SOUTH DAKOTA MINES

Department of Geology and Geological Engineering

2021 Alumni Newsletter

Faculty and Staff in Geology and Geological Engineering/Museum of Geology – 2021
Back row (l to r): Roger Nielsen, Curtis Price, Larry Stetler, Kevin Ward, Ed Duke, Trevor Waldien, and Christopher Pellowski
Front row (l to r): Kayleigh Johnson, Laurie Anderson, Gokce Ustunisik, Nuri Uzunlar, Emily Berry, and Liangping Li
Absent: Yi Fang, Nathanial Fox, Cleo Heenan (taking picture), Kurt Katzenstein, Sarah Keenan, Tim Masterlark, Darrin Pagnac, Bill Roggenthen, Arden Davis, Jim Fox, Colin Paterson, Perry Rahn, and Foster Sawyer

Submitted absent photos:

Absent Faculty and Staff in Geology and Geological Engineering/Museum of Geology – 2021
(l to r): Nathanial Fox and Colin Paterson

Dr. Perry Rahn's retirement party in spring 1997 (l to r): Dr. Richard Gowen, President, Dr. Colin Paterson, Department Chair, Dr. Perry Rahn, Professor of Geological Engineering, and Dr. J. Paul Gries, Professor Emeritus.

50-year GGE alumni from the Class of 1971 on a tour of campus (l to r): David Shaddrick, Dr. Darin Pagnac (Associate Professor), Dr. Laurie Anderson (Department Head and Professor), Randy Nelson, Leroy Foster, Dr. Jim Martin, Wayne Greaves, and Lyle Steffen.

Group photo of the GGE faculty/students who attended/presented at the annual GSA meeting in Portland, OR.

Donation of camping equipment for students

The Department of Geology and Geological Engineering hosts an annual fall field trip in the honor and memory of the late Dr. Alvis Lisenbee as a way for our students to experience world-class geology and create memorable experiences.

Unfortunately, not all the students own their own camping equipment such as sleeping bags, sleeping pads, or tents. Your donation of camping equipment that you no longer use, but is clean and still in good repair, can be checked out to the students to allow them a chance to participate in our yearly field trip.

Please contact the department to facilitate an equipment donation that the students will certainly appreciate.

Group photo of the 2021 fall field trip to Yellowstone NP and additional photos of the camp site.


FIREWOOD

From the newsletter coordinator – Christopher Pellowski

Greetings alumni and friends! Please enjoy reading the 2021 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, I hope you all are healthy and safe. As I reflect on 2021, I am struck by the resiliency of our faculty and students. Last year I wrote:

> 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.

That those sentiments remain true. I am so proud of the perseverance of our students, staff, and faculty.

We would like to acknowledge the gifts we received for the Department or the Museum of Geology. In Fiscal Year 2021 we received, $93,078 in unendowed gifts to support department initiatives and $53,490 to support the Museum of Geology.

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.

GGE Update

Outside of classroom and research efforts, GGE's efforts this year included working collaboratively with Mining and Engineering and Management (MEM) and Materials and Metallurgical Engineering (MET) to plan for and secure funding for the new Mineral Industries (MI) building, which is set to break ground in Spring 2022. I got a taste of the legislative process by testifying in support of the bill to allocate $19 million in state funds to this project. On campus, we have a great team of folks from the architectural firm, Facilities, the MI departments, and the state (represented by GeoE graduate Steve Mezger!) working on making this new facility a forward looking (but not extravagant) building.

GGE is also working with MEM to launch the Mining Hub, a center to foster innovations in mining education and research. If you would like to know more, here is a link to the Mining Hub site: https://www.sdsmt.edu/Academics/Mining-Hub/. In addition, we are working to secure a gift of a land donation adjacent to a quarry near Nemo, SD as a site to build a field station. We hope to have a gift agreement signed soon.

We also have some changes to the faculty this year. Foster Sawyer has retired, and although a great loss, I hope he plans to continue teaching field camps. We made two outstanding hires this year, with Yi Fang and Trevor Waldien joining us in August. Yi has a PhD in Energy and Mineral Engineering from Penn State and joined us after a postdoctoral position in the Institute for Geophysics at UT Austin. His work focuses on geofluids and geomechanics. Trevor has a PhD from UC Davis, and his research focus on long-term structural evolution of orogenic belts by using tools and datasets that include field mapping, petrography, and geo/thermochronology.

We also have a faculty search on to replace Curtis Price. Curtis has been teaching geospatial courses and leading statewide GIS efforts for several years after his retirement from the USGS. He has been a great asset to our department, and we hate to lose him, but he has decided to return to his native Washington state.

The number of undergraduate majors and graduate students is still trending downward slightly. That said, career placement of our undergraduates is strengthening. In 2019-20 (the latest numbers available), GEOE had 90% placement and GEOL had 86% placement. We are working in collaboration with MEM and MET to promote the MI programs to prospective students and are back recruiting graduate students at national meetings.

Both the GEOE and GEOL BS programs are beginning work on self-studies for ABET accreditation. GEOE program has long been accredited through ABET and this will be GEOL's initial request for ABET accreditation. Although the work is substantial, it has led to great discussions within and between programs on effective curricula, assessment, continuous improvement, and student learning.

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 Update

The Museum and PRL open for visitor in 2020-2021 and we were back up to just over 20,000 visitors and logged over 2,200 volunteer hours. We also hosted a US Forest Service Passports in Time volunteer event over the summer. It was great to have things nearly back to normal.

The Museum staff (Emily, Kayleigh, and Nate) worked on a strategic reevaluation and relaunch of our volunteer programs to focus especially on student cross training. They did a great job. We are about to start a similar strategic planning process on exhibits and educational programs. We would love to receive any feedback you have on exhibits and programs.

We also have been making progress on cataloging national park collections and inventorying mineral collections with the support of Rachel Benton, Steve and Donna O'Rourke, and Dakota Territory Resource Corp. We have used these gifts primarily to hire undergraduate and graduate students to gain experience in collections work, so it is a double win of providing professional experience to our students and advancing our effort to care for collections. The Museum also provided support for 6 undergraduate research projects and 12 thesis/dissertation projects in the last year.

Laurie Anderson News

I taught Senior Research I to a group of 11 geology students this fall, and it was exciting to see the wide variety of projects they are developing, from geophysics to thermochronology to photogrammetry to paleontology projects. I also taught the interdisciplinary course Developing and Planning Research (GEOE/GEOL/MEM 700). I had a group of 7 graduate students from geology and paleontology, and I'm excited for the research they will pursue while here at SD Mines. I also began teaching Invertebrate Paleontology in Spring 2021. It has been 10 years since I taught this course at another institution, and it was so much fun getting back to teaching a course in my research area.

I officially became an ABET program evaluator for geology programs this year, and thanks to Dave Hammond was assigned a program review this year. It was a huge learning experience and I hope to use that knowledge to successfully make the case for accreditation of our GEOL program next year.

I am currently working with two graduate students: Brooke Long-Fox is completing her PhD on lucinid bivalves and Peter Daly is in the midst of his MS work on foodweb modeling of Cretaceous methane seep faunas. With collaborators and students, I published two papers: one on soft tissue alterations in oysters after the Deepwater Horizon oil spill (work started at LSU), and another on endosymbiosis in lucinid bivalves from marine lakes in the Bahamas. Both Brooke and Peter gave talks at professional meetings (American Malacological Society for Brooke, GSA for Peter).

I participated in two successful grant proposals as co-PI or senior personnel. SD Mines received a grant from the National Science Foundation ADVANCE program (ADVANCE= Organizational Change for Gender Equity in STEM Academic Professions). Our efforts will focus on mentoring, engagement, policy updates, and building a more inclusive campus culture for all STEM professional tracks and ranks. As a co-PI, I am tasked with leading efforts on internal formative assessment of the project. I also am working with folks on a newly funded Governor's Research Center focused on understanding and disrupting the illicit economy in South Dakota. This multi-institutional effort is led by Jon Kellar in MET, and I am involved in efforts related to 'environmental crimes' and we are funding one of Dr. Darrin Pagnac's graduate students to estimate the impact of fossil poaching in the region over the last 25 years.

Here's to a safe and happy 2022!

2021 GGE Department news:

December 2020:

Dr. Kevin Ward – Another earthquake recorded in South Dakota…because it's 2020
https://www.blackhillsfox.com/2020/12/09/another-earthquake-recorded-in-south-dakota-because-its-2020/

Ms. Kayleigh Johnson – T. Rex fossil discovered near Mud Butte being restored at South Dakota Mines
T. Rex fossil discovered near Mud Butte being restored at South Dakota Mines | Education | rapidcityjournal.com

January:

Dr. Edward Duke – South Dakota Mines receives $1.3 Million grant for new scanning electron microscope to benefit research and industry
https://www.sdsmt.edu/Research/Research@Mines/$1-3-Million-Grant-for-New-SEM/

Dr. Timothy Masterlark – South Dakota Mines geophysicist chosen for prestigious Jefferson Science Fellowship at State Department
https://www.sdsmt.edu/News/Masterlark-Chosen-for-Science-Fellowship/

https://rapidcityjournal.com/news/local/education/mines-geophysicist-chosen-for-jefferson-science-fellowship-at-state-department/article_2aa1affd-df6b-540f-8ce4-5b6a6c19f489.html

March:

Senate approves new mineral industries building at South Dakota Mines
https://www.kotatv.com/2021/03/01/senate-approves-new-mineral-industries-building-at-south-dakota-mines/

April:

Mr. Fleford Redoloza (PhD candidate, GEOE) – 3rd place (graduate students) in 11th annual student research symposium
https://sites.google.com/view/researchsymposium/students-day-2/38-fleford-redoloza?authuser=0

July:

Drs. Darrin Pagnac and Sarah Keenan – School of Mines paleontologists visit the petrified giant of Perkins County
https://www.sdpb.org/blogs/rural-life/school-of-mines-paleontologists-visit-the-petrified-giant-of-perkins-county/

September:

Dr. Gokce Ustunisik – Researchers evaluate SURF extremophiles
https://www.sdsmt.edu/Research/Research@Mines/Carbon-Capture-at-SURF/

Dr. Laurie Anderson – Mines researcher adds to study on oyster tissue abnormalities
https://www.sdsmt.edu/Research/Research@Mines/Oil-Spill-Study/

