SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Department of Geology and Geological Engineering 2017 Alumni Newsletter

Department of Geology and Geological Engineering– Fall 2017 (above) and 1991 (below): Right to left: (from front row)- Gokce Ustunisik, Laurie Anderson (Head) and Nuri Uzunlar, Maribeth Price, Zeynep Oner Baran, Curtis Price, Kurt Katzenstein, Dan Soeder, Tim Masterlark, (Back row) Liangping Li, Foster Sawyer, Ed Duke, Chris Pellowski and Darrin Pagnac, Absent: Larry Stetler, Arden Davis, Colin Paterson, Alvis Lisenbee, Perry Rahn, Sally Shelton, Bill Roggenthen and Jim Fox.

Department of Geology and Geological Engineering

Front row, left to right: Pam Fenner, Dr. Alvis L. Lisenbee, Dr. Colin J. Paterson, Dr. Perry H. Rahn.
Middle row, left to right: Dr. James E. Fox, Dr. Paul Gries, Dr. W. M. Roggenthen, Dr. Arden D. Davis.
Back row, left to right: Dr. Jack A. Redden, Dr. H. I. Bilgesu, Dr. Ed Duke.

From the Editor – Nuri Uzunlar

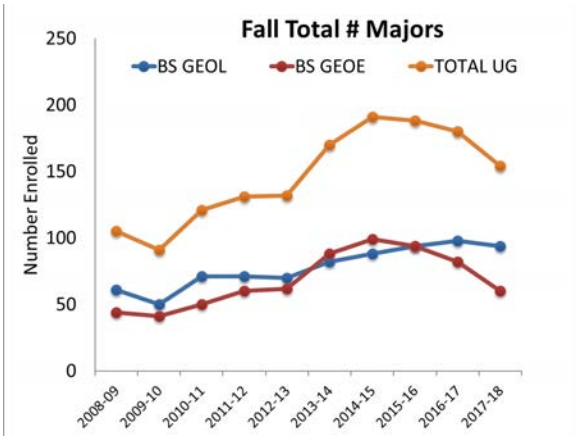
Greetings Alumni and friends!
I wish each and every one of you good health and happiness in 2018. The 2017 newsletter is being produced as PDF and DOC and posted on the department's website http://geology.sdsmt.edu. Alumni with emails will be notified that it is on the web page. Please pass this newsletter to other alums you may know without emails. Have a blessed holiday season!

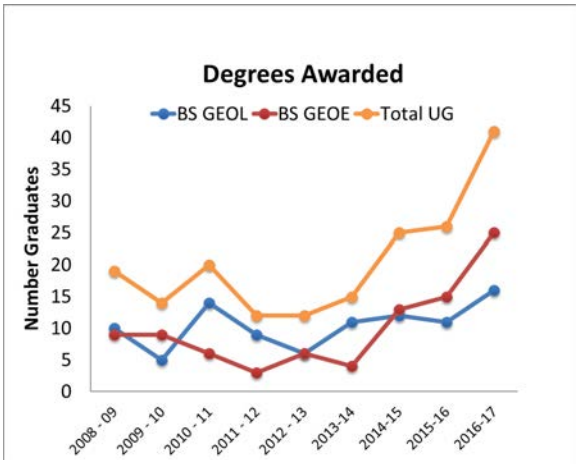
From the Head – Laurie Anderson

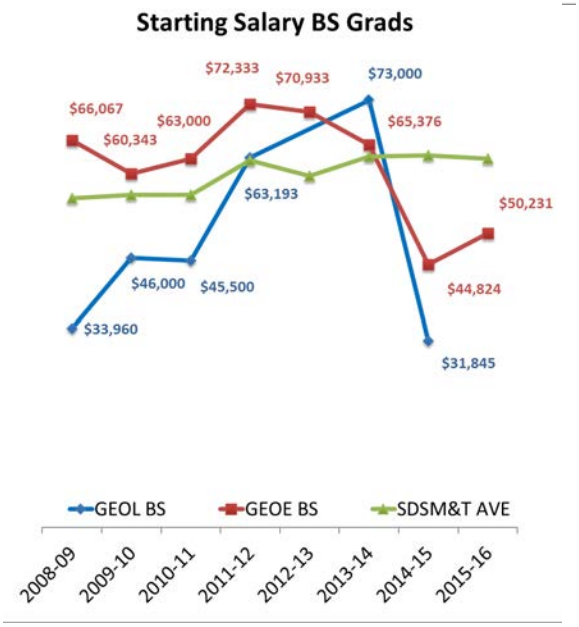
Status of the Department

Greetings at the end of 2017. We hope your's has been a happy one. The Department of Geology and Geological Engineering (GGE) had several changes this year. **The number of undergraduate majors declined, but given instability in the energy sector and our increasing number of degrees awarded, the number of undergraduate majors has shown only a moderate decline over 5 years (~9.5%). We currently have 154 GEOL and GEOE majors.** In our graduate programs, enrollment overall is stable (currently 40), while seeing 8 degree completions in 2016-17 (5 MS GGE, 1 MS PALE, and 2 PhD students graduated).

Career placement of our undergraduates has seen some of the effects from the downturn and recovery in the mining and petroleum industries. In 2015-16 (the latest numbers available), GEOE had 89% placement and GEOL had 85% placement. Average **starting salaries are still depressed from 2013-14, however.** That said, this fall we had **29 companies and agencies** recruiting our students at the Fall Career Fair (there were 30 in 2014, 15 in 2015, and 24 in 2016). We have much to do to increase the visibility of our excellent programs and students with industry at a national and international level. **We welcome any assistance that alumni and industry partners can provide in promoting SD Mines, GGE, and our students!**







We had a couple of faculty members leave us in 2016-17, one just across campus and another across the country. Maribeth Price was named the Dean of Graduate Education and started her new position in April. Christina Belanger accepted a faculty position at Texas A&M University, and she and her husband David Bapst (adjunct faculty) and their daughter left us in July.

We also have a couple of new faces in the department. Dan Soeder joined us in April as the inaugural Director of the ***Energy Research Initiative (ERI),*** *an interdisciplinary research and teaching effort on campus in energy resources. Dan's expertise is in both geomechanics of shales and water resource issues associated with unconventional resource development. We also were able to steal Curtis Price away from the USGS to become a Lecturer in geospatial technology. Curtis starts full time with us in January 2018. In addition, Kurt Katzenstein was promoted to Associate Professor with tenure.*

We have received permission to search for two new faculty members this academic year. One search is for someone in analytical paleontology (Darrin Pagnac is chairing this search) and the other is in geophysics (Kurt Katzenstein is chairing this search). We hope to report two successful hires to you soon.

We continue to strive to build our research programs in the department. Such awards help support both undergraduate and graduate students, and provide them opportunities for research experiences in the field and laboratory. Faculty who submitted grant proposals through research affairs in 2017 include Tim Masterlark (4), Gokce Ustunisik (3), Foster Sawyer (3), Liangping Li (2), Maribeth Price (2), Zeynep Baran (2), Dan Soeder (2), Jay Tung (postdoc, 1), and Bill Roggenthen (1).

We would like to acknowledge the gifts we received for the Department or the Museum of Geology. In Fiscal Year 2017, we received $360,137 in unendowed giving to the department and $1,385 to the Museum of Geology, and $95,000 for newly established or additions to existing endowments for the department and $25,000 for the Museum. We thank all friends, alumni, and corporate partners for your generous support of out students and programs.

Below is a list of departmental scholarship and other award recipients to date for 2017-18.

