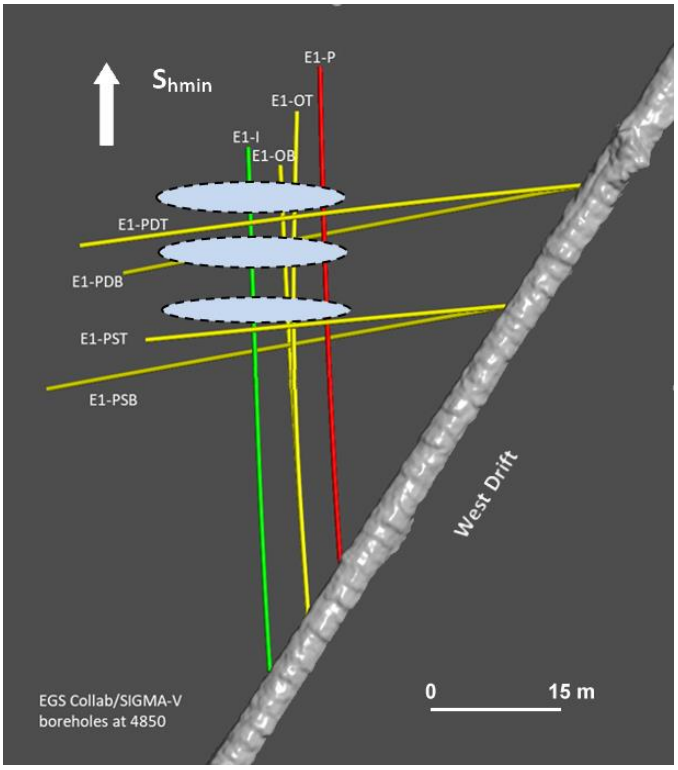


Figure 2. Pumping and monitoring instrumentation at the EGS Collab Test Bed 1 Location on the 4850 Level.



(ARMA 20-1900)

Figure 3. Location of the eight boreholes on the 4850 Level of SURF including E1-I (injection), E1-P (production), OT, OB, PSB, PST, PDT, and PDB. The boreholes have shallow angles with plunges varying between 4.8° and 25.1° downward. The predicted penny cracks (light blue discs) were designed to be perpendicular to the minimum compressive stress and to connect the injection and production borehole and are shown diagrammatically. The minimum compressive stress was assumed to be the same as the nearby kISMET determination of azimuth 002°, 9.3° downwards (Kneafsey and others, 2020; Oldenburg and others, 2017).

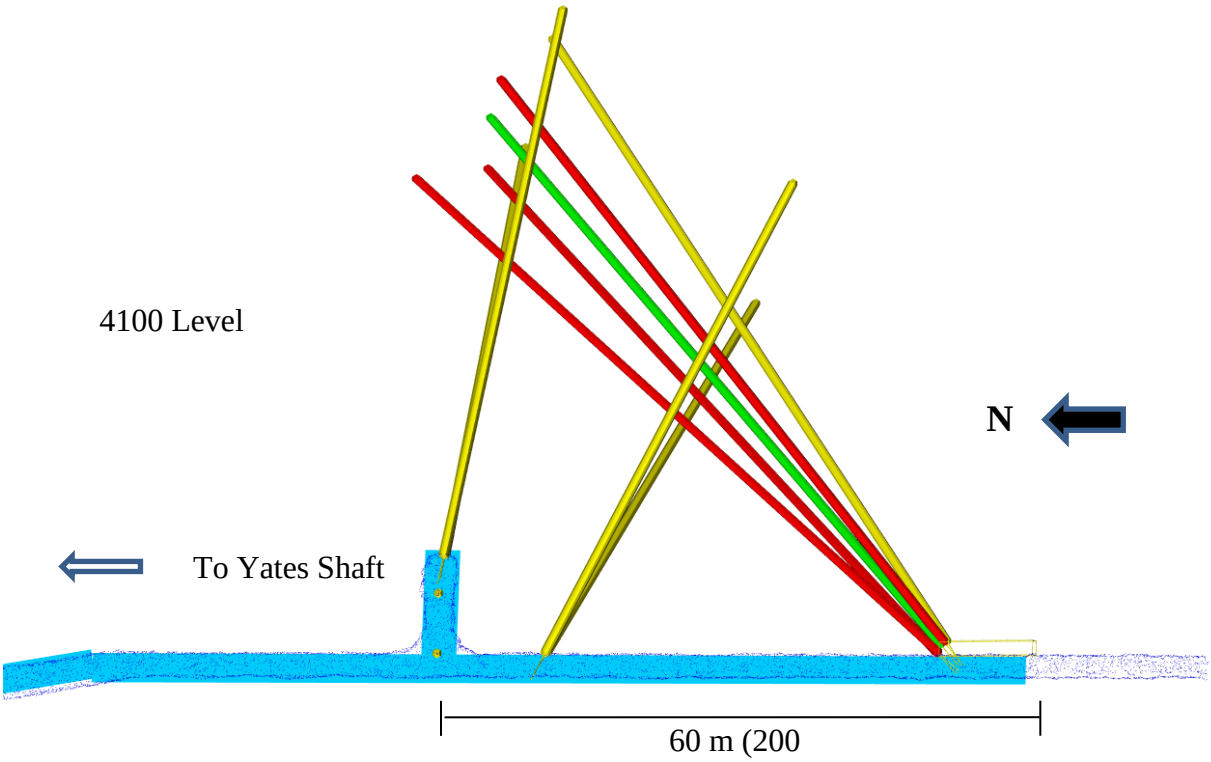


Figure 4. Location of the holes on the 4100 Level to be drilled in 2021 to establish EGS Collab Test Bed 2. The green hole shown will be the hydraulically fractured hole and the red bore hole will receive fluids from the injection through the fractures. The yellow holes will contain monitoring systems including microseismic, electrical resistivity (to monitor fluid movement), and distributed temperature sensing systems (DTS) using fiber optics that run next to the rock in the bore holes.

From our Emeritus Professors:

Arden Davis, Professor Emeritus of Geological Engineering

During the past two years, several of us worked on a project that involved the logistics of a water pipeline to bring Missouri River water to the Rapid City area. The work was sponsored by the West Dakota Water Development District. Dr. Kurt Katzenstein was the principal investigator, and others included Dr. Scott Kenner from civil engineering, the late Dr. Alvis Lisenbee, and three students, Haley Noteboom, Regan Wess, and Kaleb Hedman. Mark Anderson met with us frequently and gave invaluable assistance, after his recent retirement as district chief of the U.S. Geological Survey's Dakota Water Science Center. Syed Huq, Director of the Office of Water Resources for the Rosebud Sioux Tribe, also met with us and provided valuable help and advice. Syed received his M.S. degree in geological engineering from SDSMT.

