SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Department of Geology and Geological Engineering

2018 Alumni Newsletter

Dr. Alvis L. Lisenbee

December 3, 1940 – November 16, 2018

Faculty and Staff in Geology and Geological Engineering – December 2018

Back row (L to R) – Darrin Pagnac, Laurie Anderson (Head), Sarah Keenan, Gokce Ustunisik, Maribeth Price, Zeynep Baran, Tim Masterlark, Kevin Ward, Christopher Pellowski and Ed Duke. Front row (L to R) – Kurt Katzenstein, Nuri Uzunlar, Foster Sawyer, Curtis Price, Liangping Li and Colin Paterson (Emeritus). Absent: Larry Stetler, Arden Davis, Perry Rahn, Sally Shelton, Bill Roggenthen, Daniel Soeder, Jim Fox and Jack Redden. In 1993 below:

Front row: Dr. M.R. Islam, Pamela Fenner, Secretary, Dr. Alvis Lisenbee, Dr. Colin Paterson. Middle row: Dr. William Roggenthen, Department Head, Dr. E. Duke. Back row: Dr. John Gries, Dr. Perry Rahn, Dr. Philip Bjork, Dr. Arden Davis.

From the interim editor – Christopher Pellowski

Greetings alumni and friends! Please enjoy reading the 2018 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/

Dr. Alvis L. Lisenbee passes away

The Department of Geology and Geological Engineering has lost one of the giants in its history. Dr. Alvis L. Lisenbee, 77, died Friday, November 16th, 2018, of complications following surgery at the Rapid City Regional Health Home Plus Hospice. He joined the faculty at the School of Mines in 1972, served as department head from 1978-1985, and retired in 2006 after 34 years of distinguished service to the School of Mines as well as the State of South Dakota.

As an emeritus professor, Dr. Lisenbee was very active in outreach activities including the Journey Museum, the Darton Geological Society, Road Scholars, and the Elderhostel and continued his active research program with the other faculty and graduate students in the department in addition to teaching at the various field camps throughout the year for the Black Hills Natural Sciences Field Station. It was only eight weeks before he passed that Dr. Lisenbee led a memorable field trip for the students and faculty in the department to the Bighorns uplift and the Powder River basin. He was in his element whether on an uplift or a plate boundary, enlightening all around on the structural and tectonic implications.

We will always remember Dr. Lisenbee not only at how effective he was as a teacher, but also how he cared about the students, even to the extent of lending them money to get out of a jam. Dr. Lisenbee also contributed greatly to the understanding of Black Hills geology, especially in the nature and timing of the Laramide uplift. He often remarked "the story of the uplift is written in the book of the basin."

Along with graduate students under his direction as well as colleagues, Dr. Lisenbee spent much of his time in the field, and as a result compiled many 7.5' geologic quadrangle maps. Being a structural and tectonics geologist, his research ranged widely with applications in oil and gas, metallic ore deposits, and hydrology. He authored and coauthored many significant publications including the Tectonic Map of the Black Hills uplift and numerous publications on Laramide structures in the Rocky Mountains with particular emphasis on the history and characteristics of the Black Hills uplift. Dr. Lisenbee also conducted research in Nevada and New Mexico in collaboration with mining and oil companies and geological surveys. From the time of his doctoral research in western Turkey until the summer of 2018 at his last Taskesti field camp, he developed a comprehensive understanding of the tectonics of Turkey and its complex arrangement of accreted microplates. By the time of his passing, he had almost completed a structural contour map of the Niobrara Formation from the Black Hills south to the Wyoming Colorado border. The hope is that the department will be able to facilitate the completion of this map which also shows the distribution of major structures and oil and gas fields.