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

Outstanding GGE Student Awards:

- Redden Award (Outstanding GEOL Senior): Kayleigh Muilenberg
- Tullis Award (Outstanding GEOE Senior): Fleford Redoloza & Baylor Wagehoft
- Outstanding GGE graduate students: Brooke Long (MS PALE 2016; PhD GGE); Kyle Hazelwood (PhD GGE)

GGE Scholarships:

- D. Sherwin Artus GEOE (BS GEOE): Ryan Peyton, Nakaila Steen, Wyatt Tatge, Regan Wess
- Artus Petroleum Systems: Brittany Coupe (BS GEOE), Benjamin Douvier (BS GEOE), Mollie Hunt (BS GEOE), Andrew Lee (BS GEOE), Sterling Richard (BS GEOE)
- Mary Baresh Memorial: Dominic Krause (BS GEOE)

- Jeffrey L. Bauer Memorial: Christian Albayalde (BS GEOL), Hannah Duncan (BS GEOL)
- Lynn & Nancy Owen Bell: Bailey Schwenk (BS GEOL)
- Edwin Bittner/John Campbell MI Memorial: Jared Fox (BS GEOL)
- Homer Davis Memorial: Matthew Hedgespeth (BS GEOE)
- French: Cody Stock (MS GEOL)
- Paul & Virginia Gries (undergrads): Anthony Gordon (GEOL), Katie Kloos (GEOL) Gabriel Poteet (GEOL), Jimmy Bradford (GEOL), Hillary Ping (GEOE)*, Andrew Kiernan (GEOL), Tiffany Schilling (GEOE)
- Paul & Virginia Gries (grads): Julie Driebergen (MS PALE)*, Jared Fox (MS GEOL)*, Shannon Harrel (MS PALE)*, Alexander Rogaski (MS GEOL)*, Colton Medler (MS GEOL)*, Ryan Puzul (MS GEOL), Stephanie Loose (MS GEOL)
- James O. Harder Memorial: Jared Fox (BS GEOL)
- John & Kathy Heinemann ERI Petroleum Systems: Benjamin Douvier (BS GEOE), Johnathon Malone (BS GEOE), Sterling Richard (BS GEOE)
- Ben Holmes Memorial: Peter Daly (BS GEOL), Desiray Wilson (BS GEOL)
- Joseph W. & Josephine B. Kulik Field Station: Desiray Wilson (BS GEOL)
- Joseph W. & Josephine B. Kulik Scholarship (CO resident): Liam Smith (GEOE)*
- Dr. Ray E. Lemley Memorial (field camp): Todd Anderson (BS GEOE)
- Alvis Lisenbee (BS GEOL): Hallie Bower
- Mickelson: Scott Kottkamp (MS PALE)
- Newmont Mining Corporation: Gabriel Poteet (BS GEOL), Todd Anderson (BS GEOE), Tristan Walker (BS GEOL)
- Roadifer: Tyler Greenfield (GEOL), Michael Nieland (GEOL)
- Bill & Jean Roberts (UG): Tristan Walker (BS GEOL)
- Roberts (Western Gem and Mineral Society): Jordon Fostvedt (BS GEOL)
- Roberts (Grad): Scott Kottkamp (MS PALE)
- Surbeck-Connolly: Joron Fostvedt (BS GEOL)
- Seth Schaefer: Jordon Mason (BS GEOL), Maxwell Southbloom (BS GEOE)
- Shawn Stickler: Todd Anderson (BS GEOE)
- Whiting Scholarship/Fellowship: Hillary Ping (BS GEOE)*, Kyle Hazelwood (PhD GEOL), Michael Baranowski (PhD GEOL), Scyller Borglum (PhD GEOE)
- Whiting Student Enrichment: GSA Denver (8 students), Michael Baranowski (AGU), Scyller Borglum (SPE Russian Petroleum Tech Conf), Nicole Ridgwell (AMMP)

***Incoming Student**

Laurie Anderson News

My research this year involved both field work and collections work in the Museum of Geology. Work on a project funded by the NSF Dimensions of Biodiversity program with Annette Engel from the University of Tennessee - Knoxville and Barbara Campbell from Clemson University continues. This project is a field and lab investigation of the genetic, taxonomic, and functional diversity of modern lucinid bivalve chemosymbiosis from coastal marine biomes. At SD Mines, we are investigating how the morphology of the living bivalve hosts might reveal the presence of endosymbionts, degree of symbiotic dependence, or the type of symbiont dependence.

Field work in 2017 for this project included reconnaissance work in Florida in May. We are also taking a group of students to the Bahamas between semesters in 2017-18. Two of my graduate students, Brooke Long and Broc Kokesh, are working on aspects of this project and both are progressing well. Brooke Long (PhD, GEOL) passed her comprehensive exams this fall and is working on a phylogenetic project to combine fossil and recent lucinid taxa into phylogenies for the family and understand how morphology is controlled by that evolutionary history. She is also working on manuscripts from her MS thesis. In addition, Broc Kokesh (MS PALE) passed his MS coursework exam this semester, and is progressing on his thesis, which focuses on the lucinid *Ctena orbiculata* that is found in both coastal areas and lakes with marine conduits on San Salvador, the Bahamas.

My two other MS students, Megan Norr (PALE) and Kayleigh Johnson (PALE) are also doing very well. Megan has passed her MS coursework exam and is using western Atlantic collections to examine the morphologic response of arcid and arcopsid bivalves to a regional mass extinction in the Plio-Pleistocene. Kayleigh is in the accelerated MS program and is off to a running start with a vertebrate preparation project. Both of them are also incredibly valuable on a collections grant that is supporting their research assistantships.

I also published a paper in the Journal Applied and Environmental Microbiology on the effects of the Deepwater Horizon spill on coastal biomes in Louisiana with colleagues from Louisiana State University and the University of Tennessee-Knoxville.

The PRL is busy with many undergraduate and graduate students involved in several collections projects as well as other research. Our project funded by the Institute of Museum and Library Service wrapped up in 2017, but NSF Collections in Support of Biological Research, Bureau of Land Management, and NSF Advancing Digitization of Biological Collections grants continue.

Because I didn't have a lot of field work this summer, John and I decided it was a good time to add another dog to the household. Here we all are! Piper (left) is our new Doberman rescue.

2017 GGE Department news:

January:

Dr. Laurie Anderson explores how marine clams found their way into one of the world's largest rivers
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/2017-Legacy-News-January/

Ms. London Ruff (BS GEOL) expressed her passion for geology in a video that earned her a $10,000 scholarship from the "Search for Hidden Figures" STEM video contest. Over 7,000 entries were submitted. Two grand prizes and 10 runner-up scholarships were awarded. Congratulations, London!
https://www.youtube.com/watch?time_continue=6&v=ggFGyVmYZ3c

A Rare Find: How one fossil hunter fueled paleontology at SD Mines for decades (pages 18-19)
Firewalker: Unique rover built at SD Mines takes geologists, and possibly one day astronauts, to new surfaces for research (pages 26-27) Drs. Tim Masterlark and Theodore Donovan (PhD GEOL '16)
Amazon research: Dr. Laurie Anderson explores how marine clams found their way into one of the world's largest rivers (pages 28-29)
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Hardrock-Winter-2017/

February:
Department of Energy's Dan Soeder named as first Energy Resources Initiative Director
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/2017-February-Legacy-News-Final/

March:
Women in Science encourages girls to pursue STEM careers – Ms. Kelsie Abrams
http://www.blackhillsfox.com/content/news/Women-in-Science-encourages-girls-to-pursue-STEM-careers-415625343.html