Dr. Sarah Keenan – Dakota Life: Arches of Spearfish Canyon
https://www.facebook.com/SoDakPB/videos/452033599266219/

Dr. Timothy Masterlark – Cracking the Code of Satellite Imagery: Exposing Restless Magma and Underground Structures
https://sites.nationalacademies.org/PGA/Jefferson/PGA_368432#

October:

Ms. Mackenzie Ballou (BS GEOL) – Halloween night at the museum
https://www.newscenter1.tv/south-dakota-mines-holds-halloween-night-at-the-museum/

November:

Dr. Gokce Ustunisik – South Dakota Mines leads research to aid understanding of Earth systems with big data
https://www.sdsmt.edu/News/Big-Data-Earth-Systems-Research/

Dr. Bill Roggenthen – To advance geothermal systems, EGS Collab maps the hidden fractures behind a wall of rock
https://www.sanfordlab.org/article/advance-geothermal-systems-egs-collab-maps-hidden-fractures-behind-wall-rock

https://www.bhpioneer.com/local_news/mapping-hidden-fractures-behind-a-wall-of-rock/article_f0d8d370-5dce-11ec-90b4-ebb350a70454.html

Cleo Heenan

Happy Holidays everyone! This past year has been a treasured year with many new memories with family and friends. Was wonderful this past semester having students back in our hallways and able to get to know our students again. We had a wonderful Department Thanksgiving Potluck with Faculty and students which is a blessing we enjoyed. My family life is never boring as I have enjoyed following grandkids throughout the seasons with the many sports, they are in. I also stay busy with my group of blue haired ladies (my husband has labeled us), as we do our water aerobics and play volleyball besides doing hikes for fun. I wish everyone a healthy and Happy New Year for 2022 and keep building those precious memories.

Christopher Pellowski

It was more like a normal year amid the continuing COVID-19 pandemic as we continued to operate from the SD Mines campus. During the two five-week sessions, we had 28 students (12 SD Mines) from 12 universities in session 1, and 29 students (3 SD Mines) from 22 universities in session 2. We were able to go back to having regular classes that provided a welcome change. The weather this year was on the warm side with above average temperatures to contend with especially during week 5 of session 2 with daily highs of 99° Fahrenheit. I am currently working on identifying additional field areas for future mapping projects to be incorporated when the new field station is constructed.

I taught the Geol 351 Earth Resources and the Environment class in the spring semester with 18 students enrolled. The class was made up of mostly geology majors with two students from civil and environmental engineering and one from science, technology, and society. This year I am serving on six department committees and will be teaching Geol 451 Economic Geology/Lab during the Spring 2022 semester with 2 students already signed up.

GEOL 410 Session 1, 2021 SD Mines students/instructors.

GEOL 410 session 1 students at Elkhorn Peak mapping 'til the cows come home!

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

LIKE US ON facebook

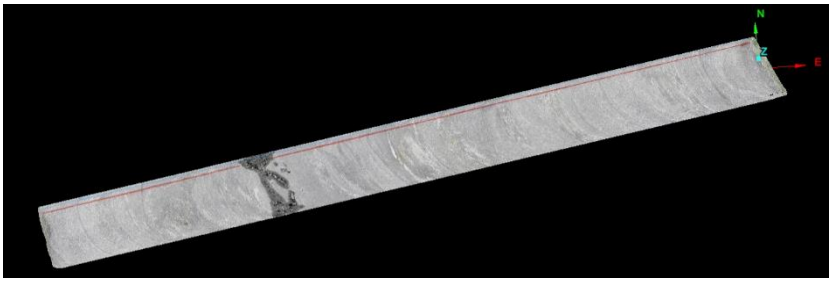
https://www.facebook.com/SDSMTGeologyGeologicalEngineering

Bill Roggenthen

Update on Activities at SURF, Lead, SD: The buildout of the neutrino far detector is well underway with excavation and mining activities taking over much of the 4850 Level of the laboratory. The underground rock tramway between the Ross and Yates Shafts is completed as has the conveyor system across Hwy 85 that delivers rock from the Yates to the Open Cut. A new air shaft drilled this year connects the 3950 and the 4850 and improves ventilation for the large experiment. The large access drifts (19 ft high) are being mined and rock is being moved to the Open Cut; this is the first time in 20 years that Lead has heard the crushers running again.

EGS Collab Project: The first phase of the large geothermal project on the 4850 Level was completed last year, and a new laboratory area for geologic studies was constructed this year to support Phase II of the program, which is supported by the Department of Energy. The primary purpose of Phase II is to investigate the mechanisms/mechanics of stimulating specific existing fracture(s) to determine the residual permeability after stimulation and to tie that information into the appropriate modeling. The new laboratory space consists of a dedicated area of the 4100 Level where a new 30 ft-long alcove was blasted out. This was finished with a concrete floor and provides space for the pumps and monitoring equipment.

Over 4000 ft of monitoring, injection, and production bore holes have been drilled using a total of nineteen bore holes of which eleven on the 4100 Level. Restrictions on travel by the national laboratories involved in the project caused major difficulties during the drilling of 4100 Level bore holes. Therefore, RESPEC was engaged to help with core logging and wireline geophysics for the holes. As a result, SDSMT alumni with that company figured prominently and included John (Butch) Knight *(GeolE, 2002)*, Brian Bormes *(Geol, 2018)*, and Eric Krantz *(BS Civil E, 2000; MS Civil E, 2002)* with the core logging as well as Tyler Artz *(BS MinE, 2015; MS MEM, 2016)* and Koby Dobler *(Mech E, 2018)* with the wireline geophysics. Their help was crucial and was greatly appreciated. The logging suite for the bore holes included gamma, resistivity, full-wave sonic, temperature, optical televiewer, and acoustic televiewer logs in all of the bore holes. It is also important to note that the EGS Collab Project and its predecessor, the kISMET Project, provided numerous opportunities for graduates and undergraduates to participate in the research. This year Carson Reimers *(BS GeolE, 2019; MS GeolE, 2021)* completed his MS degree funded by the project under the direction of Dr. Katzenstein. It involved the design and construction of a system for photographing core in three dimensions such that features and fabric in the core could be used to orient the core and the core could be returned to the *in-situ* orientation as it lay in the formation. Much of the core acquired



Example of Carson Reimers three-dimensional photography. The core photo can be rotated in all dimensions to accurately orient it with respect to the original bore hole location.

during Phase I was photographed as part of this work and is being used to provide data for structural investigations.

The monitoring boreholes contain passive geophones and hydrophones, electrical resistivity instrumentation for resistivity tomography, continuous active source seismic sources and receivers, and digital temperature sensing/digital acoustic sensing optical fiber down the entire lengths of the boreholes. The alcove contains the control systems for the packers, temperature, fluid conductivity, which are installed and operative and which are tied into the SURF fiber/internet so they can be operated remotely. Grouting of the instrumentation in the monitoring holes will begin in January and will be followed by a month of waiting to allow the cement to cure. Pumping and stimulation associated with the experiments are expected to begin in February 2022.

The panoramic, distorted view on the left shows the entirety of the packer control and fluid monitoring systems, whereas a non-distorted view of the drift is seen on the right.

From our Emeritus Professors:

Arden D. Davis, Professor Emeritus of Geological Engineering

In last year's newsletter I mentioned a project that involves a proposed water pipeline from the Missouri River to the Black Hills area. Dr. Kurt Katzenstein was the principal investigator, and Dr. Scott Kenner and I assisted, with help and guidance from Mark Anderson of the U.S. Geological Survey. Following release of the report, and subsequent organizational work by Banner Associates, a group of cities and towns in the Black Hills area formed the Western Dakota Regional Water System. The group held a water summit on campus on December 1, with about 70 persons in attendance. The summit was organized by Cheryl Chapman, a civil engineering graduate and professional engineer who retired from Banner Associates last fall. Cheryl will continue to be involved with the group as it explores options for funding to make the water pipeline a reality. Among those in attendance at the water summit were six South Dakota state representatives and two state senators, along with area mayors and city water engineers, and a staff member from U.S. Senator John Thune's office.

Our research group gave a technical presentation and held a panel discussion as part of the water summit. We described future water needs for the Rapid City area and western Pennington County, and we compared these projected needs to available supplies from surface water and groundwater in the Black Hills. The West Dakota Water Development District and the City of Rapid City hold future-use permits for water from the Missouri River, so we presented potential routes and engineering options for a pipeline to western Pennington County. Large infrastructure projects such as this could have a development timeline of decades. The development costs could be $1.9 billion dollars or more for the project, aside from operating costs, so it would require federal and state assistance. In addition to its technical and economic aspects, the project ultimately would involve legal aspects such as water rights, along with sharing of water, needs of upstream and downstream states for river transportation and other resources, and political considerations. It seems best for me to stay with the technical side of things.

From mid-May to early June, I taught an environmental field camp course through the Black Hills Natural Sciences Field Station. Mark Anderson and Liangping Li joined in teaching the class. Liangping teaches groundwater courses and conducts research in the geological engineering program. During the field camp, he took some outstanding photos at our field sites and posted them on an internet social page. Mark Anderson recently retired as director of the Rapid City office of the U.S. Geological Survey, which is now called the Dakota Water Science Center. He also has served on the President's Science Advisory Council under President Clinton and President Bush, so his expertise in water and policy added an extra dimension to the course and made it a rewarding experience for all of us. This year, Mark, Liangping, and I expanded the environmental / groundwater field camp to a variable three to four credit option, with additional emphasis on groundwater sustainability. Ten students took the three-credit course, and six took the four-credit course. The sixteen students came from schools that included Drexel University, Texas Christian University, the University of Pittsburgh, Marshall University, the University of Wisconsin-Milwaukee, the State University of New York at Fredonia, the University of

Connecticut, The University of North Dakota, Bloomsburg University, the University of Alaska-Anchorage, Grand Valley State University, Austin Peay State University, and Minot State University. Below are two photos from our field camp project sites, taken by Dr. Liangping Li.