Other work during the past year involved water resources in the Rockerville area of the Black Hills, water resources in the Caputa area east of Rapid City, and sand and gravel deposits near Caputa. Dr. Perry Rahn and I also have continued to provide information to property owners in the area who have questions about water wells and aquifers. Perry and I share an office in MI 327B of the Mineral Industries Building.

In late May the environmental field camp was delayed and later canceled because of health concerns. During the previous year, Mark Anderson and I team-taught the course. It was an enjoyable experience, and we hope to be able to offer the field course again in May of 2021.

The Western South Dakota Hydrology Conference was canceled last April, but we hope to hold the conference in April of 2021, either as an in-person meeting, a virtual meeting, or a hybrid of the two. Dr. Foster Sawyer, Dr. Liangping Li, and Joanne Noyes of the South Dakota Geological Survey are among those who serve with me on the planning committee with me. We hope to issue a call for abstracts soon.

Thanks to all who were able to stop by the campus or visit electronically in the past two years or more, including Jeff Sussman, Dennis Riding, Steve Mezger, Richard Arnold, Jonathan Emmer, Erik Walega, Abhishek Ray, Nakaila Steen, Jonathon Odland, Jonathan McKaskey, Janet Carter, Jeanne Goodman, Jim Goodman, Sherwin Artus, Barb Nielsen, Bill Eldridge, Stuart Buchholz, David Hammond, Bill Siok, Tim Wilcox, Steve O'Rourke, Scott Cooper, Joshua Valder, Todd Anderson, Joanne Noyes, Scott Miller, Roberta Hudson, Kathleen Grigg, Jay Nopola, Ray Wuolo, Mitch Kannenberg, Andy Farke, Greg Goeser, Joy Lester, Mark Fahrenbach, Brian Fagnan, Crystal Hocking, Syed Huq, Bill Engstrom, Brad Stock, Matt Minnick, Scott Letasi, Harrison Costello, Tim Thomure, Kristin Pratscher, and many others. As always, my apologies for anyone I left off. Please stay in touch.

Colin Paterson

In December, we left the US for our annual summer in New Zealand, and we are still here 1 year later –no Covid-19 here (except at the borders in quarantine), and life is normal, so no reason to return to South Dakota just yet, at least until April 2021. We have kept in touch with the department though through the Friday afternoon seminars followed by happy hour, all over Zoom. Dr Kelli McCormick and I have continued to advise the Society of Economic Geologists student chapter, and a new slate of officers was elected in September. They continued to conduct monthly meetings by Zoom, mostly presented by current students reporting on summer internships in the mining industry. Kelli McCormick (presenter), Kevin Chamberlain (U. Wyoming) and Colin Paterson gave a paper at the Annual Meeting of the GSA on "A new U-Pb baddeleyite crystallization age of a Corson diabase sill at the type locality, eastern South Dakota, U.S.A., suggests widespread early ca.1140 Ma phase of Mid-Continent Rift magmatism".

Perry Rahn

Perry Rahn reports: I'm well and still active at my log house along Slate Creek. I'm certainly "socially distant".

From the Faculty:

Ed Duke

In addition to his role with the Department of Geology and Geological Engineering, serves as Director of the Engineering and Mining Experiment Station (EMES) of SD Mines. The EMES was founded on the Mines campus in 1903 with a mission to serve the mining industry research. Today the mission has expanded to include a much broader range of academic and industry needs.

This year EMES is making major upgrades in two of its most important laboratories. A new X-ray diffraction system was installed in December 2020 with support of a South Dakota Board of Regents grant totaling $186,471. In addition, EMES collaborated on an NSF Major Research Instrumentation proposal for a new focused ion beam scanning electron microscope (FIB-SEM). The proposal was funded for $1.28 million. The team of investigators hopes to finalize an order for the new system in January 2021, and have the system installed by early summer. Addition of a focused ion beam dramatically expands its capability over the current SEM system. The ion beam allows researchers to extract samples for separate analysis in a transmission electron microscope. The ion beam also can be used to mill into sample and obtain high resolution 3D imaging or compositional mapping.

The new Malvern Panalytical Empyrean diffractometer installed in EMES.

Kurt Katzenstein

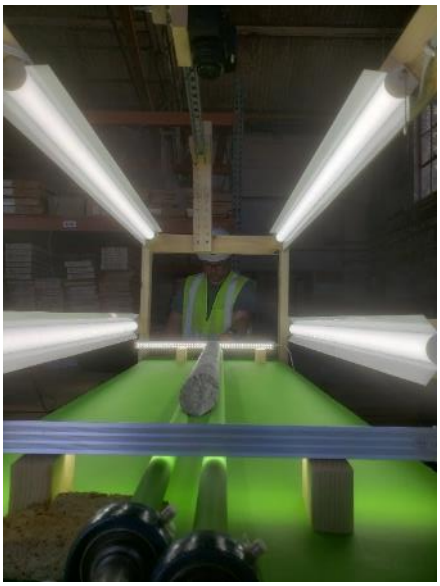
I am happy to say that 2020 is almost over! While the Katzenstein family navigated this unique year fairly well (only 40% of us caught COVID-19!), it will be nice to look towards next year where life will, hopefully, begin to slowly return to normal. Our three daughters, Brianne (10) and Hannah (9), and Leslie (6) all enjoyed playing both soccer and basketball this year and our two oldest also are learning to play the viola and violin. Unfortunately, my annual backpacking trip in the Sierra Nevada was canceled due to COVID which was a real disappointment as it was going to be the first year that Brianne planned on joining. However, I have promised her some sort of trip during the summer of 2021 come what may. One benefit of our COVID summer was that we focused on making memories around and the house and in the Black Hills by playing board games, baking, gardening (when it wasn't hailing), playing board games, beekeeping, camping, playing board games, riding our bikes on the Mickelson Trail, playing board games and hiking (we also played lots and lots of board games).



Unfortunately, with COVID dictating all aspects of our lives we had to cancel the Geology Rocks summer youth camp this year. I look forward to restarting it this coming summer assuming things progress the way we all hope they will with the ongoing vaccine effort. Prior to the current social distancing requirement, I took part in multiple outreach events including the annual Women in Science Conference and Engineer's Week events at SD Mines, the Sturgis Brown Career Fair, A Women In Science and Engineering event at South Middle School, and the STEM Careers Night at Central High School As usual, the sediment flume and the augmented reality sandbox were big hits. Dr. Foster Sawyer and I continued the annual ice fishing event in February. Amazingly, we actually had relatively comfortable weather this year which was a nice change after the previous year's -5 degrees with a stiff 20 mph breeze.