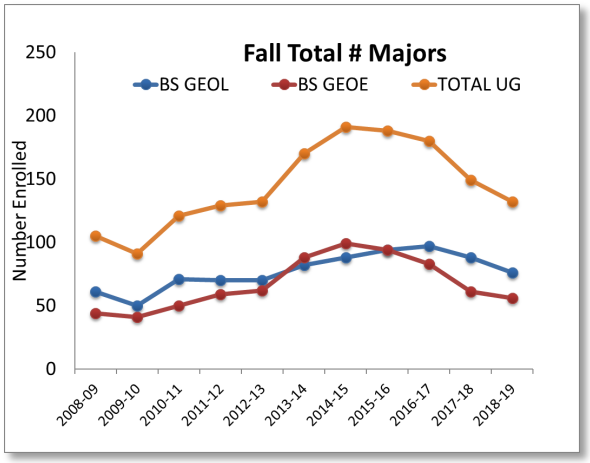
Status of the Department

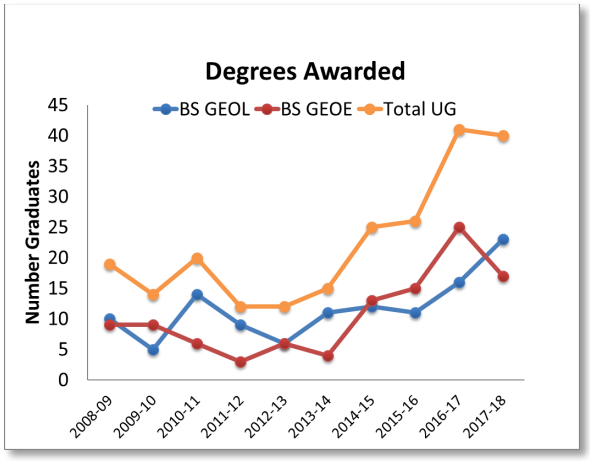
Greetings at the end of 2018. We hope your's has been a happy and productive one. The Department of Geology and Geological Engineering (GGE) had several great additions, as well as some losses, this year.

Three new faculty members joined the department in 2018. Mr. Curtis Price (https://webpages.sdsmt.edu/~cprice/People.html) became a lecturer for geospatial technology in January 2018. Curtis retired from the US Geological Survey in 2017 and brings a strong expertise in all things GIS. He is teaching the geospatial courses, remote sensing, and mine surveying for us. In addition, Dr. Kevin Ward (https://webpages.sdsmt.edu/~kward/index.html) was hired as an assistant professor in August 2018. Kevin's expertise is in observational seismology and continental tectonics. He holds a Ph.D. from the University of Arizona, and prior to joining us he had a postdoctoral position at the University of Utah. Dr. Sarah Keenan (https://webpages.sdsmt.edu/~skeenan/Keenan.html) also joined the faculty in August as an assistant professor. Her research interests span vertebrate paleontology, geochemistry, and geomicrobiology.

We mourn the loss of Emeritus Professor Alvis Lisenbee. Alvis was a great teacher and colleague and is sorely missed. I am grateful I was able to participate in a department field trip he led to the Bighorns in September. Mrs. Grace Mickelson, widow of Dr. John Mickelson, also passed away in November.

The number of undergraduate majors declined slightly in 2018-19, although the number of B.S. degrees awarded remains strong. We currently have 132 GEOL and GEOE majors**.** In our graduate programs, enrollment overall is stable (currently 44), while seeing 6 degree completions in 2017-18 (2 MS GGE, 3 MS PALE, and 1 PhD student).





Career placement of our undergraduates seems to be recovering from the effects of the downturn in the mining and petroleum industries. In 2016-17 (the latest numbers available), GEOE had 96% placement and GEOL had 93% placement. This fall we had 31 companies and agencies recruiting our students at the Fall Career Fair (there were 30 in 2014, 15 in 2015, and 24 in 2016, and 29 in 2017). 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 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. Faculty and staff submitting grant proposals through research affairs in 2018 include Tim Masterlark (7), Jay Tung (3), Gokce Ustunisik (2), Foster Sawyer (2), Liangping Li (2), Dan Soeder (2), Zeynep Baran (1), Alvis Lisenbee (1), and Kurt Katzenstein (1).

We would like to acknowledge the gifts we received for the Department or the Museum of Geology. In Fiscal Year 2018, we received $329,329 in unendowed gifts to the department and $2,410 to the Museum of Geology. In addition, we received $17,500 for additions to existing endowments. This fall, Schlumberger provided a software gift valued at over $103 million. Included were 25 licenses for Petrel, Eclipse, Techlog, and Pipesim. We thank all friends, alumni, and corporate partners for your generous support of our students and programs.

Below is a list of departmental scholarship and other award recipients to date for 2018-19.

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.