During the past year I've continued to work with CalxAqua, a company that several faculty members at the School of Mines formed as a commercial entity for removal of arsenic, heavy metals, and other contaminants from water. We've recently looked at a project that involved seepage from the Rapid City landfill, and we've continued our contacts with a gold mine. Some of the other owners of CalxAqua include Dr. David Dixon (Chemical Engineering), Dr. Cathleen Webb (formerly in the Chemistry Department, now Department Head and Associate Dean at Western Kentucky University), and Dr. Jenifer Sorensen (Minnesota Department of Natural Resources).

After retirement, I'm continuing to share an office with Perry Rahn in MI 327B. Because of the coronavirus, I haven't seen Perry as much as usual, but I think he's enjoying his time at his log house and property west of Hill City.

My wife and I again spent about 2 ½ months in Minnesota during the summer. We arrived too late for the asparagus, and it was unusually dry in Minnesota, but our garden yielded green beans, zucchini, cucumbers, and a few other things. We also had summer apples.

During the past few years it has been enjoyable to visit with graduates and Professional Advisory Board members, including Mike Ainsworth, Jeanne Goodman, Jim Goodman, Alan Bakeberg, Al Paulson, Peter Larson, Ann Barnum Curnow, Janet Carter, Barb Nielsen, Jay Nopola, Tim Barker, Ray Wuolo, Joanne Noyes, Stuart Buchholz, Richard Arnold, David Hammond, Sherwin Artus, Steve O'Rourke, Bill Siok, Scott Cooper, Andy Farke, Syed Huq, Syed Nayyer, Roberta Fivecoate Hudson, Joe Peterlin, Kathleen Grigg, Joshua Valder, Bill Eldridge, Kyle Davis, Jenifer Sorensen, Dennis Riding, Scott Letasi, Rob Livingston, Renel Hall-Beck, Tom Campbell, Katie Aurand, Jonathan Emmer, Nakaila Steen, James Sanovia, Lilly Jones Sanovia, Jonathon Odland, Cathy Hayes Daly, Mark Fahrenbach, Erik Walega, Erik Smith, Jonathan McKaskey, Karl Koth, Kathryn Johnson, Brad Stock, Matt Minnick, Jennifer Bednar, Mike Wiles, Steve Mezger, Bruce Peterman, Heidi Sieverding, Patrick Kozak, Greg Kipp, Haile Betemariam, Mitch Kannenberg, Crystal Hocking, Kristin Pratscher, Bruce Woodhouse, Joyce Fry, Mike Buswell, Halim Mutlu, Zuhair Hafi, Dave Kyllonen, Jeff Sussman, Todd Anderson, Fleford Redoloza, Carson Reimers, Frank Torvik, Colton Medler, Greg Goeser, Abhishek Ray, and many others. As always, please accept my apologies if I've left off anyone's name. I hope you can stop by and visit if you're in the area.

Groundwater / environmental field camp group at Pactola Reservoir. Photo by Dr. Liangping Li.

Stream gaging during the environmental / groundwater field camp. Photo by Dr. Liangping Li.

Colin Paterson

Because of Covid-19, our annual "summer" in New Zealand lasted 1.75 years as we didn't get back to the Black Hills until September 2021. Vaccines were quite late arriving in NZ, because Covid had been absent for a year, and it wasn't until late June that Becci and I got our first shot. We originally scheduled our return flight for August, then one Covid-19 case arrived in Auckland and began a community spread. The resulting lockdown made travel through Auckland difficult. We were able to keep in touch with the department 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 continue to conduct monthly meetings, mostly presented by current students reporting on summer internships in the mining industry, but also with presenters from mine operations, by Zoom. We did enjoy a mine tour at the Wharf gold mine in November thanks to Kenan Sarratt (GeoE alum). The difficult project just now for me is deciding what papers, rocks, etc. can be discarded prior to our move in a couple of years to a new building.

SD Mines SEG Chapter at the Wharf gold mine, November 2021

Perry Rahn

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

J. Foster Sawyer

Season's greetings and warm regards to the alumni, students, and friends of the Department of Geology & Geological Engineering! 2021 was an interesting year of change as the pandemic continued to run its course and I transitioned from an Associate Professor to an Emeritus Professor. I am extremely pleased to report that (now) Drs. Lilly Jones and Jennifer Bednar both successfully defended their dissertation research during the spring semester working on the following subjects.

Jones, L., 2021, Assessing Aquifer Vulnerability to Contamination on the Pine Ridge Indian Reservation in southwestern South Dakota

Bednar, J.M., 2021, Current Limitations, Variability, and Role of Topography in Stream Base Flow in the Northern Great Plains of the United States

I want to thank Dr. Kurt Katzenstein and his wonderful wife Lisa, Dr. Kevin Ward, Cleo Heenan, and everyone else in the Department who organized and contributed to the retirement party that was held in my honor at Sheridan Lake in May. It was a memorable evening in a beautiful location among dear friends. An evening I will never forget.

I also would like to thank Dr. Laurie Anderson and the entire faculty of the Department of Geology & Geological Engineering for their gracious nomination and confirmation of me as an Emeritus Professor in the Department. This is the largest honor of my career, and it means a great deal to me to continue to be associated with the outstanding people who constitute this Department. Laurie and Cleo found a great space for me to maintain an office in the MI building which Dr. Bill Roggenthen kindly shared.

Summer brought two field camp sessions, one in the Black Hills and one in Turkey, both of which went well despite some adverse effects I experienced from a COVID vaccine in the spring. It is my sincere hope and desire to continue working with Dr. Nuri Uzunlar and the Black Hills Natural Sciences Field Station in the future, particularly in conjunction with the Turkey field camp.

Left: Students in the 2021 Turkey field camp. Right: In Turkey with Dr. Umit Yildiz (left) and Mr. Mehmet Çam (center).

During the fall 2021 semester I served as an Adjunct Instructor for Oglala Lakota College (OLC) teaching a Physical Geology course, and recently I accepted a position as a Faculty/Research Scientist at OLC which I am greatly enjoying.

I wish all of our amazing alumni a Happy Holiday Season and a successful, healthy, and enjoyable year in 2022!

Sincerely,

Foster

From the Faculty:

Ed Duke

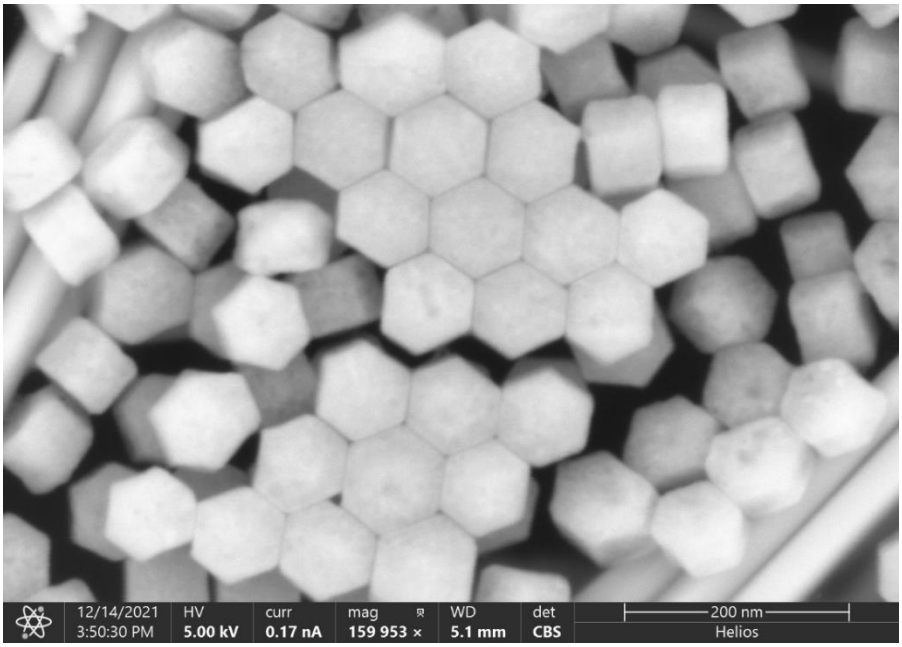
Ed Duke, in addition to his role with the Department of Geology and Geological Engineering, serves as Director of the Engineering and Mining Experiment Station of SD Mines. EMES was founded on the Mines campus in 1903 with a mission to serve the mining industry research. Today the mission has expanded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

This year EMES has continued to upgrade its major laboratory facilities. Dr. Scott Beeler spearheaded a proposal to the South Dakota Board or Regents for a microwave reaction system that will greatly expand capabilities to digest ores and other geological materials for analysis in the inductively coupled plasma mass spectroscopy laboratory. The Anton Paar Multiwave 5000 Microwave Reaction System, priced at $50,754, was purchased and installed in August, and method development is underway for utilizing the new system for digestion of a variety of sample types.

Anton Paar Multiwave 5000 Microwave Reaction System

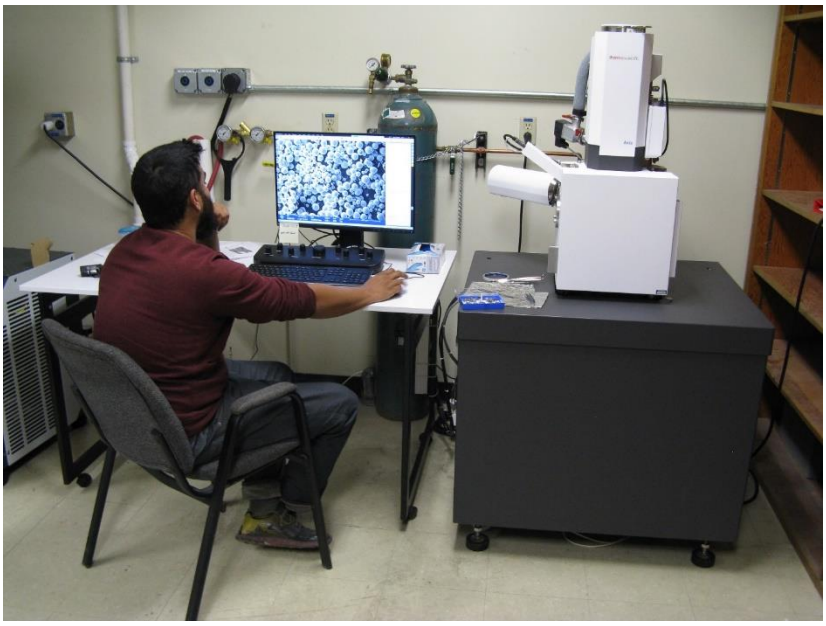
In addition, EMES collaborated on an NSF Major Research Instrumentation proposal for a new focused ion beam scanning electron microscope (FIB-SEM). The proposal was funded for $1.28 million. In addition to Duke, the team of investigators includes GGE faculty Gokce Ustunisik and Roger Nielsen as contributing scientists. During the fall, installation was finalized on a Thermo Fisher Scientific Helios 5 CX FIB-SEM with Energy Dispersive Spectroscopy and Electron Backscatter Diffraction capabilities. The focused ion beam allows researchers to extract samples for separate analysis in a transmission electron microscope or to mill into samples and obtain high resolution 3D imaging or compositional mapping.