On the research front, I had three graduate students working on interesting projects. Brittany Coupe if investigating the role that large-scale slope failures have played in the evolution of the Cretaceous Hogback surrounding the Black Hills. Frank Torvik is working to better understand the role that is played by solar incidence angle on rockfall triggering. Carson Reimers is

developing a method by which we can create high-resolution 3D models of rock core using photogrammetry. All three of these students are hoping to graduate in the Spring of 2021. I was also part of 6 proposals/pre-proposals to investigate a wide variety of topics such as thermal expansion in underground mines, mine blasting fume dispersion, three-dimensional core model development, and other topics. Unfortunately, only one of the smaller proposals was funded this year but we press on!



Here's hoping you are coping well with all that is going on and that you will thrive once again as things return to normal in 2021!

Sarah W. Keenan

2020 has presented all of us with unique challenges both on campus and in our personal lives. Any reflection on the year goes along with a cloud of pain, loss, despair, loneliness, hope, gratitude, and inspiration. I could write for pages focusing on the negatives of the past year, but we're all in this together. So instead I will focus on positives and the good things to come out of 2020.

The students at Mines found ways to adapt to the abrupt shift to remote learning in the Spring. In my geomicrobiology class, the students were able to complete their semester remotely, including a semester-long project (Winogradsky Columns or microbial ecosystems in jars, pictured above). Despite the distance, we managed to stay connected. I was impressed with how quickly and efficiently students were able to transition to a completely different world and learning style.

In the spring, my partner (Dr. Beeler in EMES) and I bought our first house. I spent part of my summer doing fun things around the house like removing wallpaper from the 1970's and putting our new miter saw to good use cutting and installing trim. We also welcomed a puppy (Stella) to our family. I also participated in the Teaching Online 101 class offered by Mines this summer in preparation for the Fall semester.

Fall 2020 presented a new set of challenges as well as a return to campus. I taught quantitative methods in paleontology (graduate-level), physical geology, and co-taught introduction to GGE and MEM with Kurt. The combination of in-person and hybrid classes made us all very familiar with the use of Zoom, and I was once-again amazed at how students were able to adapt to this new learning environment. While we couldn't go out for a local field trip in physical geology, many of the students went on their own geology adventures in small groups, bringing back photos of their discoveries to class. This semester I also welcomed three new MS Paleo students to our program, and two undergraduates working on their senior research theses. 2021 is shaping up to be very busy!

I was able to publish two papers in 2020, both with female graduate students from other institutions as lead authors!

- Emmons, A.L., Mundorff, A.Z., **Keenan, S.W.,** Davoren, J., Andronowski, J., Carter, D.O., and DeBruyn, J.M. (2020). Characterizing the postmortem human bone microbiome from surface-decomposed remains. *PLoS ONE*, 15(7):e0218636, DOI:10.1371/journal.pone.0218636.
- Fanter, C.E., Lin, Z., **Keenan, S.W.,** Janzen, F.J., Mitchell, T.S., and Warren, D.E. (2020). Development-specific transcriptomic profiling suggests new mechanisms for anoxic survival in the ventricle of overwintering turtles. *Journal of Experimental Biology*, 223, DOI: 10.1242/jeb.213918.

Wishing you all a happy, safe, healthy, and joyful 2021!

Liangping Li

Alumni and friends, Happy New Year and Merry Christmas! In 2020, I continued teaching Groundwater course (GEOE/CEE 475/575L) for undergraduate and graduate students in fall and spring semesters. I also taught a new required course for geological engineering major in fall: GEOE 456/556/L: Statistical Methods for Geology and Geological Engineering. As geosciences enter the new era of big data, it is essential for students to master basic data analysis skills to be successful. With the latest 2018 Status of the Geoscience Workforce Report, geoscience employers found that new graduates are deficient in analytical and programming techniques. This course will fill a current gap in the teaching of advanced techniques for collecting data, such as porosity and permeability and for analyzing those data. In this course, I focus on the application of statistical methods for geological engineering and geology. Besides the traditional geo-statistical methods, this course also covers trend analysis, clustering analysis, machine learning, and principal component analysis. In addition, hands-on exercises using Excel and Python programming are included in the lab sections.

My research foci have been expanded to apply machine learning and artificial intelligence to address earth resources issues. My master's student Jichao Bao, under my supervision, has published our first paper about machine learning applied in the groundwater science, entitled "*Coupling Ensemble Smoother and Deep Learning with Generative Adversarial Networks to Deal with Non-Gaussianity in Flow and Transport Data Assimilation*" in the *Journal of Hydrology*. In this work, we use deep learning to reduce the number of parameters in a groundwater model, which will assist model calibration in complex geological formations. With the preliminary results, I submitted a proposal entitled "*Using Deep Learning to Quantify Conduits for Understanding Flow and Transport Processes in Karst Aquifers*" to the NSF Hydrologic Science program for potential funding in June 2020.

I published four papers *(<u>underline</u> Corresponding author; * Student advised)*:

1. J, Bao*., **<u>Li, L</u>**., and F, Redoloza* (2020*) Coupling ensemble smoother and deep learning with generative adversarial networks to deal with non-Gaussianity for flow and transport data assimilation*. Journal of Hydrology. doi.org/10.1016/j.jhydrol.2020.125443 **[Impact Factor: 4.4]**

2. Lan, T., Shi, X., Chen, Y., **Li, L**., Wu, J., and Duan, L., (2020) *Identification of non-Gaussian parameters in heterogeneous aquifers by modified probability conditioning method through hydraulic head assimilation*. Hydrogeology. Accepted. [**Impact Factor: 2.6]**

3. Redoloza, F*, and **<u>Li, L</u>.** (2020) *A comparison of extremal optimization, differential evolution, and particle swarm optimization methods for well placement design in groundwater management*. Mathematical Geosciences. doi.org/ 10.1007/s11004-020-09864-3 **[Impact Factor: 2.0]**

4. F, Cui., J, Bao., Z, Cao*., **Li, L**., Q, Zheng (2020) *Soil hydraulic parameter estimation using groundwater penetrating radar data via ensemble smoother with multiple data assimilation*. Journal of Hydrology. doi.org/10.1016/j.jhydrol.2020.124552 **[Impact Factor: 4.4]**

Stratobowl Rim Trail, Black Hills

Tim Masterlark

Jefferson Science Fellow

The year 2020 was extraordinary in many ways. I was selected by the US National Academies of Sciences, Engineering, and Medicine to serve as a Jefferson Science Fellow. I am the first Professor from South Dakota to earn this prestigious distinction. The multi-stage selection process included essays, briefing memos, peer recommendations, a week-long interview session with US Department of State (DoS) officials and achieving a Top-Secret clearance. I will spend 2021 assigned to the Special Programs Team within DoS/Bureau of Diplomatic Security/High Threats Program. I am tasked with security assessments of US Embassies and Consulates in high-risk locations. My activities will span everything from theoretical numerical analyses to on-site field observations and tests.