April:
Mines students push to preserve gigantic Jurassic dinosaur bed in Utah – Sally Shelton
https://www.sdsmt.edu/Research/Research@Mines/Mines-Students-Push-to-Preserve-Gigantic-Jurassic-Dinosaur-Bed-in-Utah/
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Legacy-News-May-2017/
http://www.blackhillsfox.com/content/news/Hardrockers-look-to-help-fossil-preservation-in-UT-420672093.html

Dr. Maribeth Price named Dean of Graduate Education at SD Mines
https://www.sdsmt.edu/News/Price-Named-Dean-of-Graduate-Education-at-SD-Mines/

https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Legacy-News-May-2017/

SD Mines teams win Governor's Giant Vision Business Plan competition – Ms. Scyller Borglum (PhD GEOE) and Mr. Zack Malone (BS GEOE)
https://www.sdsmt.edu/News/SD-Mines-Teams-Win-Governor-s-Giant-Vision-Business-Plan-Competition-2147476884/
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Legacy-News-May-2017/

GGE students Ms. Lilly Jones (PhD GEOL) and Mr. Colton Medler (BS GEOL) were a two-way tie for third place at the Western Dakota Hydrology Conference student poster contest.
https://sd.water.usgs.gov/WSDconf/photos.html

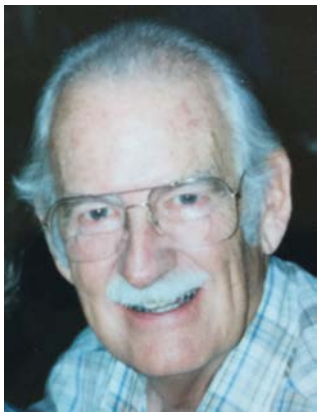
Student's experience what the job market is like at General Beadle Elementary School and one would even like to become a paleontologist!
http://www.kotatv.com/content/news/Students-experience-what-the-job-market-is-like--419327484.html

School of Mines faculty member digs up 'new' old bones – Ms. Danielle Serratos
http://www.kotatv.com/content/news/Dino-Discovery-420254353.html
School of Mines employee discovers new Elasmosaurus species – Ms. Danielle Serratos
http://www.newscenter1.tv/story/35183649/school-of-mines-employee-discovers-new-elasmosaur-species

May:
Museum of Geology named one of the 50 most impressive college museums nationwide – Ms. Danielle Serratos
https://www.sdsmt.edu/News/Museum-of-Geology-Named-One-of-the-50-Most-Impressive-College-Museums-Nationwide/
http://www.kotatv.com/content/news/SDSMT-Museum-of-Geology-named-one-of-50-Most-Impressive-College-Museums-421182194.html

June:

Paul R. Fenske (1925-2017)



Paul R. Fenske, formerly Executive Director, Water Resources Center at the Desert Research Institute of the University of Nevada System and Research Professor of Hydrology and Geology, University of Nevada-Reno, died on June 14th, 2017. He was 92. Known as a fine research scientist as well as engaging teacher of undergraduate and graduate students, he was also a sparkling conversationalist who enjoyed the company of his family and his friends, particularly during the later years of his life.

Born in Ellensburg, Washington on May 15, 1925, Paul entered the South Dakota School of Mines in Rapid City in 1943, and in October of that year, left for military service during World War II on the U.S. Territory of Guam. After his discharge on April 23, 1946, he completed his studies in Geological Engineering, which he followed with a master's degree in Geology at the University of Michigan, graduating in 1951.

Paul Fenske began his career as an oil exploration geologist at the Magnolia Petroleum Company in Bismarck, North Dakota. He continued that work in Midland and Lubbock, Texas before pursuing a Ph. D. in Geology at the University of Colorado, Boulder, graduating in 1962. He taught briefly as an Assistant Professor of Geology at Idaho State University, prior to accepting a position in research at Teledyne Isotopes in Palo Alto, California. In 1971, he was appointed Research Professor at the Desert Research Institute, University of Nevada in Reno, and from 1984 served as Executive Director of the Water Resources Center, at the time the largest of DRI's research groups. At DRI, Fenske managed ground-breaking research efforts investigating the movement of contaminants through desert groundwater systems. In doing so, he improved the understanding of the hydrologic process, work which found direct application to other problems of hazardous waste contamination.

Ask Mines Expert: Mr. Daniel Soeder, Director of SD Mines' Energy Resources Initiative (page 6)
Mammoths under LA (pages 10-11) Dr. Ashley Leger (PhD GEOL '16)
https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Hardrock-Summer-2017/

July:
$540,000 NSF grand boosts 6-12th grade STEM teaching efficacy – Dr. Foster Sawyer
https://www.sdsmt.edu/Research/Research@Mines/$540,000-NSF-Grant-Boosts-6-12th-Grade-STEM-Teaching-Efficacy/

August:
Students present research on affordable housing, buffalo water supplies, food production and more to tribal agencies – Dr. Foster Sawyer
https://www.sdsmt.edu/News/Students-Present-Research-on-Affordable-Housing,-Buffalo-Water-Supplies,-Food-Production---More-to-Tribal-Agencies/

October:
SDSM&T clubs join together to help the public identify fossils, rocks – Society of Economic Geologists, Tech Geological Association and the Paleontology Club
https://www.sdsmt.edu/News/Public-Invited-to-Bring-Rocks,-Fossils-to-Museum-for-Identification-2147476394/
http://www.blackhillsfox.com/content/news/SDSMT-help-the-public-identify-fossils-and-rocks-450487243.html

http://www.newscenter1.tv/story/36586558/sd-mines-students-rockin-it-for-rock-and-fossil-id-day
http://rapidcityjournal.com/news/mines-to-host-rock-and-fossil-id-day/article_f081022c-28bb-5c35-8278-163e5d4a74ec.html
Trick-or-Treaters "Night at the Museum" – The Paleontology Club student members
https://www.sdsmt.edu/News/Night-at-the-Museum-Features-Trick-or-Treating-with-the-Dinosaurs(2)/
http://www.kotatv.com/content/news/Trick-or-treaters-Night-at-the-Museum-453685163.html

November:
Local reaction to new Tyrannosaurus rex theory – Dr. Darrin Pagnac and his plastic dinosaur models ☺
http://www.kotatv.com/video/?vid=455753383
Eighth grade career and college fair hits Dakota Tech – Dakota Kersten (BS GEOL)
http://www.kotatv.com/content/news/Eighth-grade-career-and-college-fair--458105453.html

It starts with a scholarship…
The Fall 2017 entering freshman class of 562 includes 40 GGE students. The GGE department was able to award 14 freshman students a total of $19,675 in scholarships with awards ranging from $1,000 to $3,000. While we are highlighting freshman scholarships, we appreciate the continuing support of scholarship donors who provide scholarships to GGE student's at all academic levels. Our future goal is to award at least 50% of the entering freshman with a scholarship and any help that you can provide is greatly appreciated!