External Scholarships/Awards:

- Fulbright Fellowship (Jamaica): Broc Kokesh (MS PALE, now in the PhD program at University of Chicago)
- NASA Lunar and Planetary Institute Exploration Science Internship: Alex Rogaski (MS GEOL)
- NAGT-USGS Internship Program: Jordon Mason (BS GEOL)
- NAGT Outstanding Teaching Assistant Award: Kyle Hazelwood (PhD GEOL)
- Society of Petroleum Engineers: Outstanding Student Chapter: SD Mines Student Chapter
- ASD Students in Mining and Energy Institutional Support: Taran Bradley (MS GEOL)
- Minnesota Groundwater Association Gil Gabanski Scholarship: Ryan Puzel (MS GEOL)
- 2018 Student Poster Award, Division of Geobiology and Geomicrobiology, Geological Society of America: Broc Kokesh (MS PALE, now in the PhD program at University of Chicago)
- 2nd place poster, Western SD Hydrology Conference: Fleford Redoloza (MS GEOE)

University Scholarships/Awards:

- RESPEC Research Grant: Wyatt Tatge (BS GEOE)
- 2018 Leadership Hall of Fame: Bobbi Strange (BS GEOE, MINE)
- Joseph Nelson Fellowship: Brooke Long (PhD GEOL)
- Kate Simmons Teskey Fellowship: Colton Medler (MS GEOL)
- John P. Wold Scholarship: Desiray Wilson (BS GEOL)
- 3rd place poster, SD Mines Research Symposium: Kristen Pratscher (BS GEOL)

- Graduate Women Society Outstanding Student Member: Stephanie Loose (MS GEOL)

GGE Outstanding GGE Student Awards:

- Redden Award (Outstanding GEOL Senior): Hallie Bower & Jordon Mason
- Tullis Award (Outstanding GEOE Senior): Todd Anderson
- Outstanding GGE graduate students: Zhendan Cao (MS GEOL), Robert Huber (MS GEOE); Broc Kokesh (MS PALE), Scyller Borglum (PhD GEOE)

GGE Scholarships:

- D. Sherwin Artus GEOE (BS GEOE): Dominic Krause, Wyatt Tatge, Regan Wess
- Artus Petroleum Systems: Miranda Berg (BS GEOE), Mollie Hunt (BS GEOE), Justine Langas (BS GEOE), Jacob Truxal (BS GEOE)
- Mary Baresh Memorial: Michael Nieland (BS GEOL)
- Barrick Gold: Ryan Peyton (BS GEOE), Desiray Wilson (BS GEOL)
- Jeffrey L. Bauer Memorial: Peter Daly (BS GEOL)
- Lynn & Nancy Owen Bell: Ryan Bozer (BS GEOL)
- Edwin Bittner/John Campbell MI Memorial: Michael Nieland (BS GEOL)
- Homer Davis Memorial: Dominic Krause (BS GEOE)
- Greg French Fellowship: Alexander Rogaski (MS GEOL)
- GGE Department (Multiple Donors): Jacob Adams (BS GEOL), Jimmy Bradford (BS GEOL, Colton Mumma (BS GEOE), Perrin Salonek (BS GEOE)
- Darton Society (Field Camp): Mollie Hunt (BS GEOE), Dominic Krause (BS GEOE), Aaron Kusch (BS GEOE), Max Southbloom (BS GEOE)
- Gleason-Hammond: Hailey Noteboom (GS GEOE)
- Paul & Virginia Gries (undergrads): Coleton Deitz (BS GEOE), Corrine Cranor (BS GEOL), Richard Lim (BS GEOE), Alice Morris (BS GEOL), Hunter Schroeder (BS GEOL), Samantha Schmidt (BS GEOL)
- Paul & Virginia Gries (grads): Julie Driebergen (MS PALE), Jared Fox (MS GEOL), Shannon Harrel (MS PALE), Kayleigh Johnson (MS PALE), Brian Lauters (MS PALE), Kristen Lewis (MS GEOL), Brooke Long (PhD GEOL), Nichole Ridgwell (PhD GEOL), Patrick Wilson (PhD GEOL)
- Hammond Family Memorial: Emma Rogers (MS GEOL)
- James O. Harder Memorial: Jared Fox (BS GEOL)
- John & Kathy Heinemann ERI Petroleum Systems: Jessica Lohrenz (BS GEOE), Abhishek Ray (BS GEOE)
- Ben Holmes Memorial: Brittany Coupe (BS GEOE); Seth Vandenberg (BS GEOL)