The sandbag has been a constant companion during my journey to Kokoro 57 in 2020. Lifting, carrying, dragging, tossing, or simply holding for endless intervals. South Dakota's climate, coupled with the Black Hills and Badlands, provided a perfectly miserable mix of opportunities to train with ice, snow, cold, wet, filth, and intense heat. Leave the Gore-tex and fancy equipment at home. Embrace the suck.

Book

During this past year, I spent some time reflecting on my career. With a long list of publications, several millions-of-dollars in grants, and a leadership role in earthquake and volcano deformation research, I am faced with a particularly difficult question -*What's Next?* It turns out that the answer to this question is staring me in the face. At conferences and workshops, my colleagues invariably ask if I would help their students get started with finite element models. Dr. (Jay) Tung, a former and *incredibly* productive postdoc at Mines, expressed similar experiences. In response to these requests, Jay and I are now well on our way with writing our book: "*Designing Finite Element Models for Earthquake and Volcano Deformation*". This book is eagerly anticipated and will likely serve as a catalyst for new advanced undergraduate and graduate courses world-wide.

Kokoro

I spent the past two years training for SEALFIT's Kokoro crucible. This 52-hour test of mental and physical toughness (sleep deprivation is part of the test) is the most challenging experience of its kind in the world. I was selected to attend Kokoro Class 57, scheduled for July, 2020. Alas, Class 57 was postponed indefinitely, due to the close-quarters severity of tasks and pandemic considerations. My first thought at this cancellation was "two years down the tubes". But there is a silver lining to this story. I realized that it is the journey, not the destination, that matters. My training regimen was brutal and uncompromising. Whether or not the crucible becomes available in the future is irrelevant. I will continue on this path and let the discipline, confidence, and joy of overcoming obstacles propagate into every corner of my life. Want to know more about this journey? Follow me on Facebook for a daily dose of inspiration.

Roger Nielsen

Clearly, this has been a year without precedent in every aspect of our professional and personal lives. For me, it has made me grateful that I am predominantly an experimentalist and theoretician. That means that I can do most of my research from my recliner. In fact, this has been an unusually productive year, with two newly funded projects in data science and three papers that I finally got out the door. It has also made me anticipate work that I will be able to pick up as we all "get our shots". I may actually be tempted to do something extreme, like occasional field work.

More realistically, I am working with Dr Ustunisik and colleagues at Woods Hole Oceanographic Institute on a proposal to investigate the role of volatiles in the production of magmas in the upper mantle. This research will involve work on a type of mid-ocean ridge lava – plagioclase ultraphyric basalt (PUBs). These lavas are key to our understanding heat and mass transfer in the largest igneous environment on the planet – where over 70% of the earth's crust is generated – and without which, there would be no tectonics, making this a much more boring place to be a geologist.

Darrin Pagnac

Happy Holidays, alumni!

What can be said? 2020 has been an extremely interesting and challenging year. EVERYTHNG we've done has been affected, indeed dictated, by safety concerns over the COVID-19 outbreak. Personally, I have still managed to stay productive, but in a limited capacity.

Field work during the summer of 2020 was effectively halted. However, as my annual work on the Missouri River is funded by the Department of Defense (US Army Corps of Engineers), my crews were deemed "essential". How field paleontologists become "essential workers" is beyond me, but hey, it got us into the field!

We spent a month working out of Chamberlain, SD. We had to take extreme precautions to prevent the spread of COVID-19. We constantly social distanced, and when we couldn't, we wore face masks and gloves. We were only able to prospect and document specimens in 2020, as any excavation would necessitate working in close proximity for extended periods of time. As usual, we documented several great specimens from the Cretaceous Western Interior Seaway from the Pierre and Niobrara formations, including the little gem you see to the right…

How some of the things we find on the river get there is a mystery…

While we thought the start of fall classes might usher in a bit of a return to normal, it was not meant to be. Courses were held either distanced via Zoom, or in a hybrid fashion with half the students attending in person, half via Zoom, swapping each class period. For the most part this worked out alright, especially regarding lecture sections of courses.

Our new field methods course, GEOL 323L, commenced this fall. Fortunately, I already had experience with COVID precautions in the field during August, so continuing these measures in September with this new laboratory course went fairly seamlessly. The lab course is an introduction to field methodology. The first weeks included exercises intended to familiarize students with the Brunton compass, the Jacob staff, and detailed rock descriptions.

Students logging section in the Sundance Formation.

We then endeavored to log two stratigraphic sections. Both were fairly straightforward as most students had not logged any section. We visited outcrops of the lower Cretaceous Lakota Formation near Piedmont, SD, and a great exposure of middle Jurassic Sundance Formation near Hermosa, SD. The students thoroughly enjoyed the section of Sundance Formation, pictured to the left, as it contained excellent examples of sedimentary structures like ripple marks, and numerous examples of fossil starfish.

A look into a virtual world of geologic mapping.

I wanted to provide the students with a capstone experience for the end of the field lab. This was, however, quite challenging, given quarantine restrictions and late-season weather conditions. I finally settled on a "virtual" geologic mapping application produced by the University of Leeds in the UK, figured to the left. The application is a sort of "video game" where students wander around a virtual landscape documenting the nature of rock outcrops. They then plot lithology on a topographic map and ultimately produce a geologic map of the virtual region. It proved to be a workable facsimile for a capstone experience, and the students loved it!

I'm looking forward to a vaccine and getting a back to "normal", whatever that may mean for the future. Hopefully we will be back in the field and teaching in a normal capacity soon.

Best wishes for a happy and healthy holiday season and a, hopefully, better 2021!

Curtis Price

http://webpages.sdsmt.edu/~cprice / curtis.price@sdsmt.edu

Wow, this year has been a challenge, starting with our abrupt jump to 100% online after spring break in March. I feel fortunate because much of what I teach is technology-centered enough that screen-sharing on Zoom works well. In fact, for my Intro to GIS lab, working online is easier than leaning over student shoulders to help them wrangle GIS software into doing what is needed. In contrast, adapting to the virus was not as straightforward with my surveying course (GEOE 201L), where we work with equipment hands-on in teams. Fortunately, South Dakota Mines students are resilient, and team players, so we did very well, working masked out on the quad during our labs, and the few students that were positive or exposed cheerfully attended online and returned when their quarantine was completed. I half-jokingly say that Mines students did well because after taking calculus they have an understanding that even things you can't see can be absolutely true! Thanks to students wearing masks, sanitizing hands, and distancing we didn't have to leave campus earlier than planned, at the Tuesday before Thanksgiving. The entire Mines community should be very proud.

Many of us had the opportunity to take several online classes over the summer to gain new skills for teaching online (led by Mines faculty). This training really helped me with developing online content. This really helped me when GEOL 420/520 (Remote Sensing) this fall entirely online. There were readings, labs, interactive discussion, all "asynchronous" – we had only one live meeting online for student presentations. The student surveys aren't in yet, but I think it went well. However, I am very much looking forward to teaching this course in person again next time because there is great learning value in working with old-school air photo stereo pairs, and we also missed our traditional field day collecting and processing UAV (drone) imagery with Dr. Katzenstein!