It starts with a scholarship (a new video for the Foundation's scholarship drive)
https://www.youtube.com/watch?v=YgxWc0B27cU
SD Mines Foundation – ways to give
https://foundation.sdsmt.edu/giving/donate-now
It starts at SD Mines (a new recruitment video for the university)
https://www.youtube.com/watch?v=PFgEu8e4QSs
Why study geology and geological engineering at SD Mines? (A new video used for department recruitment efforts)
https://www.youtube.com/watch?v=TfVznueYhBw

Flickr albums:
Geology and Geological Engineering
https://www.flickr.com/photos/sdsmt/sets/72157680169276090
Paleontology
https://www.flickr.com/photos/sdsmt/sets/72157683278512481
Black Hills Natural Sciences Field Station (BHNSFS) field camps
https://www.flickr.com/photos/sdsmt/sets/72157665745896659
Mr. Kenny Brown spending time at his ranch and in the PRL building prepping fossils
https://www.flickr.com/photos/sdsmt/sets/72157680250387136
Dr. Laurie Anderson conducting Amazon River research
https://www.flickr.com/photos/sdsmt/sets/72157678701249195

Christopher Pellowski

It was another busy year at Ranch A with three five-week sessions being offered this past summer. During the three five-week sessions, we had 22 students from 13 universities in session one, 28 students from 15 universities in session two and 26 students from 13 universities in session three. The weather this year was certainly a mixed bag of sorts with some pretty cool days in session 1 after the first week of above average temperatures along with some extended periods of hot weather throughout sessions 2 and 3 and certainly no shortage of rainy weather as well. This video was created by session one instructor Dr. Greg Baker (U of KS) and it gives a bird's eye view of how we spent our five weeks in the field. https://vimeo.com/230846622

Session 1, 2017 students and instructors

The counselors from Admissions have once again invited our department to join them for recruitment visits to promote our programs. We loaded up the new Augmented Reality Sandbox (Dr. Katzenstein's latest creation - https://arsandbox.ucdavis.edu/), packed up some mineral and fossil specimens to display and handed out our undergraduate degree brochures to interested students. We visited North Middle School's STEM Night on November 8th as well as the first annual Rapid City Area Schools Eighth grade college and career fair held on November 16th at Western Dakota Technical School to help the students better understand what geologists, geological engineers and paleontologist do each day and why this could be one of their career choices in the future.

North Middle School students enjoyed forming their own landscapes in the new Augmented Reality Sandbox created by Dr. Katzenstein. Photo by Dr. Katzenstein

I taught the Geol 351 Earth Resources and the Environment class in the spring semester with 31 students enrolled. The class was made up of geology students along with students from Civil and Environmental Engineering, Mechanical Engineering, Materials and Metallurgical Engineering and Interdisciplinary Sciences. The students really enjoyed learning about Earth's (finite) resources and the impact they make upon their daily lives and the environment.

This year I am serving on three department committees and will be teaching GEOL 451 Economic Geology during the Spring 2018 semester with 12 students already signed up.

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

https://www.facebook.com/SDSMTGeologyGeologicalEngineering

From Our Emeritus Professors:

Colin Paterson

I spent January through April in Te Anau, New Zealand, and led a 2 week tour of the South Island for SDSM&T faculty, including Alvis Lisenbee.

The **Society of Economic Geologists student chapter**, headed by Cody Stock, continues to be very active in the department with about 20 members involved in monthly meetings, field trips, outreach activities, and sponsoring of refreshments for the department seminars. Five students (sophomore to graduate) went on the SEG-sponsored trip in October to the Turquoise Ridge gold mine (NV), hosted by Tony Gesualdo (MS Geol 2016). In October, we hosted Dr. Dan Wood

(SEG Thayer Lindsley Visiting Lecturer) – he presented a department talk on "Future Exploration – How Will We Need to Explore?" On the same day, Dr. Steve Enders (Dept Head, Colorado School of Mines) presented on "Essential Elements for Exploration Success" at the SEG meeting.

Kelli McCormick (Mining Dept) and I have been working on dating igneous rocks in SE South Dakota, and published a paper along with Kevin Chamberlain (U Wyoming) in the Canadian Journal of Earth Sciences: "U–-Pb baddeleyite crystallization age for a Corson diabase intrusion: possible Midcontinent Rift magmatism in eastern South Dakota". The date of 1149 ± 7 Ma is the first obtained on these dikes that intruded the Sioux Quartzite and basement gabbroic rocks, and makes the link to the Mid-Continent Rift about 200 km to the east.

If any of you are in New Zealand or intending to travel there, email me – Becci and I will be based in our summer residence in Te Anau, gateway to Fiordland National Park in the southwest of the South Island, during January-April 2018. Our home is available as a vacation rental outside those months –google "Mountain Vista on Matai". If you are interested in geological/cultural tours of New Zealand during January-April 2019, email me.

SEG Student Chapter group at Turquoise Ridge Au mine, Nevada.

Perry Rahn

The department often gets inquiries from locals concerning water table conditions in the Black Hills. Perry Rahn helps to respond to these inquiries. This past summer Perry helped teach the geological engineering field camp. He just published a paper about tritium in groundwater in the Inyan Kara Group. Perry's activities since June have been hampered because of a shoulder injury, the result of falling down a cliff while chain-sawing a bug-killed tree. An outcrop of meta-graywacke wrecked his "rotator-cuff".

Bill Roggenthen

Geological work on experiments at the Sanford Underground Research Facility (SURF) continued this year through the initiation of the EGS (Enhanced Geothermal Systems) Collab project. This new project uses the information gained through the hydraulic fracturing experiments of kISMET (Permeability and (k) and Induced Seismicity Management for Energy Technologies) to design a program that involves modeling of rock response to fracturing, energy production from the hot rocks on the 4850 Level of the facility, and evaluation of the modeling results. The ongoing work involves drilling a 60 m long horizontal holes injection hole along with a parallel production hole that will accept water pumped through the injection borehole to determine the heat transfer efficiency of the rock system. Six other 60 m long boreholes will be used to monitor the fracturing and stimulation process using seismic and electrical resistivity methods. This is a large project which includes seven national laboratories and six academic institutions. Several students from the department are involved with the project including the coring and drilling process and analysis of the cross-hole seismic data. Sterling Richard, a senior in geological engineering, is shown in the photograph working on core from the first hole of EGS Collab on the 4850 Level.

Arden D. Davis

Professor Emeritus of Geological Engineering

During the past year I've continued to work with CalxAqua, a company formed by several faculty members at SDSMT as a commercial entity for removal of arsenic and heavy metals from water. I'm sharing an office with Perry Rahn in MI 327B, which is interesting and enjoyable. During retirement, I've taken some time to work on several papers for journals, including the following:

Davis, A.D., Webb, C.J., Sorensen, J.L., and Dixon, D.J., Thermodynamic constraints on limestone-based arsenic removal from water: Submitted with revisions, Environmental Earth Sciences.

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Hudson, R.I., Geochemical thermodynamics of lead removal from water with limestone: Submitted with revisions, Environmental Earth Sciences.

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Hudson, R.I., Geochemical thermodynamics of cadmium removal from water with limestone: Submitted with revisions, Environmental Earth Sciences.

Li, L., and Davis, A.D., A sand-tank model for groundwater flow and contaminant-transport modeling instruction: In preparation for submission to Journal of Geoscience Education.

Li, L., Puzel, R., and Davis, A.D., Data assimilation in groundwater modeling: ensemble Kalman filter versus ensemble smoothers: Submitted to Hydrological Processes.

Rahn, P.H., Detwiler, A.G., and Davis, A.D., 2017, Tritium in groundwater in the Black Hills of South Dakota: Environmental Earth Sciences, 76: 762.
https://doi.org/10.1007/s12665-017-7082-y

Sawyer, J.F., and Davis, A.D., The karstic Madison aquifer and groundwater's role in public water policy: In preparation for submission to Groundwater.