Thermo Fisher Scientific Helios 5 CX FIB-SEM with Energy Dispersive Spectroscopy and Electron Backscatter Diffraction capabilities



Helios 5 CX image of nanoparticles and silver nanowires at magnification of 159,953X (image by Jacob Petersen, EMES).

Along with the high-end FIB-SEM, EMES acquired a lower-resolution Thermo Fisher Scientific Axia ChemiSEM with high vacuum and low vacuum capabilities. The system is ideal for many geological applications and for teaching. Students in GEOL 656L this fall used the Axia in projects that examined igneous rocks, speleothems, fossil wood, and economic mineral deposits.



Thermo Fisher Scientific Axia ChemiSEM with high vacuum and low vacuum capabilities

Uncoated sample of Icelandic basalt showing dendritic ilmenite grains (image by Erica Cung, GGE MS student).

Yi Fang

Dear Alumni,

Merry Christmas and Happy New Year!

2021 was extraordinary because I am very fortunate to join the department as a new assistant professor of geological engineering.

I am a cross-disciplinary guy with a broad educational background and research interests. I majored in Underground Construction and Bridge Engineering when I was an undergraduate student at China University of Geosciences, Wuhan. Then I went to California State University, Long Beach, and spent two years in a master's program in geology, working on stable isotope analysis of fluid-rock interaction in a fault zone. Yes, that was a big switch – from Civil Engineering to Geochemistry. After that, I continued my Ph.D. at Penn State University. I switched my research again – working on rock mechanics and fluid flow in rock fractures to understand the induced seismicity during subsurface fluid-injection activity. I became, sort of, half-petroleum engineer and half geophysicist. I always enjoy extending my research areas. After graduation, I went to the University of Texas at Austin and worked as a postdoc on a methane hydrate project in the deepwater of the Gulf of Mexico. For me, the research was like a combination of soil mechanics and fluid flow in sediments.

At SD Mines, I am very excited to have my own lab – subsurface geomechanics and geofluids lab. I am looking forward to applying the fundamental disciplines (e.g., rock mechanics, soil mechanics, hydrogeology, and geochemistry) to understand the coupled multi-physical processes (i.e., how fluid flow, heat transfer, deformation, mineral dissolution/precipitation concurrently work together) occurring in the geomaterials. And the ultimate goal is to address the associated challenges in geoengineering activities (e.g., subsurface energy and mineral resources characterization and recovery, waste storage and disposal, geohazards mitigation, and environmental remediation).

I feel at home at SD Mines. Since mid-August, I have already received strong support from super nice colleagues and the department chair. The more exciting thing for me is that I have already found many outstanding faculty members in SD Mines to collaborate with.

I am looking forward to a fruitful 2022! Go Hardrockers!!!

Kurt Katzenstein

Greetings! I hope your year has been a good one and that you and your family are doing well. Our family enjoyed some sense of normalcy this year with many trips out of state to soccer and basketball tournaments and one long family road trip to a wedding in Spokane with a few nights spent in Island Park, ID to visit the Grand Tetons and Yellowstone. Our oldest daughter Brianne and I went backpacking in the Sierras on a tri-generational trip with my dad who turned 77 this year. The trip was a bit rainy but was very successful for a first trip for Bri. Our two younger daughters are excited to give it a try next year so planning has begun for that trip already. As usual, our family also got out and enjoyed the Black Hills as much as possible through hikes, bike rides, and other activities.

Upper Left: Brianne enjoying her first backpacking trip in the High Sierra above Bishop, CA.
Upper Right: A rare occasion where the Katzenstein family is presentable (family wedding photo).
Lower Left: Enjoying ourselves in Yellowstone.
Lower Right: Stopping off at Zabriskie point on our drive between Las Vegas and Ridgecrest, CA (our hometown) on the way home for Thanksgiving.

I was excited to host the Geology Rocks Youth Camp once again after a year off due to Covid. We had 19 eager young geologists and we spent four days exploring all of the great things the Black Hills have to offer. This year, the model for the camp changed from an overnight camp to a day camp. This worked well, but some of us feel that something was lost too so we are already planning to add a second session during the Summer of 2022 where students can camp out again.

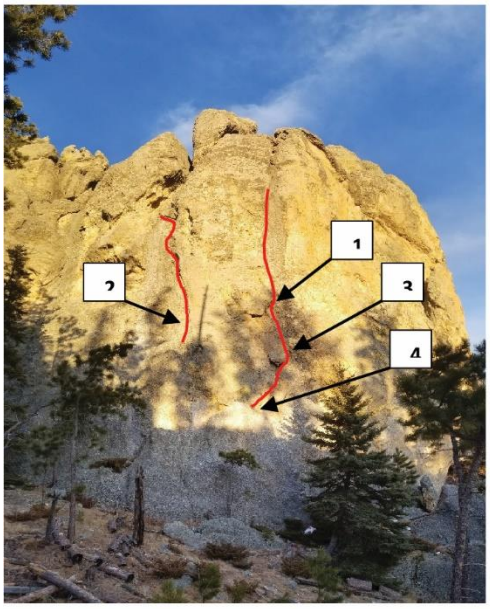
As Covid begins to dictate our lives less and less we are starting to see outreach events pick up again. Our Go-To-Mines events were in-person again this year as were a few other outreach events at local K-12 schools. A few of us recently participated in an 8th Grade STEM Day at the University Center here in Rapid City and I am looking ahead to participating in the Sturgis-Brown Career Fair in February which is attended by numerous regional schools. Our GGE Recruitment Committee is also working hard to try and bring in more students through advertising efforts and other K-12 school interaction opportunities.

Foster Sawyer and I once again hosted the annual GGE Ice Fishing Potluck. The weather this year was great and about 20 people attended. We also celebrated Foster's retirement with a fun potluck at Sheridan Lake. I, like many of our students and other faculty, have benefited greatly from having Foster around the department during the past 14 years. He will certainly be missed but I wish him the best of luck in all his future endeavors!

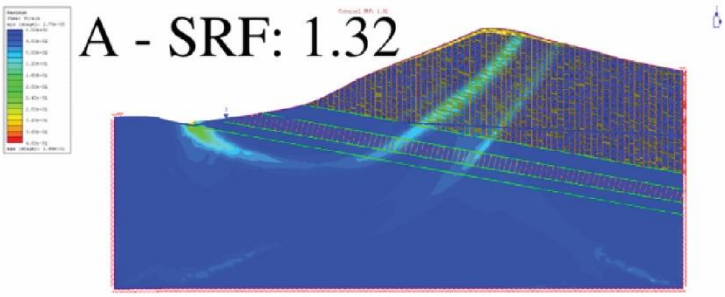
Left: Local 8th graders enjoying the augmented reality sandbox at the 2021 STEM Explorations fair.

Right: Geology Rocks Campers enjoying hiking in Badlands National Park.

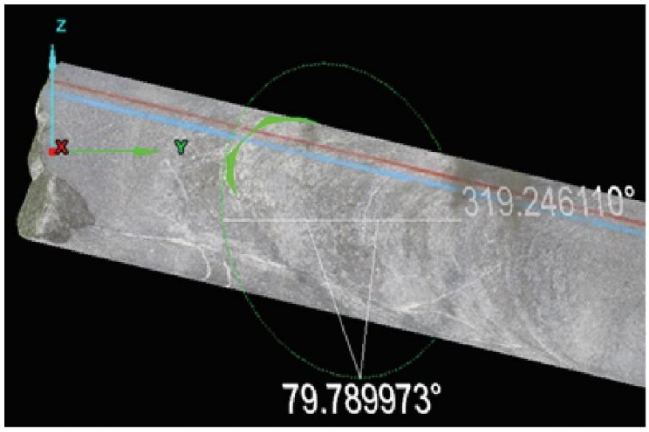
On the research front, two of my graduate students graduated in 2021. Brittany Coupe finished her work investigating the role that large-scale slope failures have played in the evolution of the Cretaceous Hogback surrounding the Black Hills and now works with the SD DOT in Pierre, SD. Carson Reimers completed his work which developed a method by which we can create high-resolution 3D models of rock core using photogrammetry and is now working with Golder and Associates in Tucson, AZ. I expect that Frank Torvik will graduate in the Spring of 2022. He is working to better understand the role that is played by solar incidence angle on rockfall triggering and has continued his employment with GeoStabilization International. I currently have a proposal in development that would fund a graduate student to conduct some InSAR ground surface deformation research at a mine site in the western U.S. (more on that if funding comes through!).



Vibrating Wire crackmeter deployment in Custer SP as part of Frank Torvik's thesis work. The red dashed line shows the approximate extent of the fracture between a rock flake and its associated outcrop between which we hope to measure aperture variation resulting from thermal expansion. The arrows indicate the location of each sensor, and numbers 1-4 correspond to the datalogger channel. Photo by F.H. Torvik.



An example of an RS2 model output evaluating the stability of the Cretaceous Hogback surrounding the Black Hills as part of Brittany Coupe's Thesis work.



An example of a spatially oriented 3D photogrammetric model of drill core from SURF allowing for the measurement of bedding attitudes digitally. This work was done by Carson Reimers as part of his M.S. Thesis.

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 2022!