This fall, my turn came up for our GGE department rotation for a teaching review. My GGE faculty colleagues visited my GEOL 419 Advanced Spatial Analysis lecture and reviewed my course materials, including assignments and exams. Honestly, I approached this with no small amount of trepidation, but the comments I got were very helpful and will improve the class. Thank you, Drs. Li, Duke, and Keenan for your time and dedicated efforts!

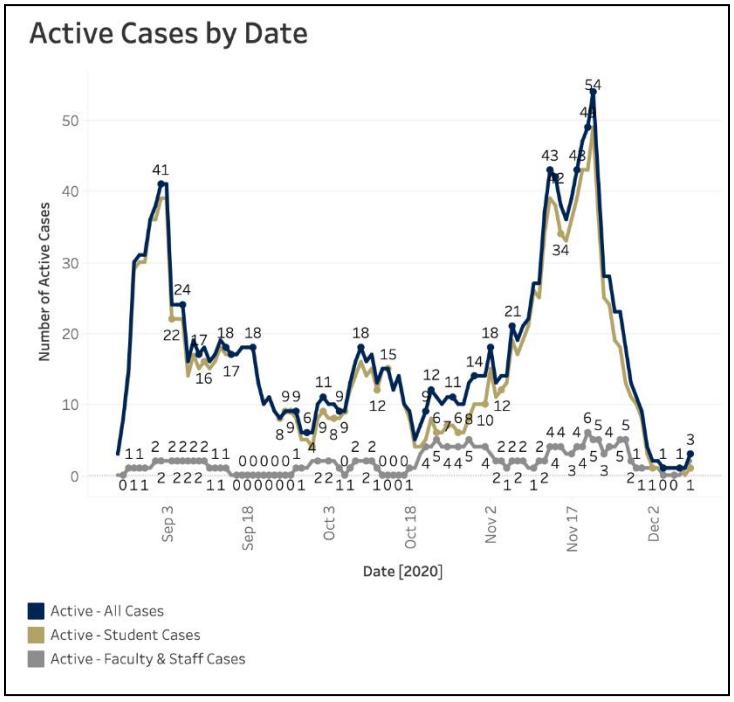
This year I have had the pleasure of arranging the Friday GGE seminars, which have been held entirely on Zoom to promote social distancing. On the plus side, this has allowed friends of Mines near and far to attend our talks on many interesting topics. We've had audiences of 40 to 70 people. You can see seminar notices and attend http://sdsmt.edu/GGEseminar -- hope to see you on a Friday soon!

This December marks the end of my fourth year in teaching at South Dakota Mines (I started in Jan 2017 teaching as an adjunct professor, and full time Jan 2018), so it occurs to me that there

are now more than a few of my former GIS students reading this newsletter. Drop me a line; we all love to hear “news from the road.”

Stay safe this holiday season. I hope we can very soon have all of you come back and visit campus and catch up.

Price’s GEOE 201L students (safely) collecting GPS data out on the quad, on a very warm November 8, 2020.



COVID cases on South Dakota Mines campus, Fall 2020.

Foster Sawyer

Season's greetings and warm regards to the students, alumni, and friends of the Department of Geology & Geological Engineering! It's been quite a year but I'm happy to report that the Department has come through approximately nine months of a global pandemic relatively intact. Now that vaccines are becoming available it's my sincere hope that things will be back to some semblance of normalcy in the coming months.

The biggest news of the year was probably the abrupt move to online status for courses and all other academic activities last spring when the pandemic swept the nation. It actually forced me to install a satellite system at my cabin in the hills which is earth shaking news in itself! Once we made it through the spring semester our attention turned toward moving all or portions of our summer field classes to virtual formats. Our traditional field geology course (GEOL 410) was divided into a virtual introductory three-week course followed by an in-person three week field experience (please see photos below), and I am happy to report that both components went well and we had no incidences of students contracting COVID-19. The Petroleum Field Camp that I also teach was moved to an online-only status, and I was pleased that we were able to transfer all

Clockwise from upper left: A cohort of students in the face-to-face module of Field Geology in 2020, view of Bear Butte from Elkhorn Peak, field mapping in the Black Hills, students learning to measure section in strat/sed lab.

regular course components to virtual formats and the students indicated that they enjoyed the course although all of us were disappointed that we had to forego the flagship field trip to Alcova Reservoir and other points of interest in central Wyoming!

The fall semester continued under unusual circumstances as we held face-to-face, hybrid, and online courses depending on the size and nature of each class. Face-to-face courses were held under CDC guidelines which meant widely spaced seating, masks, and other precautions that appeared to help tremendously since we had relatively few viral infections among the student body and faculty. I did have several students in quarantine throughout the semester and one student who tested positive after being in a van on a field trip (all subsequent field trips for that course were cancelled). Courses for the spring 2021 semester are scheduled as face-to-face, and all of us will do our utmost to help the students have excellent experiences as we continue to contend with unusual circumstances due to the pandemic. Although classes and other student activities have been challenging, it has been an honor to assist in whatever way possible in bringing the Department and the university through the pandemic in good shape and ensuring that our students receive quality instruction and outstanding educational opportunities. Thanks to everyone working together, and especially the efforts of students and faculty, the Department is doing well and is moving forward toward an exciting future!

Student research is always a highlight for me, and this year I am extremely pleased to report that two doctoral candidates under my advisement are planning to defend their dissertations during the upcoming spring semester. Lilly Jones will defend her dissertation related to aquifer vulnerability mapping on the Pine Ridge Reservation, and Jennifer Bednar also will defend her dissertation pertaining to groundwater/surface water interaction in semi-arid regions such as the northern Great Plains. Undergraduate/senior thesis research with which I am involved includes working with Garrett Fedora on a subsurface modeling project at Salt Creek Dome, Wyoming, and working with Chris Patterson on a petrographic investigation of the Niobrara Formation in southwestern South Dakota. All of these students exemplify the outstanding quality and caliber of the student body within the Department and the School of Mines overall, and it has been a distinct pleasure to work with each of them.

On a bittersweet note, I must report that this will be my last newsletter submission as an Associate Professor in the Department as I have decided to take early retirement in June 2021. I want to sincerely thank our incredible students and alumni, as well as my outstanding colleagues, for all of the support, friendship, and wonderful memories over the past twelve years. What a treasure to have had these experiences. I will greatly miss all of you.