I'm also working on a paper with Dr. Kurt Katzenstein and others on subsidence from groundwater pumping. During spring semester, I hope to start on a paper with Dr. Maribeth Price and Dr. Alvis Lisenbee on our groundwater sampling for dissolved arsenic and other contaminants in Precambrian wells of the central Black Hills.

In late May and early June, I taught my three-week environmental field camp course, GEOE 412. As usual, we had students from several different universities around the country. Dr. Liangping Li also joined us during most of the course. We had projects at interesting sites in the Black Hills, including springs at the headwaters of Rapid Creek, Iron Creek dam and spillway, slope failures, springs in the southern Black Hills, the Belle Eldridge Mine, and the Gilt

Edge Superfund Site. The course is taught through the Black Hills Natural Sciences Field Station, which Dr. Nuri Uzunlar directs.

Last summer, my wife and I again spent most of the summer at our farmstead in Minnesota. We try to take care of the two houses, farm buildings, gardens, orchard, lawns, and windbreak.

During the past year it was enjoyable to visit with graduates and Professional Advisory Board members, including Janet Carter, Jeanne Goodman, Ken Buhler, Roberta (Fivecoate) Hudson, Kathleen Grigg, Joshua Valder, Jenifer Sorensen, Bill Eldridge, Kyle Davis, Stuart Buchholz, Richard Arnold, Ray Wuolo, David Hammond, Sherwin Artus, Steve O'Rourke, Tim Wilcox, Bill Siok, Ahmad Ghassemi, Chance Costello, Mike Mahowald, Susan Ray, Jonathan McKaskey, Brad Stock, Matt Minnick, Jennifer Bednar, Steve Mezger, Neal Olmstead, Caren Goodrich, Renel Hall, Greg Kipp, Joe Peterlin, and many others. For those of you who know Joe Peterlin, you might have noticed the erroneous report of his passing, in the Summer 2017 issue of the Hardrock alumni newsletter. Fortunately it turned out to be incorrect. I'm happy to report that Joe is doing well and his sense of humor is intact.

Please stop by and visit if you're in the area.

arden.davis@sdsmt.edu

From the Faculty:

Larry Stetler

In 2017 I taught 3 courses in the spring term, 2 field camp courses in the summer, and 3 courses in the fall semester. Currently I am advisor for 3 MS GeoE students, 2 PhD GeoE students, and 1 PhD Geol student. I have had one journal paper published in 2017, one journal paper is in review (authored with one of my PhD students), another journal paper in review, and one journal paper accepted for publication. One of my PhD students presented a paper at an International SPE Conference in Russia that has a proceedings publication. I have two additional manuscripts in various stages of preparation for submission in 2018.

Research in 2017 focused on the DoE Deep Borehole Field Test proposal, a new award made to define a potential drill site in western South Dakota. The entire project was again cancelled by DoE in early spring 2017 as the Yucca Mountain Site in Nevada was reactivated. Currently, I am working with one of my PhD students to submit a proposal to NSF Geomorphology that would fund a postdoc project for age-dating surfaces to determine the timing of key events in development of Black Hills geomorphic features. This proposal will be linked to a proposal from Germany through the German Research Foundation.

Liangping Li

Alumni and friends, Happy New Year and Merry Christmas! In 2017, I continued teaching Groundwater course for undergraduate students in fall and spring semesters. It was my first time to teach Groundwater Modeling course for graduate students. In this new course, I used a spreadsheet to solve groundwater flow equation for a sand tank model and students can understand the finite-difference method better. Also, we run pumping test at MI wellfield, and students can collect data such as head and temperature using pressure transducer to calibrate the groundwater flow and solute transport model.

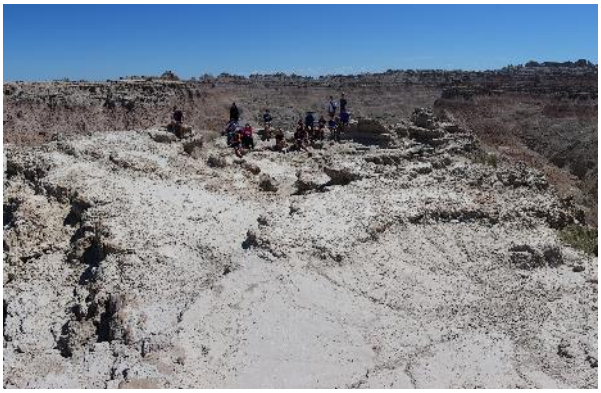
For the research, my proposal entitled "*Development of a Tool for Assisted History Matching Using Multiple-Point Geostatistics in Oil Reservoir Simulation*" was funded by SD Board of Regents' Competitive Research Grant. Zhendan Cao, an accelerated graduate student with Geology major, is working on this project. Collaborated with Dr. Qiao from Mathematics and Computer Science Department and Dr. Katzenstein, the proposal entitled "*Active Online Learning Modules for Introducing Well Tests in Groundwater Education and Research*" was funded by Mobile Computing Grant. Three undergraduate students will be funded by this project. I am also a Co-PI for a project entitled "*Development of a Tool for Predicting Fate and Transport of Organic Wastewater Constituents during Wastewater Infiltration*." This project was funded by SD Mines Nelson Research Grant and led by Dr. Geza from Civil and Environmental Engineering Department. As a guest editor, I organized a special issue entitled "*Gas-Water-Rock Interactions and Implications for Geo-environmental Issues*" in *Geofluids* journal, and it will be published in March 2018. I was invited to review manuscripts for a couple of top journals such as Water Resource Research, Advance in Water Resource and Groundwater. I was also invited as an expert panel for reviewing proposals for German Science Foundation in May 2017. I published two articles in 2017:

- Liangping Li, Meijing Zhang and Kurt Katzenstein, *Calibration of a land subsidence model using InSAR data via the ensemble Kalman filter,* Groundwater, 55(6): 871-878.
- Liangping Li and Meijing Zhang, *Inverse modeling of interbed parameters and transmissivity using land subsidence and drawdown data,* Stochastic Environmental Research and Risk Assessment, doi:10.1007/s00477-017-1396-x.

Kurt Katzenstein

It is hard to believe the end of another year is here! I hope you and your family had a wonderful 2017. I had another busy year between family time and projects here at SD Mines. Our kids continue to grow and I have enjoyed sharing my love of the outdoors with them (among many other things). My two oldest daughters will commonly come home with pockets full of rocks to share with me. So it looks as though I have successfully passed on the rock hounding disease to them as well!


The “Geology Rocks” youth camp was a success once again this year. We had a total of 20 campers this year and they got to experience the unpredictability of summer weather in the Black Hills first hand! We had thunderstorms each night that we camped out which ensured that each camper would have a new story to tell when they headed home. All in all, they were troopers and were one of the most enjoyable groups I have had in the five sessions I have led since 2013.

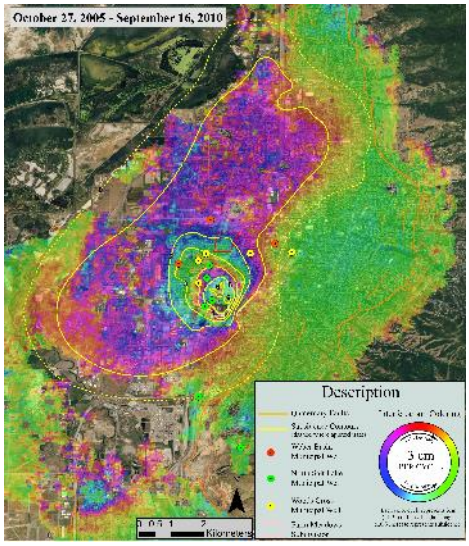



This year, as part of my ongoing outreach and recruitment efforts, I decided to construct a mobile Augmented Reality Sandbox. This technology, developed by researchers at UC Davis, allows students to instantly see the topographic map and shaded digital elevation model that represents a topography that they have created in a roughly 3 by 4 foot sandbox. We have already used this in four recruiting events and it has been a huge hit. I also continue to use the sediment flume I built back in 2013 at similar events.