Sarah W. Keenan

2021 certainly has been exciting! Getting vaccinated (and boosted) was definitely a highlight, and I am very thankful for all the hardworking scientists and doctors that continue to work tirelessly. The Frost Heaves (A) were victorious throughout the season, including one game with a 6 stone, come from behind win (6-5). Kurt, Foster, Scott, and I ended our curling season in 2nd place—not bad for our first season as a team! Scott, Stella, and I have been busy hiking around the Black Hills, including dinosaur park (B). She is growing fast and loves the snow (and chasing deer and squirrels). We were able to find time for a vacation to Joshua Tree National Park this summer, including stops at the Salton Sea, a fault surface en route to Joshua Tree (C), Palm Springs, and the San Diego Zoo. Being back in-person this fall was awesome, and allowed us to plan fun departmental events again, including the trip to Yellowstone and a group outing to the Rapid City Rush (D).

We had some excitement around the Paleontology Research Lab this fall when our walk-in freezer holding a large number of animal carcasses for my lab group's research failed. As the smell of skunk wafted around the building (and campus), we moved into action to start research projects ahead of schedule. I excavated a simulated grave, collecting soils for biogeochemistry prior to placing the skunks (E). After spending hours collecting samples, making initial measurements, planning future sampling, labelling all bags and tubes with "skunk grave", we opened the bag, and found ourselves faced with raccoons. A funny plot twist that resulted in starting a second experiment the following week examining surface decomposition of the skunks we had planned to bury. These experiments join other on-going, long-term decay experiments taking place in Hermosa.

My lab group has grown to 6 M.S. Paleontology students and 1 undergraduate student conducting his senior research project. Everyone is working hard to conduct cool experiments, utilize material in the Museum of Geology collections, and plan exiting research projects for the spring semester. Michael and Colleen (M.S. Paleo) both attended and presented at the Geological Society of America meeting in October in Portland, representing our school with their fantastic presentations! Grace (M.S. Paleo 2021) also presented—it was great to catch up with one of our recent alums! Next GSA is in Denver, so hopefully we'll have a big South Dakota Mines contingent and an alumni get-together!

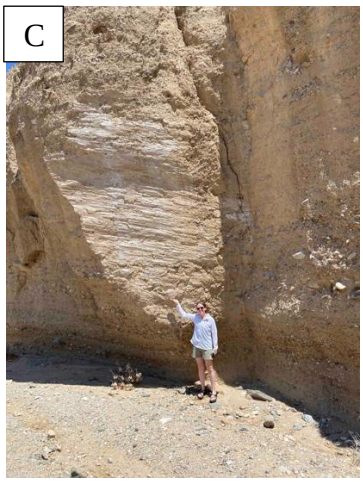
I was co-author on one peer-reviewed publication, completing a project we've been working on for awhile to unravel the identity of the first cave-adapted aquatic snail in Tennessee:

> Gladstone, N.S., Pieper, E.B., **Keenan, S.W.**, Paterson, A.T., Slay, M., Dooley, K., Engel, A.S., and Niemiller, M.L. (2021). Discovery of the Blue Ridge Springsnail, *Fontigens orolibas*, Hubricht, 1957 (Gastropoda: Emmericiidae) in east Tennessee and its conservation implications. *Freshwater Mollusk Biology and Conservation*, 24: 34-42.

A

B

C



D

E

Wishing you all a happy and health 2022!

Liangping Li

Alumni and friends, Happy New Year and Merry Christmas! In 2021, 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. I co-taught Environmental and Groundwater Hydrology Field Course with Dr. Arden Davis and Mr. Mark Anderson from the USGS in the summer of 2021. In this course, we covered a range of topics such as sustainability, slope stability, dam safety, groundwater contamination, aquifer protection, environmental monitoring, aquifer remediation, groundwater-surface water interaction, surface water, water rights, well tests, and flooding. We visited Badlands National Park, Rushmore Cave, Mount Rushmore National Memorial, Hot Springs, Deadwood, Homestake Mine and Custer Stake Park.

I continued conducting research for projects funded from NSF and USGS 104b. For the enhanced geothermal recovery project funded by the NSF, we developed a novel data assimilation method based on machine learning and we published our first paper in the journal of Hydrology. We plan to apply the proposed method into the enhanced geothermal recovery site at the Sanford Underground Research Facility. For the USGS 104b grant, we modeled groundwater flow and contaminant transport for the Madison aquifer and conducted sensitivity analyses of contaminant source on the plume migration. In collaboration with State Department of Environmental and Natural Resources, an undergraduate student (Caleb Schraeder) characterized the groundwater contamination from a gasoline leak near Purbeck Center, as his senior research project.

I published two papers:

1. Leung, J. Y., Li, L., Morgan, E., & Emami-Meybodi, H. (2020). IAMG 2019 Special Issue. Mathematical Geosciences, doi.10.1007/s11004-020-09902-0. (Impact Factor: 2.5)

2. Gómez-Hernández, J.J., Li, L., Xu, T. and Alcolea, A., 2021. Editorial: Stochastic Modeling in Hydrogeology. Front. Earth Sci, 9, p.698925. . (Impact Factor: 3.2)

Rushmore Cave (Environmental and Groundwater Hydrology Field Camp)

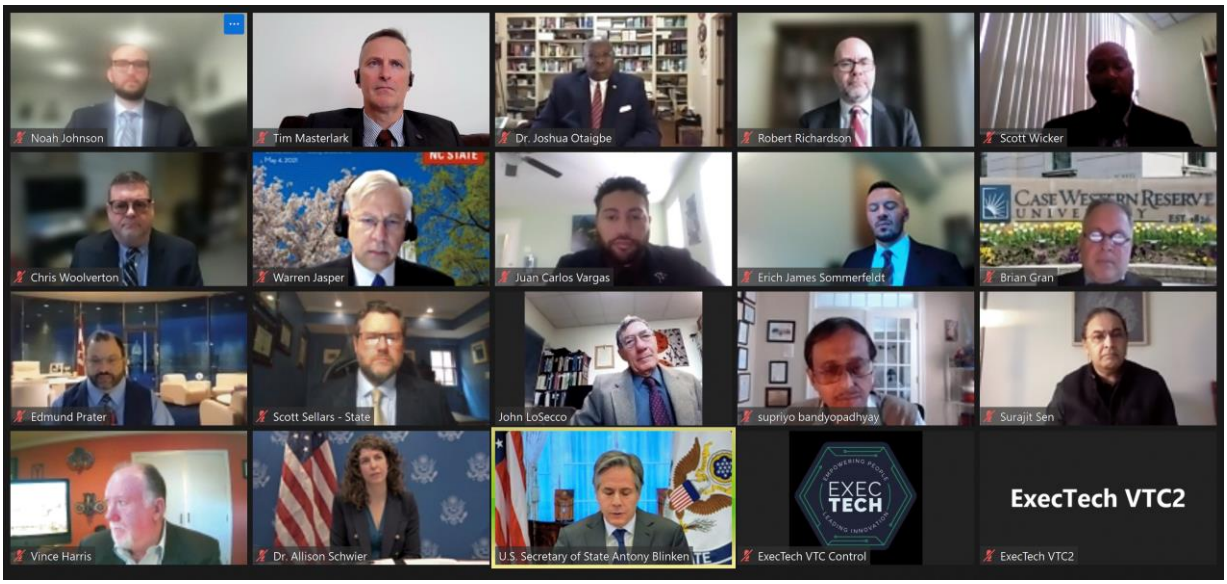
Run Crazy Horse Half-Marathon

Tim Masterlark

Jefferson Science Fellowship

If I had to describe my expertise in one word, it would be this: *Modeler*. As a modeler, I am always on the lookout for patterns and constantly evaluating systems and driving mechanisms behind these patterns. This path invariably leads me to the challenge of differentiating facts from assumptions and developing quantitative explanations for observations. The year 2021 presented an opportunity to step outside of my role as a professor and apply my perspectives as a modeler to engage something much bigger. The National Academies selected me to serve as a Jefferson Science Fellow with the U.S. Department of State's Bureau of Diplomatic Security (DS). I am the first professor from any South Dakota university to achieve this distinction. My tour of duty with DS was an immersion in training, analysis, and advising to improve the security for U.S. personnel, information, and facilities that is necessary to advance U.S. foreign policy. This journey led me to

SHEEPDOG 2021. Masterlark reloads under the watchful eyes of SEALFIT instructors during a field training exercise in a desert environment. Evolutions simulated hand-to-hand self-defense, securing a casualty under duress, and maneuvering through cover and concealment to neutralize an armed threat.



U.S. Secretary of State Antony Blinken (bottom row, center) discusses the importance of STEM for effective foreign policy with the 2020-21 Jefferson Science Fellows (Masterlark, top row, second) and officials from the U.S. National Academies of Science Engineering and Medicine.

understand transformative Lean Six Sigma (measurable objectives vs busywork) and Red Team (question everything) strategies. My journey with DS underscored the essential roles of innovation and resiliency in the Great Power Competition that will dominate our national focus for the foreseeable future.

I am indebted to those who supported, encouraged, and enriched my JSF odyssey, including my DS OPI Team, The Foreign Service Institute, US Joint Special Forces University, USMC Training Operations Group at Twentynine Palms, and my SD Mines colleagues who created the necessary time and space. Lastly, I am thankful for my wife, Scyller, whose endless patience and unyielding support allowed me to focus on operating without having to worry about the home front. Moving forward, I will retain my security clearance (and my Diplomat Passport) and continue my service with DS as an ongoing consultant fellow when I return to my day job as a professor. This service will not replace my geophysical research initiatives. Instead, it opens a portal to new opportunities that address national security.

Return to South Dakota Mines

I am eager to bring my retooled skills and perspectives back to South Dakota Mines and I will be back in the classroom in January 2022. An important lesson-learned from two decades of hot wars and field operations in foreign countries is that tourniquets are now a primary option for treating bleeding injuries. This is a complete turn-around from customary first-aid training of the past, where tourniquets were treated as a last resort. Accidents are the number one cause of death among college-age adults. I secured resources for the necessary training aids, and I will teach Physical Geology students how and why to deploy tourniquets. These skills directly address Field Safety and Societal Impacts of our students and, more importantly, may save a life.

On the research side, I am happy to report that I have a new NSF grant: "*Probabilistic Scenarios for Megathrust Earthquakes and Tsunami Genesis*". This proposed work will combine innovative numerical modeling, Bayesian methods, information theory, with machine learning to forecast tsunami predictions through the lens of probability density functions. The grant includes travel and logistical support for bringing graduate students from U.S. universities to the SD Mines campus for a short course "*FEMs for Simulating Earthquake Deformation*". Check out my website if you are interested in more news, research, and resiliency is the face of a chaotic environment: https://sites.google.com/sdsmt.edu/masterlark/home.