Wishing each of you a successful, healthy, and enjoyable year in 2021,

Sincerely,

Foster

Larry D. Stetler

2020 was a year of uncertainty. In-person classes were cancelled after spring break in March. While this had smaller impact on lecture-style courses, it had a high impact on the geological engineering design course. After spring break, we were scheduled to go to the field for collection of samples that were to be analyzed in the EMES labs using XRF, XRD, and SEM. This all had to be cancelled. I spent 2 weeks looking up old analytical data I had in my files so that re-written design projects could be given to the 4 teams to do some analysis of the geochemical results. Their results were good, but the students, unfortunately, missed out on the unique opportunity of collecting samples and using the analytical instruments themselves to collect geochemical data.

The summer GeoE 410 Engineering Field Geology course was cancelled and replaced with two separate online courses for the six-credits. The 1st 3-credits were a general stratigraphy and mapping course. The engineering portion consisted of a 3-credit online 'field' course that relied heavily on Goggle Earth and maps. It was not the best situation for the students not being able to get into the field, but it was somewhat satisfying knowing that the field work could be minimally replicated online. Students were, at the least, able to experience the engineering analysis we do during the full 6-credit course in a normal summer. In fall 2020, we did have in-person classes, albeit with particular guidelines as to room occupancy, etc. I had one student with confirmed covid and two others who were quarantined. Overall, it was not a major impact on the course as all lectures were presented using Zoom when students were unable to attend.

Research was focused across a few fronts during the year. I have been working on a soil genesis project in the Black Hills and had prepared collected field samples for geochemical analysis that was to begin after spring break. After classes were cancelled, this lab work was unable to be completed. I was able to spend some time in the field furthering my erosion study at Badlands National Park. Also, a former Ph.D. student and I were able to continue working on some fundamental geomorphic problems in the Black Hills.

One paper and one book chapter were published in 2020. The paper, *Cenozoic Geomorphic Evolution of Fluvial Landscapes in the Black Hills, SD*, is currently in press in volume 99 of the South Dakota Academy of Science. The book chapter *Erosion by Wind: Principles* was published as chapter 16, Section II COV: Comparative Overviews of Important Topics for Environmental Management, in Volume 3: Managing Soil and Terrestrial Systems, in Environmental Management Handbook, Second Edition, by CRC Press.

I can be contacted for a full electronic copy.

I have two manuscripts in preparation for 2021 publications. One is a decadal erosion analysis of Badlands slopes and the second is a ~50-year historical review of the 1972 Rapid City flood.

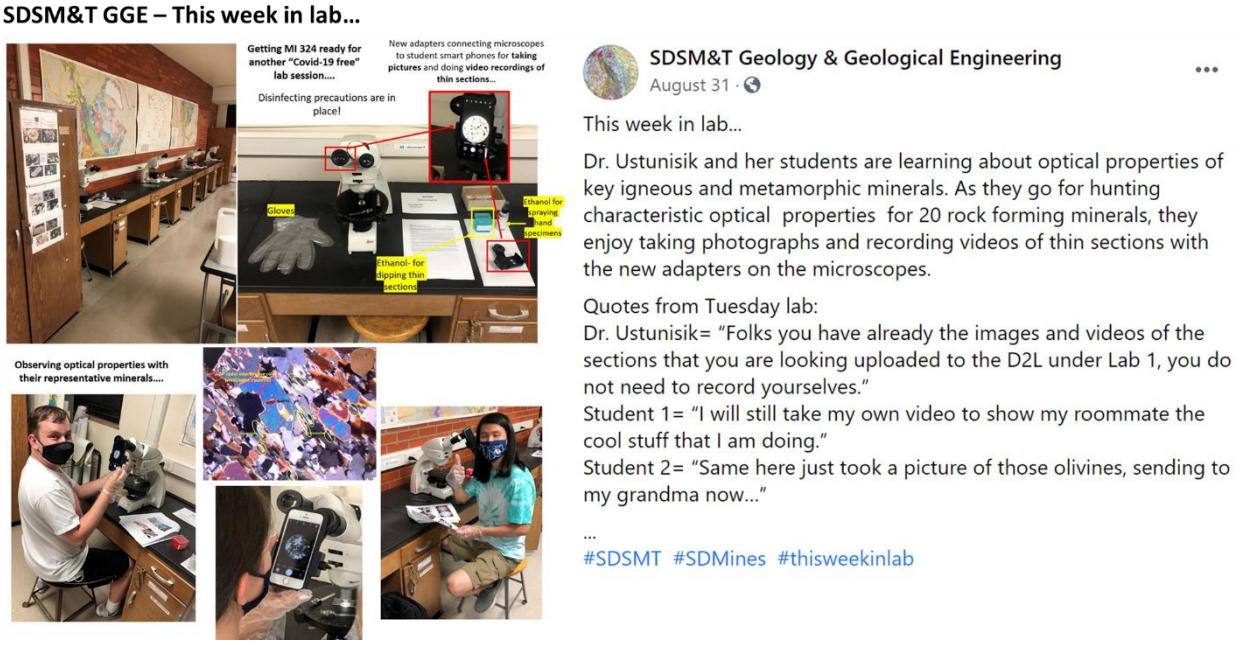
Currently I am advisor for 1 Ph.D. GeoE student, 1 Ph.D. Geol student, and 1 M.S. GeoE student.

Gokce Ustunisik

Alumni and friends,

Merry Christmas and Happy New Years! Spring and Fall 2020 will likely go down in history...but, it is hard to describe...you had to have been there… Part of me says "Where did this year go?" and other side says, "My goodness, January 2020 felt like a very long time ago with the new reality of our lives - "Covid-19"..

I continued to teach 2 core GGE curriculum courses - "Igneous and Metamorphic Petrology" in the Fall, "Mineralogy and Crystallography" in the Spring in addition to my 2 graduate courses "Volcanology" and "Planetary Geology". After Spring break, the shift to online teaching was a challenge for many of us. At the end, it served me as an opportunity to improve my course materials with incorporation of many excellent teaching tools (e.g. Virtual microscope, 3D scans of mineral and rock specimens) and emphasized the benefits of teaching and learning in an online environment. Now Mineralogy and Petrology collection have a digital repository (photograph, video recordings, thin section images, thin section recordings) of 100 minerals that was useful for teaching Petrology in the Fall in hybrid mode (lectures- synchronized online, labs - in person). In spite of the pandemic's crush, our students seemed eager to learn and engage to the best of their ability over zoom sessions. For my undergraduates, the assignments were done (on time!), presentations were made (sometimes on short notice!), chapters and papers were read, lectures were attended, and lab assignments were completed.