I participated in research associated with three projects this year. We completed our third year of a major ($1,250,000) grant to investigate complex ventilation and radon mitigation in block-caving mining operations. Thus far this project has provided funding for seven M.S. students and one Ph. D. student. This year we presented three abstracts and submitted two manuscripts associated with this project. In another funded project I used InSAR to investigate land subsidence associated with distress to a housing development in an arid valley in the western US (the final report will be released within a month or so but until then, I cannot say exactly where this study was located). Finally, one of my M.S. students, Robert Huber, is investigating/monitoring subtle ground motions at the Carnegie Quarry at Dinosaur National



Monument to better understand the mechanics behind fractures that have propagated across bones displayed in the quarry face. As part of this study, we installed 4 vibrating wire extensometers and 10 analog crack meters to monitor movement on the steeply dipping sandstone bone quarry. In September, Robert presented his preliminary results at the 2017 Association of Environmental and Engineering Geology conference in Colorado Springs.




I hope that you have enjoyed 2017 and that you are looking forward to 2018 as much as I am.

Tim Masterlark

This past year was remarkable. I carried 40 pounds of iron for 26 miles to complete the 75th Bataan Memorial Death March at the White Sands Missile Range, New Mexico. My zeroth-order goal was to finish alive. Instead, I placed 10th out of 160 competitors and mine was a salient smiling face in a field of misery. What's next? I initiated the application process to join the Phantom Airborne Brigade. If I am selected, I will be jumping from a vintage C-47 in 2018. This is an opportunity to push the clock back 30 years to my time with the US Army Airborne School, class 1-87. In the meantime, I will practice, practice, practice my parachute landing falls.

A perfect after-hours diversion during the Fall AGU Meeting –Black tie, box seats, champagne, and the San Francisco Symphony's exquisite performance of Handel's *Messiah*.

My Geophysics Research Team continues to advance the pursuit of science. Stephanie Loose's MS research is progressing nicely and I expect that she will graduate in Spring 2018. Congratulations to Michael Baranowski for successfully completing his comprehensive exam and earning PhD Candidacy. Michael and I represented my Geophysics Research Team with multiple presentations at the AGU Fall Meeting in San Francisco. Congratulations to Jared Fox (accelerated MS student) for his scholarship from the South Dakota Space Grant Consortium. Dr. Caihong Zhang (Research Fellow from the Institute of Seismology, China Earthquake Administration) continued her work in constructing finite element models of co- and post-seismic earthquake deformation of the 2008 Sichuan Earthquake, China. Dr. Jay Tung will continue as a post-doc researcher in my Geophysics Research Team for the next few years, thanks to a newly-awarded grant from the NASA Earth Surface and Interior Program. I devoted significant effort this past year in support of professional service by reviewing 31 proposals for NSF and DOE, 6 manuscripts for various peer-reviewed geophysical journals, and 81 abstracts for AGU. My Geophysics Research Team had a remarkably productive year for publications, including several manuscripts submitted, accepted, and published in prestigious journals, such as the *Bulletin of the Seismological Society of America*, *Geophysical Journal International*, *Geophysical Research Letters, Journal of Geophysical Research*, and *Tectonophysics*. I also had a chapter published in the book *Volcanoes*. I gave a live interview to SD Public Broadcasting on the topic of *Super Volcanoes*. I was invited to present at Penn State's Geodynamics Seminar Series and the icing on the cake was an invitation to deliver a keynote lecture at the upcoming NSF-sponsored AGU Chapman Conference in Santiago (Maule Volcanic Region), Chile.

Foster Sawyer

Wishing Happy Holidays and warm regards to the students, alumni, and friends of the Department of Geology & Geological Engineering! As usual, there is too much going on around the department to squeeze into a brief newsletter, but suffice it to say that we have a healthy, vibrant department that grows stronger every year. Highlights for me included coordinating the PEEC program at SDSM&T which had another highly successful year with a number of reservation-based student projects aimed at sustainable housing, sustainable food supplies, and hydrological investigations. The PEEC program culminated last summer with a student poster session on the Pine Ridge Reservation (at Oglala Lakota College) which drew a surprising level of media coverage and attendance. I also was involved in the NSF Research Experience for Teachers program at SDSM&T which brings area high school teachers onto campus where they participate in summer research programs that will enhance their existing curricula. This year for the first time I also taught at the geology field camp in Turkey that is sponsored by the Black

Hills Natural Sciences Field Station which was an amazing experience (the North Anatolian Fault Zone passes through the grounds of the field station!).

A. **B.**

A. Geology students participating in the Turkey field camp near Cayirhan, Turkey.
B. Scenery near Yeniceseyhler, Turkey.

Collaborative activities with Tribal colleges and agencies remain strong, and this year significant effort was invested in developing our relationship with the Mandan-Hidatsa-Arikara (MHA) Tribe in North Dakota who have expressed interest in teaming up on a number of environmental projects on the Fort Berthold Reservation. Our relationship with Oglala Lakota College also continues to grow with numerous collaborative grants and programs underway and/or planned for the future.

The level of activity around the department also remains high, with many meetings, field trips, and social events sponsored by the department and by our incredibly active student associations including the Student Chapter of the Society of Petroleum Engineers and the Tech Geological Association (the student organizations that I advise and co-advise, respectively) among others. As always, teaching classes and labs, advising students, and working with my distinguished colleagues to meet new challenges and keep the department moving forward are extremely rewarding components of my work.

I wish everyone a successful, healthy, and enjoyable year in 2018!

Sincerely,

Foster

Maribeth Price

Hello Alums!

It is with both excitement and regret that I have resigned from the department faculty and accepted the position of Dean of Graduate Education at SD Mines, effective April, 2017. It has been a pleasure and a privilege to teach GIS and geology in the department for the last 22 years, and I have many wonderful memories of alums, students, faculty, and staff to sustain me as I move forward.

I expect that I will remain active in GIS for a few more years at least—I am still working on book projects and have a new 8th edition of *Mastering ArcGIS* coming out this spring and a manuscript for the first edition of *Mastering ArcGIS Pro* heading to the publisher before the year's end. I enjoy seeing many of my former students at workshops and conferences in South Dakota, a delight that will no doubt grow more precious in future years. I retain an appointment in the Geology and Geological Engineering faculty and as the Map Curator for the Museum of Geology, and I look forward to continuing to work with department students and faculty in those capacities, even as I forge ahead with my responsibilities to the Graduate School at SD Mines. I thank all of my students for the joys and challenges you've presented. I thank my colleagues for their dedication and for the collegial partnerships we've developed over the years. I wish you all of the best, and I'm glad that I'm just one building away from MI!
Best wishes for the New Year,
Maribeth Price

Darrin Pagnac

Greetings and Happy Holidays! 2017 was another busy and productive year. I spent time finishing up some old projects and starting some new ones.