Roger Nielsen

This has been both a challenging and rewarding year – with Covid continuously pushing us to be creative about how we serve our professional community. The advent of new mitigation methods, including vaccination, has slowly allowed some of our operations to begin to return to normal. This includes attending in person conferences at GSA Portland and AGU in New Orleans this fall – something I appreciate even more after a year and a half of on-line only conferences.

My research has gone extremely well this year, with a number of publications and new grants focused on using Big Data approaches to building models of igneous systems, as well as new funding to continue our work on understanding how the oceanic crust forms. These will allow us to bring resources to SD Mines to recruit more first-class graduate students.

In my other role in Academic Affairs, I helped (with Laurie Andersen and several others) to write a successful NSF Advance grant proposal. This effort will involve new faculty evaluation processes that we hope will provide consistency and fairness in faculty development efforts as they are implemented next year.

Darrin Pagnac

Happy Holidays, alumni!

Well, 2021 was markedly better than 2020, but still filled with challenges. COVID-19 restrictions were relaxed quite a bit, but we still had to deal with numerous challenges concerning teaching, research, and fieldwork. Overall, the more open state of affairs was a great relief.

Field work during the summer of 2021 was still pretty restricted, but I did get out a bit, certainly more than in 2020. In May, Sarah Keenan and I took a trip up to Harding County to take a look at a HUGE petrified log in the upper Cretaceous Hell Creek Formation. This thing is immense, almost ninety feet long, and completely silicified, so it's very heavy and not going anywhere. The landowners were very gracious to help us find it, and it resulted in two spots on SDPB.

Sarah Keenan and I examining the petrified log.

We spent late July and early August out of Chamberlain, SD in the upper Cretaceous Pierre and Niobrara Formations. COVID-19 restrictions were lessened quite a bit this season, so we were able to even do some excavating this season. The 2021 season was exceptionally successful. Due to excessively low water levels on Lake Francis Case, a ton of outcrop was exposed and accessible. We documented over 140 specimens, a personal record for my time conducting surveys on the river. Several notable finds were documented as well, including numerous shark teeth, a complete mosasaur upper jaw, and spectacular jaws of a needle-toothed fish called *Cimolichthyes*.

Gorgeous jaws of the fish *Cimolichthyes*.

Fall 2020 courses were essentially held normally, and it was a relieving breath of fresh air. All my courses were held in-person, and I was able to experience something I'd nearly forgotten, real contact with students. It was amazing and badly needed. This fall I taught courses in historical geology, field methods, and phylogenetic systematics, or constructing evolutionary trees. The students were equally as grateful to be back in the classroom and performed exceptionally.

Speaking of classrooms, we had a change to teaching facilities this fall in the Paleontology Research Laboratory. Our old classroom, connected to the vertebrate collections, was a bit small and did not have a drop ceiling, so the acoustics were not ideal. So, we moved the teaching classroom over to a larger room initially meant for curation and map storage. The new room fits up to twenty-five students, has large wood-topped tables for laboratory work, and the carpeted floor and ceiling tiles make for excellent sound quality. The students love it too!

My partner and I suffered a hard loss last spring. Our beloved chiweenie Hilde left us due to diabetes and glaucoma. She was with us for seven excellent years and had a good long life of sixteen years. We scattered her ashes in the hills amid a ton of squirrels, so she'll be happy and busy.

But, this holiday season we welcomed a new addition to the family, a precocious and stubborn little pup from the Black Hills Humane Society. She is a mutt, and we're not sure what breeds she is, but she's an adorable handful. We have yet to even give her a name. As I write this, she's gnawing on my toes with those deadly sharp puppy teeth. She's a fantastic breath of life to the house this holiday season.

Left: our precious little girl, Hilde. Right: our new bundle of insanity. Name suggestions are welcome!

Best wishes to you all for the holiday season and a successful 2022!

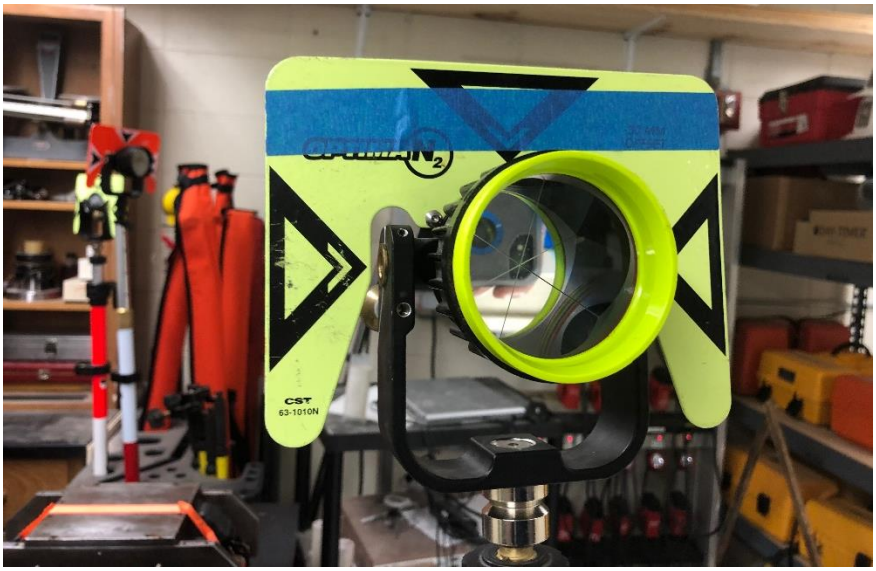
Curtis Price

This has been quite the year 2021 teaching all things geospatial, dodging covid-19 and student absences thereof (I am triple vaxxed, thank you very much) and facing the big 61 in a few days (a Mines colleague called me "spry" today). I have continued teaching my fall (4) and spring (3) courses, including some great fun with a new (to us) iSite 5800 terrestrial lidar, some new BadElf GPS devices, and Dr. Price's new GIS book (second edition coming soon)! We worked hard with the local GIS nerds to produce a successful online Black Hills Digital Mapping Association conference and also on the Undergrad Recruiting Committee – it seems some of our efforts (and the adjustments to a post-covid world) are working in our favor – the numbers for 2022FA are looking promising! The GEOL faculty all worked very hard on our ABET accreditation process which seems right on track. And, grad school: I passed my PhD qualifying exams last April so I'm ABD. My dissertation involves extracting stream profiles and knickzone features thereof from digital elevation data, doing comparative analysis of results between DEM sources, and comparative analysis among these profiles in Laramide terranes of the Northern Plains (my committee includes Drs. Stetler, Pagnac, and Sawyer, among others). I have a feeling that this is something I should be doing, because back in the early 1990s I was working with USGS's Sue Greenlee and Dave Wolock on elevation derivatives (you can look it up) so it is one of those full-circle deals. I've been very busy teaching, so progress has been slow since then, but looking to present some preliminary results perhaps at ASPRS in March and definitely at the Black Hills Hydrology conference next year.

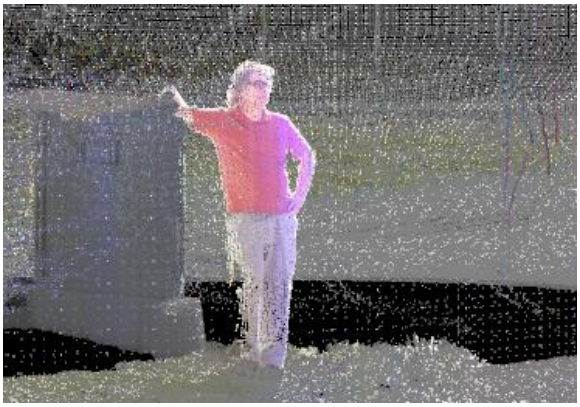
The biggest news I should report to you is that after a rewarding five years, I have decided to resign from the faculty effective in August 2022 to focus on my dissertation, consulting, and teaching, and (happily) return to my old stomping grounds on Whidbey Island on the Salish Sea (north of Seattle) so this will be my last newsletter post! I am so grateful for the support and encouragement from the GGE and South Dakota Mines faculty and staff. There are far too many to list, except I must give a special shout-out to our hard-working and patient (with me) GGE chair Dr. Anderson, and (of course!) Cleo. I am excited for what a new candidate more versed in the newfangled ways of The Cloud will bring to our geospatial students, keeping in mind (of course) that it's all about the fundamentals!

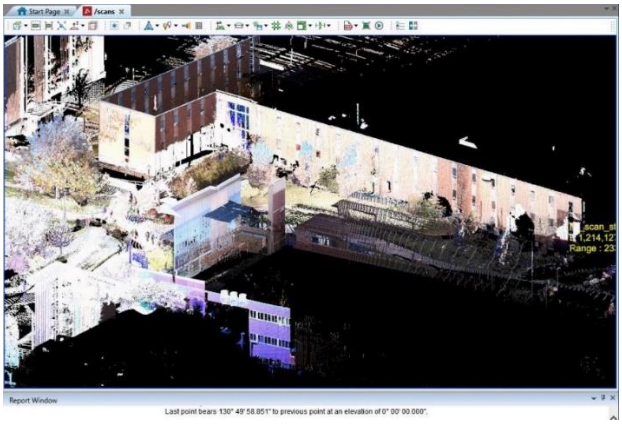
As we used to say in the Dartmouth College Precision Marching band: "Remember where you are!"

Keeping the energy up through the fall term



These prisms were looking a little rough, so we bought some new ones with GIS workshop money. Interested in learning or updating your GIS skills? Join us online!





Mr. Price captured by our iSite 5800 terrestrial lidar scanner (speaking of old relics, we also captured the MI building in a “point cloud” for posterity).

Larry D. Stetler

Courses during 2021 were near-normal. During spring 2021, class size was restricted with most courses being assigned two to three rooms for lecture delivery. Both my GeoE 461 Drilling and Petroleum Engineering and GeoE 482 Applied Geomorphology were assigned three rooms. This meant only a few students were in the same room as I, which may not have been as large an impact for lectures but was less than idea for labs. However, we made it through unscathed.

Fall 2021 was back to normal with no class size restrictions.