- Joseph W. & Josephine B. Kulik Field Station: Dominic Krause (BS GEOE), Tristan Walker (BS GEOL)
- Joseph W. & Josephine B. Kulik Scholarship (CO resident): John Murzyn (BS GEOL)
- Dr. Ray E. Lemley Memorial (field camp): Tristan Walker (BS GEOL)
- Alvis Lisenbee (BS GEOL): Hannah Duncan
- John Mickelson Fellowship: Kyle Hazelwood (PhD GEOL)
- Newmont Mining Corporation: Jacob Adams (BS GEOL), Chloe Jungwirth (BS GEOE), Dominic Krause (BS GEOE), Regan Wess (BS GEOE)
- Roy Roadifer: Marissa Holinka (BS GEOL), Joshua Sarver (BS GEOE), Claudia DeBlieck (BS GEOL), Grace Lickteig (BS GEOL)
- Bill & Jean Roberts (UG): Joseph Durst (BS GEOL), Gabriel Poteet (BS GEOL)
- Roberts (Western Gem and Mineral Society): Victoria Karnes (BS GEOL)
- Roberts (Grad): Disha Gupta (MS GEOL)
- Surbeck-Connolly: Michael Nieland (BS GEOL)
- Seth Schaefer: Tristan Walker (BS GEOL), Maxwell Southbloom (BS GEOE)
- Shawn Stickler: Anthony Gordon (BS GEOL)
- Whiting Scholarship/Fellowship: Todd Anderson (MS GEOE), Taren Bradley (MS GEOL), Kyle Hazelwood (PhD GEOL), Mike Baranowski (PhD GEOL), Zhendan Cao (MS GEOL), Ryan Puzel (MS GEOL), Colton Medler (MS GEOL), Fleford Redoloza (MS GEOE)
- Whiting Student Enrichment: Taren Bradley (AMNH), Zhendan Cao (AGU), Andrew Clift (RMR, GSA), Michael Day (GSA, Goldschmidt 2018), Robert Huber (AEG), Kayleigh Johnson (AMMP), Lilly Jones (CUAHSI), Broc Kokesh (GSA), Devin Last (RMR), Brooke Long (mothur workshop), Kristin Pratscher (GSA), Nichole Ridgwell (AMMP), Alex Rogaski (GSA, AMNH

Laurie Anderson News

My research this year involved working on data, helping student finish thesis, and only a little bit of field work. 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 2017/18 included taking a group of students to the Bahamas between semesters. Our lucinid collaboration also published one paper in 2018 in the ISME Journal with more on the horizon. 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) is in the midst of her PhD data collection and analysis for a phylogenetic project to combine fossil and recent lucinid taxa into phylogenies for the family and to understand how morphology is controlled by that evolutionary history. Work from her MS project has been submitted to a journal and is currently under review. Broc Kokesh (MS PALE) completed his degree in May. His project focuses on the lucinid *Ctena orbiculata* that is found in both coastal areas and lakes with marine conduits on San Salvador, the Bahamas. He is now at the University of Chicago working on a PhD and was awarded a Fulbright Fellowship. In addition, he won a student poster award from the Division of Geobiology and Geomicrobiology, Geological Society of America at the meeting in Indianapolis this fall.

My two other MS students, Megan Norr (PALE) and Kayleigh Johnson (PALE) are also doing very well. Megan completed her degree in May, with a project that used western Atlantic collections to examine the morphologic response of arcid and arcopsid bivalves to a regional mass extinction in the Plio-Pleistocene. Megan is now working for the National Park Service at Yellowstone. Kayleigh is in the accelerated MS program and defended her thesis in November. Her project tested the effects of preparation by air abrasion on microwear patterns in mammal teeth. At the end of this month she will become the preparator and lab manager for the Museum of Geology here on campus.

I also had the opportunity this fall to work with four students on their senior research project proposals. The projects take advantage of data and collections that we have cataloged in the museum as part of multiple grants over the last five years. I'm excited to see how these projects turn out!

The PRL is busy with many undergraduate and graduate students involved in several collections projects as well as other research. Our projects funded NSF Collections in Support of Biological Research, Bureau of Land Management, and NSF Advancing Digitization of Biological Collections grants continue. In Fiscal Year 2018, 246,706 specimens were entered into the Museum Database (84% of that effort with grant support).