My Master's students are working on a variety of interesting projects, from dog evolution, to the diets of early horses, to the habitat of Oligocene frogs and salamanders. Work from a former student was published in March in the journal Palaios. Alysia Korn published the results of her Master's work showing that concretion formation in the remains of late Cretaceous mosasaurs (marine lizards) from the Pierre Shale seems to occur preferentially in the head and body regions. The fins and tail appear devoid of concretionary material.

My own research has progressed as well. I'm continuing work on my NSF funded project on diversity and inclusion in field geoscience settings. My colleagues and I are preparing a workshop to share ideas and develop strategies with other field educators from around the country in October of next year. Additionally, I've just submitted a new manuscript on the use of dinosaurs to teach critical thought skills. I've taught a course on dinosaurs here since 2010 and have gradually incorporated methods by which I can foster critical thought skills in the students. These skills will not only aid them in being better paleontologists, but will allow them to recognize false information, persuasion techniques, and faulty arguments to better assess any information they are presented with.

Field paleontology was a blast this year! Four students and I went up to North Dakota in June to work with some colleagues from the North Dakota Geological Survey. We spent two weeks working with them in the Oligocene White River Group near Dickinson. The fossil content was unbelievable! In two weeks we found hundreds of small fossils of everything from frogs to deer to rhinos. The students learned a great deal of practical field skills and had a great time as well. The two-week project has also resulted in some research potential on the stratigraphy of the White River Group on the North and South Dakota border.

August was spent on the Missouri River working the Pierre Shale with the US Army Corps of Engineers. This year's survey proved challenging, however, as the boat's hull cracked. As such,

we were limited to pedestrian surveys. That didn't keep my crew down, however. We soon came across an absolutely gorgeous, articulated specimen of the large fish *Ichthyodectes.* About five feel long, this specimen took a good two weeks to excavate, but when we finished we had the whole animals, from snout to tail.

Photogrammetric image of the *Ichthyodectes* specimen collected in August. Portion of the tail is to the right, and vertebrae can be seen across the entire image. Skull elements were discovered later in the lab.

2018 promises to be another wonderful year with new students, new challenges, and new accomplishments. Best wishes!

Dan Soeder, Director, Energy Resources Initiative, SD School of Mines & Technology
Daniel.Soeder@sdsmt.edu

Six months into my position as director of the Energy Resources Initiative (ERI), things are steadily moving forward despite a few setbacks. Low oil and gas prices and the resulting depressed state of the energy economy has been our greatest challenge. Companies that supported us financially in the past have pulled back, and the number of students interested in petroleum careers has fallen along with the job prospects. Reductions in oil and gas drilling in surrounding states have decreased South Dakota's level of interest in energy. Nevertheless, energy is a cyclical business, and SD Mines can and should use this time advantageously to position ourselves for a resurgence.

One advantage of the "bust" part of the cycle is that energy companies are willing to talk to us. During boom times, people are only interested in drilling wells and producing hydrocarbons, not discussing technical issues with university researchers. The slowdown has been advantageous from a communications standpoint, allowing for conversations with a number of operators and service companies about some of their technical concerns, and chats with several top-level researchers. We have been invited to visit Whiting Petroleum's core analysis lab in Denver, and see Ahmad Ghassemi's rock testing laboratory at the University of Oklahoma. We have

discussed analytical techniques for water monitoring near shale gas wells with researchers at Warwick University in Coventry, England, and participated in technical discussions with the Geological Survey of Canada on directions for shale gas environmental risk assessment. Future collaborations include core analysis technology developments with Munir Aldin at Metarock Laboratories in Houston, a visit to a field site set up by Aaron Cahill of the University of British Columbia for environmental monitoring around shale gas wells, and participation on a roundtable at a shale gas workshop for the Chinese Academy of Sciences in Wuhan.

We have been working hard to establish research projects and facilities for the ERI at SD Mines. I had hoped that some of these efforts would bear fruit quickly, but it looks like we must be both patient and persistent. I am eager to show some accomplishments, but I also recognize that getting a new program started from scratch in six months is probably unrealistic. Nevertheless, we do have several irons in the fire, and I'm anticipating that one or more of these potential programs will develop into research projects within the next six months.

Bakken Environmental Access Research Site (BEARS): This project has been under development for the past year with the Mandan-Hidatsa-Arikara Nation on the Fort Berthold Reservation in North Dakota to perform prospective environmental monitoring on and around a Bakken shale oil production site. The goal is to quantify the actual environmental risks of drilling and fracking shale on a pristine site. The project would be run by the tribe, with SD Mines acting as technical advisors and consultants.

Optimization of Fossil Fuel and Geothermal Resources by Indigenous Development (OFFGRID): This proposal is under development for the South Dakota EPSCoR NSF program to assess, develop and utilize local resources of shallow gas and geothermal heat in isolated rural and tribal communities that currently import energy supplies like propane from great distances. The goals of the project are to assess geothermal and shallow gas resources in South Dakota, develop or adapt engineering technology to recover the resources near small communities in an environmentally-responsible manner, and determine how the resources can be utilized locally for energy security and sovereignty.

Stranded gas: A project started several years ago among SD Mines, the U.S. Department of Energy and Sinte Gleska University on Rosebud Reservation to assess the potential for developing shallow gas in the Niobrara Formation ended at the stage of designing and locating a possible demonstration production well near the town of Mission, SD. Lessons learned from this investigation will be applied to the OFFGRID proposal if the project is funded.

Gas conversion: Natural gas requires a pipeline system to move it efficiently to markets. In the absence of a pipeline, gas is either not produced, or if produced with oil, it is typically flared off. This project seeks to find beneficial uses for natural gas on a drill site by generating electricity if there are powerlines nearby, or converting the gas to liquids like methanol or solids like plastic polymers that can be removed by truck. A project like this would obviously be focused in the chemical or electrical engineering departments at SD Mines, but ERI would play a coordinating role.

Tribal Energy Assistance Center (TEAC): Last year the DOE Office of Indian Energy expressed support for the establishment of a center at a university in Indian Country to provide

assistance on fossil energy development on reservations and geological renewables, like geothermal. Such a center at SD Mines would be well-positioned to assist Rocky Mountain tribes with fossil energy issues. Although we are waiting, no funding announcement has been forthcoming thus far from the DOE Office of Indian Energy.
Some additional ERI research ideas under development include:

- **Cement properties/wellbore integrity study with RESPEC:** An analysis of Pennsylvania state compliance reports showed a statistically valid correlation between well type and probability of cement/casing failure, with shale gas wells experiencing a six times greater risk of wellbore integrity problems compared to conventional wells. The study did not explain why this might be, but research on how casing and cement respond to repeated frack pressures can help improve the understanding of microannulus formation.
- **Natural attenuation (NA)** is the process by which organic compounds degrade chemically and biologically in groundwater. Although natural attenuation processes and rates are well known for many common chemicals like gasoline and solvents, very few NA studies have been done on the compounds used in hydraulic fracturing. Laboratory-based investigations are needed to define the breakdown pathways and rates of the frack chemicals of interest.
- **Enhanced Geothermal Systems:** A relatively new idea in geothermal technology takes advantage of oilfield techniques to extract geothermal energy from just about anywhere on Earth. Enhanced geothermal systems are currently hampered by high drilling costs and slow rates of penetration to reach hot rock (200 – 400 deg C) at depths of roughly 4-8 km (13K -26k feet). To achieve drilling efficiencies that are comparable with shale gas development, significant engineering is needed to develop specialty bits, muds and frack fluids that are effective on hot, hard rock. SD Mines has the interdisciplinary expertise to contribute to such drilling advancements, especially in collaboration with other institutions.