The summer GeoE 410 Engineering Field Geology course was once again conducted live and in the field! This was for most students the 1st time since March 2020 that they were unrestricted. Students were excited to be out again and thoroughly enjoyed themselves.

Currently I am working on re-analysis of USGS original Rapid City flood assessments made in 1972 after the June 9, 1972 Rapid City flood (which I experienced 1st-hand). This will hopefully result in a journal publication and presentations. I will be working on some of this with USGS scientists from the Rapid City office. I also started a YouTube channel in summer 2021 the focuses (mainly) on Black Hills and local geology. You can take a look here: Rock'n DrRocs. I am making a video series for spring release that details a watershed analysis and walk-through of the 1972 flood event. Also, if you would like me to visit a particular location for a Rock'n DrRocs episode, let me know.

In 2021, I am/was advisor for 1 Ph.D. Geol student, and 1 M.S. GeoE student and several MS CEE students.

Gokce Ustunisik

Alumni and friends,

Season's Greetings! Another year has flown by! It feels like it was just a few weeks ago that I was writing a letter as we come to the end of the wild and crazy 2020… This past year was a hectic yet very rewarding one, in many aspects. The big news is that I submitted my tenure dossier to be considered for promotion to Associate Professor in October 2021! Over the past 5 years, I found it extremely rewarding to be able to make significant contributions to my field as I built an Experimental Petrology Laboratory from the ground up, developed an externally funded research program in petrology and geochemistry supported by 6 research grants from several different programs under National Science Foundation (NSF) and SD Board of Regents, and trained promising graduate students.

2021 was a busy year for grant funding. Currently my research program is funded by 4 active grants (3 federal, NSF and 1 state, SD BOR). This year, I submitted 5 new grant proposals, 3 as a PI, 1 as a senior personal, and 1 as a co-PI. Among these, 3 of them are major research grants submitted to various programs under NSF including Ocean Sciences/Marine Geology and Geophysics (OCE/MG&G), Geoinformatics (GI) and NASA - Solar System Workings (SSW); 1

of them is an instrumentation grant submitted to NSF-Major Research and Instrumentation (MRI) program; and the final one is a STEM education grant submitted to NSF-EPSCoR. A few weeks ago, I was happy to receive a preliminary notification from the NSF – OCE/MG&G that we got funding for a 3-year 655K project in collaboration with Woods Hole Oceanographic Institute (WHOI). In addition to undergraduate and graduate student support, the broader impact of this project involves efforts for developing analytical infrastructure, teacher training under the Bridge program, and research projects for undergraduates in partnership with Oglala Lakota College and the Tiospaye Scholars program.

On the teaching side, I continued teaching "Mineralogy and Crystallography" in the Fall and "Igneous and Metamorphic Petrology" in the Spring in addition to my 2 graduate courses "Volcanology" and "Planetary Geology". The pandemic threw our program into emergency coping mode, but as a consequence we developed a variety of new teaching approaches that mitigated the risk including online and hybrid delivery. All of this provided us a new perspective in teaching and learning, incentivized redesign of the courses and incorporation of new teaching tools (Virtual microscope, Crystal maker, 3D scans of mineral and rock specimens, use of phones as a camera for the microscopes), and produced a digital repository (photograph and video recordings of hand specimens, thin sections, mineral ID tests) of the department's Mineralogy and Petrology collection. More importantly, these challenging times reminded us that online teaching is a way to reach a wider and more diverse student audience.

I am very proud of the effort and progress put forward by my graduate students. Erica Cung (University of California - Santa Barbara) and John Hewitt (SD Mines) established their thesis committees, successfully defended their MS thesis proposals in Spring and Summer 2021 and submitted abstracts to present their thesis research at the Annual GSA Fall Meeting and AGU Fall Conferences. Erica completed her first year and was funded under my NSF-OCE/MG&G grant in addition to graduate teaching assistantship (GTA) during Fall 2021. Erica's research focuses on evaluating the influence of dataset characteristics for the minerals garnet, amphibole, and clinopyroxene focusing on the substitution mechanisms by which rare earth elements (REEs) and high field strength elements (HFSEs) partition. John started his work with Dr. Roger Nielsen and I during his senior thesis research, funded through my SD BOR grant, and transitioned into a graduate student starting from Fall 2021. During Summer 2021, John is supported through Geology Museum's Mineral Collection while working on expanding his MS thesis research. John's research is comparative geochemical and textural study of Plagioclase Ultraphyric Basalt (PUB) lavas from the Northeastern Pacific and Gakkel Ridge systems using plagioclase compositions with associated mafic phases. His research focuses on to understand how the textural features and compositions exhibited by plagioclase megacryst in PUB lavas are affected by active magmatic processes and how the changes in magma supply, spreading rate, and mantle composition influence the association of those textures and composition. Both Erica and John are on track to graduate in Spring 2022 and are planning on submitting their thesis manuscripts to the journal Geochemistry, Geophysics, Geosystems.

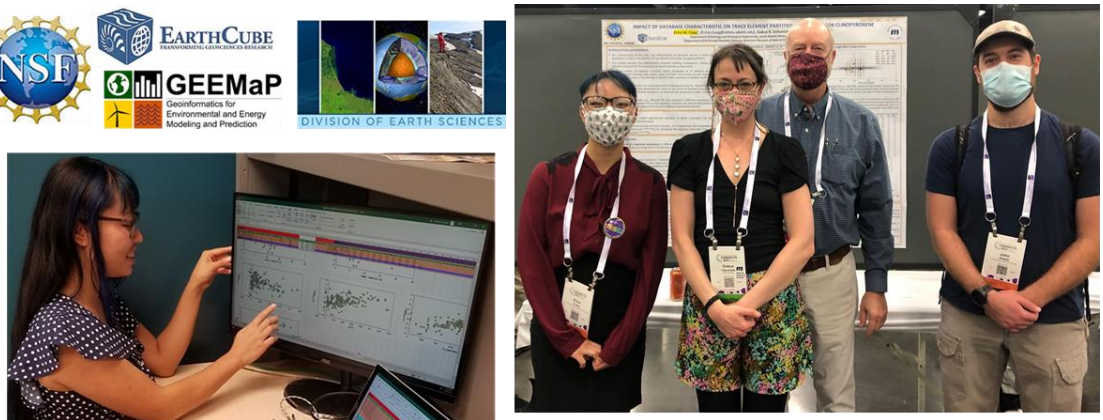
Thanks to my graduate students (Kristen Lewis, Taran Bradley) and collaborators in various projects including Dr. Roger Nielsen and Dr. Ed Duke, 2021 was an amazing year for publications. We published 6 journal articles, a book chapter, and a white paper.

- **Ustunisik, G.**, Nielsen, R. L., and Walker, D. (**2021**, In-Press in Geochemistry Geophysics Geosystems) The Missing Magmas of MOR: Insights from Phase Equilibrium Experiments on Plagioclase Ultraphyric Basalts. **Impact factor 3.447**.
- Bradley, T.*, **Ustunisik, G.**, Duke, E. F., Unluer, A.T.*, Yildirim, D.K., and Flores, K. F., **2021**, Qualitative Barometry of High P/T Rocks with Field Based NIR Spectroscopy of White Mica. Lithos. **Impact factor 3.93**.
- Onal, M., Daglar, S., **Ustunisik, G.**, Pekdemir, A. D., and Sarikaya, Y., **2021**, Thermal Crystallization Kinetics of an Opal-like Biogenic Silica. Silicon, **Impact factor 2.67**.
- Bayram, H., **Ustunisik, G.**, Onal., M., and Sarikaya, Y., **2021**, Optimization of Bleaching Power by Sulphuric Acid Activation of Bentonite. Clay Minerals. **Impact factor 1.361**.
- Kosan, I., Ustunisik, G., Onal, M., Sarikaya, Y., and Acar, P., **2021**, Irreversible Ammonia Adsorption on Asphaltite Bottom Ash: A Thermodynamic Approach. Colloids and Surfaces. 126933. **Impact factor 4.539**.
- Lewis, K.*, **Ustunisik, G.**, and Nielsen, R.L., **2021**, Experimental Constraints on Homogenization of Plagioclase-Hosted Melt Inclusions from Plagioclase Ultraphyric Basalts. Frontiers e-book entitled Crystal Archives of Magmatic Processes by Teresa Ubide, David A Neave, Maurizio Petrelli, and Marc-Antoine Longpré.
- Rose-Koga, E.F., Bouvier, A.S., Gaetani, G.A., …, **Ustunisik, G.**, Waelkens, C., Zhang, Y., and Zhou, T., **2021**, Silicate Melt Inclusions in the New Millennium: A Review of Recommended Practices for Preparation, Analysis, and Data Presentation. Chemical Geology, **Impact factor 4.015**.

Since pandemic slowed down us during 2020 attending in-person, my students and we tried making up for this during 2021. My graduate students and I also submitted 6 conference proceedings/abstracts. One was presented at the 71st Annual Meeting of Society for Industrial Microbiology and Biotechnology (SIMB) Conference in Austin, TX in August 2021; 2 were presented at the Annual *Meeting of the* Geological Society of America (GSA) in Portland, OR in October in October 2021; and 3 were presented at *American Geophysical Union (AGU) Fall Meeting in* New Orleans, LA in December 2021.

- Cung, E.*, **Ustunisik, G**., and Nielsen, R. L. Quantitative Analysis of Trace Element Partitioning Data for Clinopyroxene, Garnet, and Amphibole Using Statistical Methods.
- Hewitt, J. B.*, **Ustunisik, G**., and Nielsen, R. L. Petrogenesis of Plagioclase Ultraphyric Basalts (PUB) from the NE Pacific Ridge System: Evidence from Mineral Textures and Trace Element Characteristics.
- Dygert, N.#, **Ustunisik, G**., Lewis, K.*, and Nielsen, R. L. Application of a Eu-in-Plagioclase-Melt Oxybarometer to Phenocryst-Host Pairs and Melt Inclusions in MORBs Reveals Resolvable Heterogeneity in Oxygen Fugacity.
- Cung, E.*#, **Ustunisik, G**., and Nielsen, R. L. Impact of Database Characteristic on Trace Element Partitioning Models for Clinopyroxene.