2018 GGE Department news:

2017 December:
Dr. Darrin Pagnac – SD Mines Paleontologist Lands NSF Grant to Increase Diversity in Earth Sciences
https://www.sdsmt.edu/News/SD-Mines-Paleontologist-Lands-NSF-Grant-to-Increase-Diversity-in-Earth-Sciences/#.Wj0ZsDdG2Uk
and, SD School of Mines Paleontologist Researches Diversity in the Geosciences
http://listen.sdpb.org/post/sd-school-mines-paleontologist-researches-diversity-geosciences

January:
Ms. Danielle Serratos – Museum of Geology Kids Zone Features New Activities
https://www.sdsmt.edu/News/Museum-of-Geology-updates-Kids-Zone/#.WnCtUudG2Uk
https://www.kotatv.com/content/news/Renovated-Kids-Zone-at-Museum-of-Geology-now-open-469039653.html
Mr. Kyle Hazelwood (PhD GEOL candidate) – SD Mines Receives National Teaching Assistant Award
https://www.sdsmt.edu/News/SD-Mines-Student-Receives-National-Teaching-Assistant-Award/
Dr. Alvis Lisenbee – Learning About Geology in South Dakota
http://listen.sdpb.org/post/learning-about-geology-south-dakota

March:

The Paleo Club student members – Unearth the Mysteries of History at the Dinosaur Eggstravaganza

https://www.sdsmt.edu/News/Unearth-the-Mysteries-of-History-at-the-Dinosaur-Eggstravaganza/

Museum of Geology and GGE Department – Girls learn about STEM careers

https://www.kotatv.com/video/?vid=476062723

April:

Mr. Daniel Soeder – SD Mines Energy Resources Initiative Builds Momentum as US Production Peaks

https://www.sdsmt.edu/Research/?month=2&year=2018

May:

Dr. Tim Masterlark – SDSM&T professor discusses science behind Hawaii volcanic eruptions

https://www.blackhillsfox.com/content/news/SDSMT-professor-discusses-science-behind-Hawaii-volcanic-eruptions-482118011.html

Ms. Danielle Serratos – National Dinosaur Day celebrated at School of Mines Museum of Geology

https://www.kotatv.com/content/news/National-Dinosaur-Day-celebrated-at-School-of-Mines-Museum-of-Geology-482736131.html

July:

Newly Minted PhD Takes Winding Road to Engineering (pages 16-17) – Dr. Scyller Borglum (PhD GeolE 18)

https://www.sdsmt.edu/Campus-Services/University-Relations-and-Media/Publications/Docs/Hardrock-Summer-Fall-2018/

Dr. Darrin Pagnac – A camp of mammoth proportions: Students get lesson in all things prehistoric

https://rapidcityjournal.com/news/a-camp-of-mammoth-proportions-students-get-lesson-in-all/article_5e03b811-1134-5d6e-a0be-e801306b8fb4.html

Mr. Daniel Soeder – Thailand cave rescue efforts hindered by hydrology and geology

https://www.newscenter1.tv/geology-meteorology-and-science-in-general-working-against-thai-cave-rescue/

August:

Mr. Broc Kokesh (MS PALE 18) – SD Mines Paleontologist Lands Fulbright Scholarship to Study Invasive Species Impact

https://www.sdsmt.edu/Research/Research@Mines/SD-Mines-Paleontologist-Lands-Fulbright-Scholarship-to-Study-Invasive-Species-Impact/#.W2hgGbhMHVg

Dr. Darrin Pagnac – Digging up history on the meg

https://www.kotatv.com/content/news/Digging-up-history-on-the-meg-490861251.html

and, Deconstructing "The Meg": Shall we suspend our disbelief?

https://www.newscenter1.tv/deconstructing-the-meg-shall-we-suspend-our-disbelief-2/

September:

Ms. Sally Shelton – Mines Celebrates Museum Day with Paleontology Lab Open House

https://www.sdsmt.edu/News/09-19-2018-MuseumDay/

and, A look at a fossil's journey

https://www.newscenter1.tv/a-look-at-a-fossils-journey/

October:

Mr. Curtis Price – Digital Mappers Invite Public to Learn the Craft

https://www.sdsmt.edu/News/10-22-2018_Digital_Mapping_Conference/

Mr. Daniel Soeder – New Horizons Energy Conference Explores Oil, Gas and Geothermal Potential

https://www.sdsmt.edu/News/10-22-2018-Energy-Conference/

and, When oil and water mix understanding the environmental impacts of shale development

https://www.sdsmt.edu/Research/Research@Mines/When-oil-and-water-mix/

Microbiologist speaks on understanding hydraulic fracturing at energy conference

https://www.blackhillsfox.com/content/news/Microbiologist-talks-about-hydraulic-fra-498601631.html

November:

Ms. Julie Driebergen (MS PALE candidate), Ms. Shannon Harrel (MS PALE candidate) and Ms. Megan Norr (MS PALE 18) – Mines Students Help Build Plesiosaur Display for New Exhibit at Deadwood's Adams Museum

https://www.sdsmt.edu/News/11-2-2018-Adams_Museum_Exhibit/

Drs. Liangping Li and Bill Roggenthen – SD Mines Researchers Explore Hydraulic Fracturing to Expand Geothermal Energy

https://www.sdsmt.edu/Research/Research@Mines/SD-Mines-Researchers-Explore-Hydraulic-Fracturing--to-Expand-Geothermal-Energy/

and, Sanford Underground Research Facility studying geothermal fracking

https://rapidcityjournal.com/news/local/sanford-underground-research-facility-studying-geothermal-fracking/article_ba904f05-b921-59d1-95ab-042b894546c0.html

https://rapidcityjournal.com/news/photos-see-researchers-at-work-a-mile-underground/collection_336e555b-b035-58a5-b61a-317b47ff5566.html

Dr. Colin Paterson – Will plans for new exploratory gold drilling lead to a construction of an underground mine?

https://www.kotatv.com/content/news/Will-plans-for-new-exploratory-gold-drilling-actually-lead-to-a-construction-of-an-underground-mine-501399711.html

It starts with a scholarship…

The Fall 2018 entering freshman class of 457 includes 35 GGE students. The GGE department was able to award 14 freshman students a total of $15,675 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!

Scholarships make a difference at SD Mines (video for the Foundation's 2018 scholarship drive)

https://www.youtube.com/watch?v=g8dZikgrrfU

SD Mines Foundation – ways to give

https://foundation.sdsmt.edu/giving/donate-now

Christopher Pellowski

It was another great year at Ranch A with three five-week sessions being offered this past summer. We had a slight decline in the number of enrolled students each session likely due to the overall declining enrollments being experienced throughout the country. During the three five-week sessions, we had 15 students from nine universities in session one, 22 students from 17 universities in session two and 20 students from 13 universities in session three. The weather this year was fairly enjoyable without any of the usual extremes that we have experienced in the past with only two weather days all summer.

Session 1, 2018 SD Mines students (L to R) Nicholas Reid, Jacob Adams, Trevor Mount and Brittnie Wratchford

For many years, Dr. Alvis Lisenbee was a stalwart supporter of the Ranch A geology field camps and unselfishly devoted his time and energy to make it the best possible experience for the students and we'll miss him greatly. I feel truly fortunate to have been able to work alongside and be mentored by a field geologist of this caliber and will always cherish the times when new ideas and interpretations were realized from our discussions together on the outcrop.

I taught the Geol 451 Economic Geology class in the spring semester with 10 students enrolled and a few of them are even considering future careers in mineral exploration/mine geology. Once again the Mineral Venture mineral exploration game was the highlight of this course with three student teams all feverishly competing to locate the largest Zambian copper/cobalt deposit. The stakes were raised this year with the challenge of finding a deposit(s) valued at one billion dollars or more with an exploration budget of three million dollars per team.

This year I am serving on four department committees and will be teaching GEOL 351 Earth Resources and the Environment during the Spring 2019 semester with 19 students already signed up.

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

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https://www.facebook.com/SDSMTGeologyGeologicalEngineering

Dan Soeder - ERI Update, December 2018

The Energy Resources Initiative continues to grow and develop at SD Mines. The first ERI graduate research assistant, Scyller Borglum, completed her Ph.D. in May, graduated, and promptly got elected to the South Dakota state house as a representative from Rapid City. A new ERI graduate assistant, Disha Gupta, started in August and has been contributing to the ongoing ERI Pierre Shale and groundwater methane research projects (described below). The New Horizons Energy Conference was held successfully on Thursday, October 25, 2018 at South Dakota School of Mines & Technology. A feature article by ERI was published in the September issue of *GSA Today* on the environmental impacts of unconventional oil and gas

development, and an issue paper on what is known and not known about groundwater effects from shale gas development was published in the November/December issue of *Groundwater*. These kinds of publications greatly increase the visibility of the ERI and the university. The draft of a textbook called The Fossil Fuel Revolution: Shale Gas and Tight Oil by Dan Soeder and Scyller Borglum to be published by Elsevier is nearly complete, with an expected production date in 2019.