Petrophysical Engineering and Research Laboratory (PEARL): This ERI flagship laboratory under development will be dedicated to core analysis on a variety of shale lithotypes to better understand the petrophysical behavior of gas and oil bearing shales. Goals include quantifying the effects of stress on fine-grained rocks in response to hydraulic fracturing or high stress excursions during drawdown, and investigating methods to improve hydrocarbon recovery from both shales and residual oil zones in conventional reservoirs.

ERI lab funds in the Foundation account are limited. Thus, funding for big-ticket laboratory equipment was sought from the SD Board of Regents through an R&D Innovation Grant proposal. The BOR would only accept one proposal per institution, so the PEARL was included with two other SD Mines lab equipment requests. The BOR awarded grants for the other two requests, but declined to fund equipment for the PEARL. Another attempt to obtain major funding for lab equipment will be made through a National Science Foundation Major Research Instrumentation (MRI) proposal, due in February 2018. In the meantime, Foundation lab funds were used to purchase a pressure generator, a high-pressure syringe pump, and two Hassler-type triaxial core holders for the construction of a core flood apparatus to run residual oil recovery experiments that are of interest to a student for a senior research project.

Potential program growth areas: Several meetings have been held to discuss ERI research projects of interest and benefit to midsize producers in the Rocky Mountains and elsewhere. These companies are typically too small to have a "research department," but the ERI can provide scientific expertise and technical assistance. Engaging students on these projects gives them real world experience on practical, meaningful research that boosts their resumes when seeking jobs. Discussions about relevant research ideas were held with Rick Ross of Whiting Petroleum on November 7, 2017, and with Dan Watson of Sterling Energy and John Chandler of Flatirons Resources, LLC, on November 15, 2017. All are SD Mines alumni located in the Denver area. We will be following up to flesh out details.

Energy research programs could also potentially be developed with the U.S. Department of Energy, the Department of the Interior, the Environmental Protection Agency, and the Department of Defense. Military bases in particular have received a mandate to become as self-sufficient as possible on energy supplies for security reasons. Discussions were held with Ellsworth AFB on the potential for shallow gas production from the Niobrara Formation, and low-temperature geothermal for district heating. The base is interested and wishes to be kept informed about our progress with the OFFGRID proposal.

Shale gas resources are of interest internationally in Europe, Australia, Africa, China, and South America. Many nations have been hesitant to develop their shales until environmental issues are resolved in the United States and Canada, the current major developers. SD Mines has an opportunity to step onto the world stage as the go-to resource for technical advice related to shale gas. International outreach has included engaging researchers in the United Kingdom at the University of Warwick on the applications of a Fourier-transform ion cyclotron resonance (FT-ICR) mass spectrometer for environmental monitoring of the Bakken Shale. The Geological Survey of Canada (GSC) invited me to Quebec in September 2017 to discuss the future priorities and orientations of the GSC Environmental Geoscience program with respect to shale gas. Scyller Borglum, graduate research assistant on the ERI, has also been in similar discussions with researchers from the University of Alberta that she met at the SPE meeting in Moscow, Russia last year. Dr. Liwei Zhang, one of my former post-doctoral interns at DOE, currently has an appointment at the Chinese Academy of Sciences, and recently invited me to present a talk and join a panel discussion at a shale gas environmental workshop the Chinese Academy is planning for July 2018 in Wuhan.

Recent ERI-related publications:

- Soeder, Daniel J.: Unconventional: The Development of Natural Gas from the Marcellus Shale: GSA Special Paper 527, Boulder, Colorado: Geological Society of America Books, 143 p., March 2017.
- Soeder, Daniel J.: The successful development of gas and oil resources from shales in the United States, invited review paper: *Journal of Petroleum Science and Engineering* (in review), submitted 3 August 2017.
- Soeder, Daniel J.: Groundwater Quality and Unconventional Gas and Oil Development: Current Understanding and Science Needs: report on results of April 2017 National Ground Water Association workshop; will be published as a DOE technical report and condensed form in *Groundwater*.

- Soeder, Daniel J. and Kent, Douglas B.: When oil and water mix: Understanding the environmental impacts of shale development: *GSA Today* (in review), submitted 21 September 2017.
- Soeder, Daniel J.: Clay, Geologic Formations, Carbon Management and Industry: Chapter 3 in Romanov, V. (ed), Greenhouse Gases and Clay Minerals; Cham, Switzerland: Springer International Publishing AG; 187 p., November 2017.
- Thomas, L., Tang, H., Kalyon, D.M., Aktas, S.S., Vidic, R., Soeder, D., Filshill, A., Carey, W., Hsuan, G., Blotevogel, J., Arthur, J. D., Shah, S., Fu, P., Hu, T. and Young, M.: Towards Better Hydraulic Fracturing Fluids in Energy Production: A Review on Sustainable Technologies and Reduction of Potential Environmental Impacts: report to the National Science Foundation (draft)
- Soeder, D.J. and Borglum, S.J.: The Fossil Fuel Revolution: Shale Gas and Tight Oil: Elsevier, Inc., publishing agreement signed 21 September 2017; 200,000 word (approx.) manuscript due to publisher on 01 September 2018.
- Springer has expressed interest in a book proposal by Dan Soeder on "Hydraulic fracturing and the environment: a scientific assessment." This has not been submitted yet – it may become a PhD dissertation, which will be explored after the holidays.

ERI Outreach: A brochure on the Energy Resources Initiative is under development along the lines of other research area brochures at SD Mines. Scyller Borglum is taking the lead on this, with several examples to use as templates. The Halliburton Foundation provided funds for a group from Women in Science & Engineering (WiSE) to participate in an energy field trip led by me to North Dakota in early October.

ERI Program Needs: Eventually the ERI would like to offer/sponsor some classes at SD Mines that are energy-related, perhaps as part of the Petroleum Systems minor. Ideas include:

- Energy Survey class of different energy types
- Petroleum engineering focused on unconventional oil and gas reservoirs
- Laboratory-based petrophysics

Support for an "energy lecture" as part of the regular GGE Department weekly lecture series is being sought. The goal is to bring an energy-themed speaker in about once a month, or every 4th lecture. Dedicated funding on the order of $10-$15K per year should be sufficient.

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

This has been an incredible year for BHSFS. Our proposal for building a field station in the Black Hills has been accepted. We are looking for a suitable land in the northern Black Hills (Nemo, Whitewood, Spearfish areas). The details of the new development will soon be sent to alums by the Foundation.

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 six continents. In 2017, 287 students

from 98 institutions across the USA mapped geological environments ranging from volcanoes to fault zones in Hawaii, Turkey, Iceland, Nepal, Ecuador, the Galapagos Islands, and the Black Hills of South Dakota. We are getting ready for the winter camps in Hawaii and Death Valley. Both camps will start after Christmas. In support of our newly established Minor and certificate programs in petroleum systems we initiated three new camps in western California, Book Cliffs Utah and New Zealand.

In addition to traveling from camp to camp I have been very active in departmental committees and the department's graduate recruiting efforts. I attended GSA in Seattle and AGU in New Orleans, where the field station and the department had an exhibit. I also attended to AAPG conference in London.

For additional information about upcoming field station activities please visit: http://geologyfieldca mp.sdsmt.edu, call me at (605) 394–2494 or write to nuri.uzunlar@sdsmt.edu

Sampling lava in Hawaii in 2017

In Atlas Mountains scouting project sites with Alvis for the new Morocco field camp

Mapping in the Black Hills, 2017