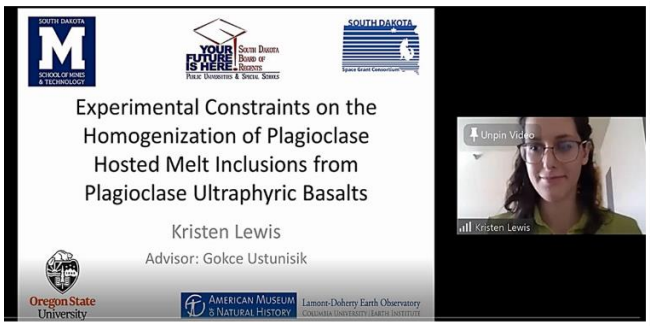
On the graduate student side: 2 of my graduate students (Kristen Lewis and Taran Bradley) successfully defended their MS thesis in Spring 2020. Kristen accepted a fully funded PhD offer to continue her work in study of plagioclase- and olivine-hosted melt inclusions at the University

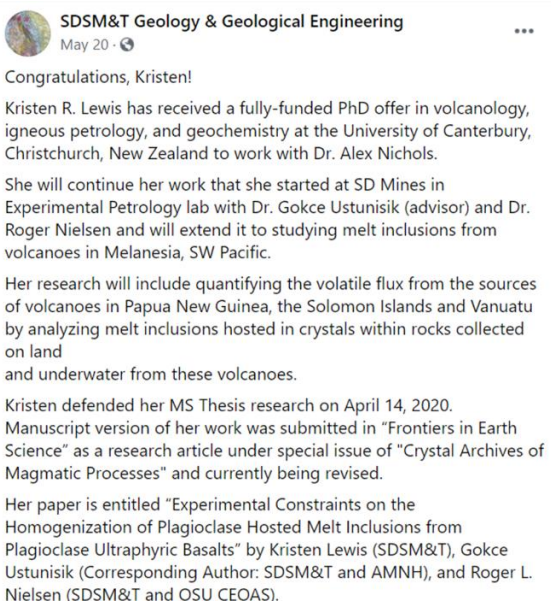
of Canterbury, New Zealand. She published a paper from her thesis work in Frontiers in Earth Science under the special issue of "Crystal Achieves of Magmatic Processes". Taran is currently working on graduate school applications. 2 new students joined to my research group. Erica Cung from University of California - Santa Barbara started her MS degree in the Fall along with one of our seniors, John Hewitt who started his accelerated MS degree. My students and I published 2 peer-reviewed papers:

- Lewis, K., **Ustunisik, G.,** and Nielsen, R.L. (**2020, In-Press in Frontiers of Earth Sciences**) Experimental Constraints on Homogenization of Plagioclase Hosted Melt Inclusions from Plagioclase Ultraphyric Basalts. **Impact factor 2.69**.
- Nielsen, R.L., **Ustunisik, G**., Lange, A., Tepley III, and Kent, A.J.R., 2020, Trace Element and Isotopic Characteristics of Plagioclase Megacrysts in MORB Plagioclases Ultraphyric Basalts (PUBs). *Geochemistry, Geophysics, Geosystems*. **Impact factor 2.98**.

and 4 oral presentations in virtual Goldschmidt conference in June 21-26, 2020. (Virtual conferences - quite an unusual experience!):

- **Ustunisik, G**., Nielsen, R. L., and Walker D. The Missing Magmas of MOR.
- Nielsen, R. L. and **Ustunisik, G**. An Alternate Perspective: Plagioclase Megacrysts and their Inclusions. (Invited Presentation).
- Lewis, K., **Ustunisik, G**., and Nielsen, R. L. Experimental Constraints on the Homogenization of Plagioclase Hosted Melt Inclusions from Plagioclase Ultraphyric Basalts.
- Lehnert, K.A., Antoshechkina, P., Block, K., Ghiorso, M., Grossberg, M., Ji, P., Nielsen, R. L., Profeta, L., **Ustunisik, G.**, Walker D, and Wolf A. (Next Generation Cyberinfrastructure for Geochemistry & Petrology: Connecting Data (EarthChem) and Models (ENKI).




SDSM&T Geology & Geological Engineering
May 20 ·

Congratulations, Kristen!

Kristen R. Lewis has received a fully-funded PhD offer in volcanology, igneous petrology, and geochemistry at the University of Canterbury, Christchurch, New Zealand to work with Dr. Alex Nichols.

She will continue her work that she started at SD Mines in Experimental Petrology lab with Dr. Gokce Ustunisik (advisor) and Dr. Roger Nielsen and will extend it to studying melt inclusions from volcanoes in Melanesia, SW Pacific.

Her research will include quantifying the volatile flux from the sources of volcanoes in Papua New Guinea, the Solomon Islands and Vanuatu by analyzing melt inclusions hosted in crystals within rocks collected on land
and underwater from these volcanoes.

Kristen defended her MS Thesis research on April 14, 2020. Manuscript version of her work was submitted in "Frontiers in Earth Science" as a research article under special issue of "Crystal Archives of Magmatic Processes" and currently being revised.

Her paper is entitled "Experimental Constraints on the Homogenization of Plagioclase Hosted Melt Inclusions from Plagioclase Ultraphyric Basalts" by Kristen Lewis (SDSM&T), Gokce Ustunisik (Corresponding Author: SDSM&T and AMNH), and Roger L. Nielsen (SDSM&T and OSU CEOAS).

2020 was an exciting year for grant funding. I finalized work toward the research objectives and formally closed-out an **NSF-OCE** grant partnered with Columbia University "IEDA 2016-2020: Operation of a Multi-Disciplinary Data Facility for the Earth Science Community". This project also partially funded a post-doctorate researcher Jay Tung and my graduate student Kristen. This year, I submitted 5 new proposals to NSF, NASA, and SD Board of Reagents - 4 as a Principal Investigator (PI) and 1 as a co-Principal Investigator (Co-PI) and got funded on 4:

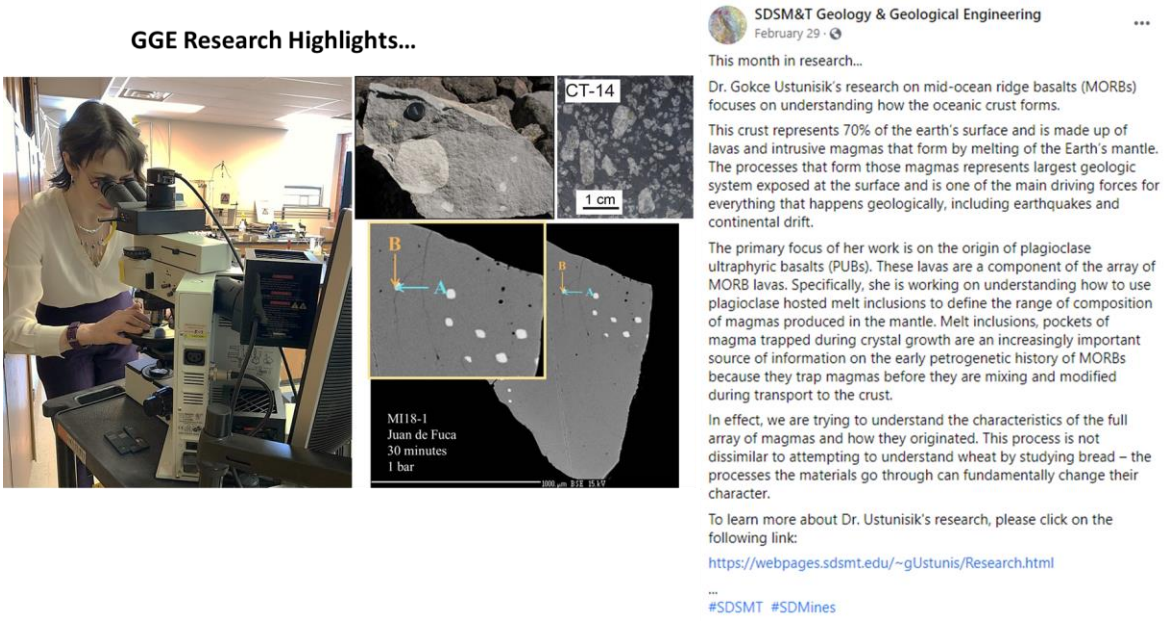
- **NSF EarthCube** Earth Cube Data Capabilities: A Data-Driven Modeling Infrastructure to Support Research and Education in Volcanology, Geochemistry and Petrology.
- **NSF Geoinformatics** Collaborative Research: EarthChem & SESAR - Data Infrastructure for Geochemistry and Earth Science Samples Communities.
- **NSF CBET** NSF 2026: EAGER: Accelerated Carbon Mineralization Sequestration in Cation Rich Rock Formations via Microbial Augmentation And Stimulation.
- **SD BOR Competitive Research Grant Program** Understanding the Mantle Carbon Budget: Insights from Melt Inclusions.

With the new funding, I am currently working on recruiting PhD students to join my lab.

Nowadays, we are conducting virtual graduation ceremonies with the hope that graduates will join any future commencement ceremony to receive their degree in person. Fall 2020 Commencement will premiere on the university's YouTube page https://www.youtube.com/user/gotomines on December 19, 2020 with the congratulatory remarks of Drs. Anderson, Katzenstein, Keenan, and I.

Also, do not forget to check out our "This week in lab" and "GGE Research Highlights" Facebook pages which were put together by our own Dr. Pellowski:

https://www.facebook.com/SDSMTGeologyGeologicalEngineering/?ref=page_internal



Best wishes to you and yours for a happy and healthy holiday season and lots of hopes for 2021!

From Black Hills Natural Sciences Field Station (BHNSFS) and Nuri Uzunlar:

The BHNSFS is the world's largest field school offering summer and winter camps in earth science and related engineering fields including geology, geological engineering, environmental geology and engineering, volcanology, and geomorphology on six continents.

It has been a strange and difficult year for me and the field station. In March, most of the colleges and universities shuttered their doors, sent their students home, and transitioned many of the face-to-face classroom courses to fully online classes so their students could complete the semester. For many reasons, fully online geology courses cannot replace the experiences of making geologic maps in the field. The fundamental skills that students learn throughout the coursework of an undergraduate geology program also require time studying rocks and the natural world in the great outdoors, the more the better. To most students, field camp is a life-changing experience as they live in shared accommodations with other fellow students and faculty for five to six weeks learning about rocks and life.

We decided on a hybrid course, divided into 14 online course days immediately preceding the 15-day in-person field camp. Overall, it took more than 30 students, nine instructors, and administrative staff from South Dakota Mines to make this course a successful reality. It took countess hours to deliver one online module and many more to complete the field phase of the hybrid course. Many would say, "*Why do this if it clearly took a large budget to deliver*?" Simple. We did it for our students. We felt we could make a small contribution by helping them finish their undergraduate degrees and get out of school and onto their careers.

Many may not recognize the amount of consideration it takes to lead a hybrid course like this. The online course was fairly standard, except for the fact that we purposefully overloaded the course so as to keep students busy at home, in quarantine, for the 14 days prior to the start of the in-person field course. The logistics from here get a bit more complicated. For the field camp, we split the students into 10-person cohorts to prevent mixing of the student body during the course. Each cohort had two full-time instructors. On field days, vans consisted of five students and one instructor (that was also the driver). We drove with the windows down (even in the rain), masks on, with air conditioning on anything less than max to prevent recirculation. But before loading the vans, forehead temperature checks were taken (see photo below – in this case, we had to expand our skillsets to mimic some of the work performed by physicians). Following commutes to and from the field sites, the instructors sprayed disinfectant on all internal and external surfaces that were touched by the passengers. If a student or instructor were to become symptomatic at any time during the camp, we had plans to place the entire cohort under quarantine measures based on the guidance of relevant government and health authorities.

All campus dining was located in the cafeteria at the Surbeck Center. Students were to keep 6-ft distancing at all times, were served by staff in order to eliminate possible contamination from touching anything. Dining tables were spaced with only one person per table, with most facing toward the door. A bit unconventional, but it worked. Masks were to be worn at all times, except while eating. One of the nice things about working in the field was that we could eat our prepared brown bag lunches on hilltops overlooking the beautiful Black Hills every day we were in the field. It's during these times that we have another reminder that we're thankful we're field geologists.

Unfortunately, once again we ended up cancelling most of the winter field camps but one. Arizona field camp will take place in Bullhead City, AZ with 23 students and four instructors from Dec. 27 to Jan. 18. We also offered the online portion of the hybrid course in early December so students could take both courses to earn six credits to graduate. We also developed and now offering couple other online courses such as depositional systems and basic field methods. 13 students enrolled in the field methods course and 24 students registered to attend online depositional systems course from Dec. 28 to Jan. 14. We plan on offering all of our summer camps and hope that the pandemic will be behind us by then.

For additional information about upcoming field station activities please visit: http://geologyfieldca mp.sdsmt.edu, call me at (605) 431-1275 or email me @ nuri.uzunlar@sdsmt.edu

Happy Holidays …..Be well and safe….Nuri

Kevin Ward

The end of the year seems to sneak up on me and appears shorter and shorter every year. This is especially so of this year as most of us probably spent 2020 in a holding pattern with the effects of the COVID-19 pandemic dominating 2020 for nearly every person. Rather than reiterate the challenges and hardships faced to some extent by all of us this year, I simply want to highlight a positive in what has otherwise been a shipwreck of a year. The hard work of the SD Mines community including the staff, administration, faculty, and especially the student population has been remarkable. From the rapid transition of "normal" to online only instruction in March through the planning and execution of an effective yet safe fall semester, it is difficult to imagine what more could have been asked or delivered from these respective specific populations. Looking forward, I am eager to resume many outstanding research and teaching projects in the coming year and there is good reason to be hopeful looking to the future. I hope you share a similar since of sanguinity moving forward and wish you and your family another healthy and happy year.