- Hewitt, J. B.*#, **Ustunisik, G**., and Nielsen, R. L. Textural and Compositional Features of Plagioclase and Mafic Phases of Plagioclase Ultraphyric Basalts (PUB) from the NE Pacific Ridge System.
- Govil, T*#., Vaughn, M.*, Soeder, D., **Ustunisik, G**., Lingwall, B., and Sani, R. CO_2 Solutions - Driven by Enzyme-Enabled Carbon Capture.



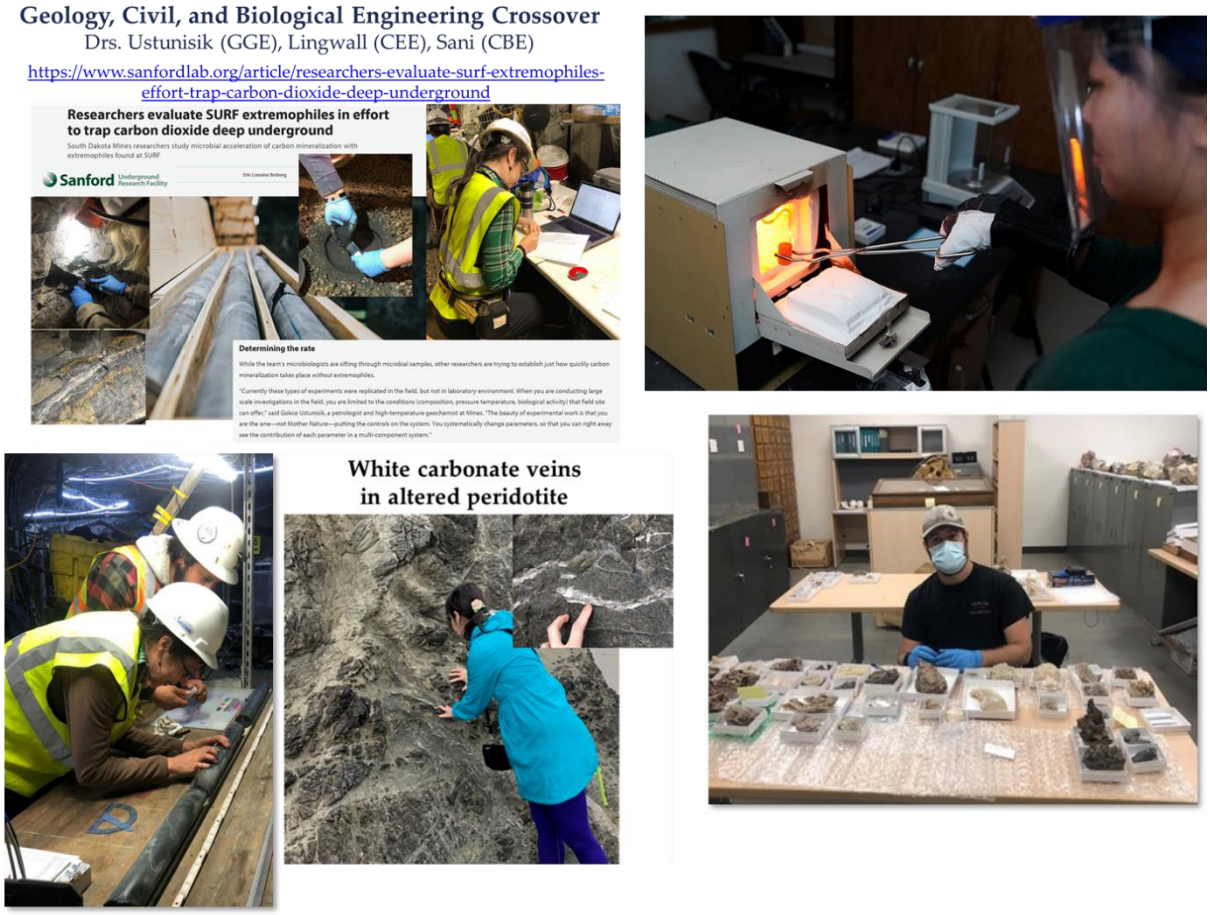
Left to right: Erica Cung, Gokce Ustunisik, Roger Nielsen, John Hewitt at Annual Meeting of the GSA, Portland, OR October 2021.

Left to right: Grace DeVault, Erica Cung, Colleen Sullivan, Michael Cyrier, Rudy Hummel at Annual Meeting of the GSA, Portland, OR October 2021.

Besides, research and teaching, I continued being involved in several department, university, and professional committees. Of those, I believe that I had the highest impact as part of the Peer-Review of Teaching committee; Structural Geology/Tectonics Search committee; Women in Science and Engineering (WiSE) advisor of GGE department; University Research committee; leading the IEDA traceDs and Library of Experimental Relationships (LEPR) (EarthChem- Experimental Petrology); and getting involved in the Tiospaye Organization and STEM Tribal College Committee. I am very excited about our 2 new hires - Dr. Trevor Waldien and Dr. Yi Fang and looking forward to possible research collaborations with both of them.

Last, but not the least, my group's research was featured in couple press articles including "Meet Sanford Underground Research Facility (SURF)'s tiniest tenants" Sanford Press Release

by Erin Broberg and "South Dakota Mines Leads Research to Aid Understanding of Earth Systems with Big Data" SD Mines News Release by Mike Ray. You can read more about *Geochemical Controls on Carbon Sequestration regarding our recently funded NSF CBET project - Ustunisik (co-PI, GGE), Lingwall (PI, CEE), and Sani (co-PI, CBE)* at https://www.sanfordlab.org/article/researchers-evaluate-surf-extremophiles-effort-trap-carbon-dioxide-deep-underground and *A research team at South Dakota Mines led by Dr. Ustunisik create a system that can compile experimental data from around the world on the elements that make up the earth's crust and mantle* at https://www.sdsmt.edu/News/Big-Data-Earth-Systems-Research/#.Yb_zNWjMJdg.



Best wishes to you and yours for a happy and healthy holiday season and lots of hopes for 2022!

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.

Again 2021 been a difficult year for me and the field station. We ended up cancelling all international camps except Iceland and Turkey. We managed to offer all other camps with 267 students attended.

We plan on offering all 21 courses in 2022 (shown in Table below). This winter I will be travelling to Arizona, Death Valley and Hawaii for our winter camps. About 760 students attending winter camps.

We are actively working on building the new field station. We have made substantial progress and the details of the new developments will soon be sent to alums by the Foundation.

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

Trevor Waldien

Hi Everyone! I'm Trevor Waldien- a new structural geology/tectonics professor in the department. I come to SDSMT straight from graduate school at UC Davis and prior to that I earned a bachelor's degree at Oregon State University (I also grew up in Oregon). My research interests are relatively broad within the fields of Tectonics and Structural geology but can be boiled down to the question- "why do some faults get reactivated, and others don't?". This and related questions motivate multiple research projects focused on deciphering the origin of major structures in orogenic belts, how those fault systems evolve in response to changes in plate boundary conditions, and how the tectonic evolution of long-lived plate margins influences the mechanical properties of the lithosphere. All of my work to date has been focused on western North America from California to Alaska, where I am currently focusing on the evolution of strike-slip fault systems during oblique subduction. Research tools I use include geologic mapping (everything has to start with a map!), thin section rock fabric analysis, several types of geo/thermo-chronology, and remote sensing (because sometimes active surface deformation is too subtle to see in the field!).

Although I just started, I inherited a graduate student when I came here, who successfully defended his MS this fall. I am advising two undergraduate researchers. One is focused on a geostatistical meta-analysis of all of the published low-temperature cooling age data in southern Alaska with the goal of testing a long-hypothesized spatial correlation between young cooling, elevated topography, and Quaternary faulting in Alaska. The other student is working on a remote mapping project in northeastern California with the goal of understanding how strike-slip faulting is overtaking the southern Cascade arc. I am actively recruiting graduate students for fall 2022 to work on projects related to strike-slip faulting in Alaska and blueschist exhumation in southwestern Oregon.

I am absolutely tickled to have ended up in Rapid City! Admittedly, I hadn't thought much about South Dakota prior to applying to the job here. However, in just my first semester I have been quickly tuned in to the great geology that the Black Hills offer. Aside from the academic stuff, I'm finding that the Black Hills and Rapid City have pretty much everything that I could hope for: fall colors, great mountain bike trails, climbing, skiing, craft beer, craft coffee, etc... In sum- I'm settling in nicely and I feel like this place is a good fit for me.

Dr. Trevor Waldien on a recent sampling traverse in the Alaskan Range with the Delta River in the background.

Kevin Ward

Hello all and welcome to 2022. As I reflect on 2021, I found it to be a productive year. Over the winter, I was busy leading the search for our new structural geologist. It is somewhat satisfying to see our new hire fitting in well, advising graduate and undergraduate students, and already teaching some of our bigger geology courses here at SD Mines. Over the summer, I was busy hosting an Incorporated Research Institutions for Seismology (IRIS) undergraduate intern and a SD Mines undergraduate student who worked on research projects with me. The highlight of the summer was deploying 755 seismic stations along the Cascadia margin from northern California to southern Washington. This was a large, multi-institutional project that allowed me to work with several volunteers from around the country. Many of them veterans and students from other disciplines such as physics or chemistry. Providing research opportunities to students who might

not otherwise have this type of field experience is always satisfying, even if it was a logistical behemoth of an undertaking.

A highlight of the fall was our in-person annual GGE fall field trip, again traveling to Yellowstone National Park this year. This year we had our largest participation yet with 25 students attending along with a big thanks to Dr. Keenan for helping again with this trip. Our goal is to visit Yellowstone National Park every other year both allowing for some flexibly in locations every other year while also making sure every student, B.S., M.S., and Ph.D. has the opportunity to attend a Yellowstone trip during their tenure here at SD Mines. As 2021 wraps up, I find most of my time being spent working on a new course offering for our undergraduates. Geological Disasters and Society will be offered for the first time in spring 2022 and it will focus on the most common natural hazards and potential for disasters resulting from living on a dynamic Earth in the context of their impact on society. Enrollment for this class is already full and I am looking forward to trying some new interactive and engaging teaching methods that are well suited for the content of this course. But enough about my year, how was your 2021? Next time you are on campus, stop by and let me know. I hope it was a productive year for you as well.

Group photo of the GGE faculty/students who attended/presented at the fall AGU meeting in New Orleans, LA.