New Horizons Energy Conference (NHEC)

The tenth conference in this series was held on Thursday, October 25, 2018 in Surbeck Center Ballroom at South Dakota School of Mines & Technology. The NHEC featured 18 oral presentations and a half dozen posters, along with two fieldtrips on Friday, October 26 – one underground to the 4850 ft. level of the SURF in the old Homestake mine, and the other to view Paleozoic outcrops in the northern Black Hills. Energy presentations ranged from oil & gas exploration, resource assessment, and residual oil zone recovery to deep sedimentary basin geothermal energy development. Talks on energy and the environment included water use for oil & gas development, methane migration in groundwater, and water quality impacts from frack chemicals, wastewater spills, and leachate from drill cuttings. An energy policy panel discussion produced a lively Q&A session with local utility company executives.

The conference had 48 pre-registered attendees, including 29 paid professional attendees and 19 registered students who were admitted free. A number of additional students came and went during the day without registering. Estimated total attendance was around 60. Professional attendees included academics, consultants, state government employees, federal government employees (mostly USGS), and a few people from small energy companies. The continued depression of oil and gas prices made Industry attendance less than hoped for, despite repeated efforts to advertise the conference in North Dakota, Wyoming and Colorado. The modest registration fee of $200 provided sufficient funds to cover all expenses and we thank our attendees. We also received donations from Steve and Donna O'Rourke, RESPEC, and the Firehouse Brewing Company, and we gratefully acknowledge their generous gifts. With the passing of Dr. Alvis Lisenbee, who began this conference in the 1990s, the NHEC has become the responsibility of the ERI. We intend to hold this conference periodically to keep the local geoscience and engineering communities apprised of developments in energy.

ERI Proposals in Process

Petrophysical Engineering And Research Laboratory (PEARL)

A proposal is ready for submittal to the Earth Sciences Program within the National Science Foundation (NSF) Geosciences Directorate for an Instrumentation and Facilities Program grant to fund a state-of-the-art laboratory to study unconventional and conventional hydrocarbon-producing reservoirs. The Petrophysical Engineering and Research Laboratory (PEARL) is envisioned to provide technology to measure and assess the physics of gas and liquid movement through the nanometer-scale pore structure of very impervious natural materials such as shale with nanodarcy resolution. The lab will feature high-precision steady-state and pulse permeameters designed to investigate net stress response, hysteresis, threshold pressures, and multi-phase fluid interactions. Additional pore characterization equipment such as a mercury porosimeter, helium pycnometer, and gas adsorption analyzer will also be obtained as part of this grant. Existing imaging instruments at SD Mines, such as the transmission electron microscope, scanning electron microscope, and micro-CT scanner will be used as part of an overall institutional capacity development for characterizing tight rocks. In addition to shale gas, the PEARL is expected to have applications to enhanced geothermal systems, storage or sequestration of carbon dioxide, and for the isolation of chemical and nuclear waste.

Focused Ion Beam Scanning Electron Microscope (FIB-SEM)

The ERI, the EMES, the GGE Department, the AMP Lab, the MME Department, and the Nanotechnology Program are collaborating on an NSF Major Research Instrumentation (MRI) proposal to obtain a Focused Ion Beam - Scanning Electron Microscope (FIB-SEM) at SD Mines. The FIB-SEM uses an ion beam to etch or mill samples at the nanometer scale, and it can image the samples with this beam. It can also employ a scanning electron beam to image samples like an ordinary SEM. These dual-beam systems have become standard research tools in materials science and geoscience.

The Energy Resources Initiative will use the FIB-SEM primarily for the characterization of pore structures in ultrafine-grained hydrocarbon source rocks like shales and tight limestones. Shales in particular lose visible pore structure if subjected to standard sample preparation methods like mechanical cutting and polishing. Because of the high clay content of these rocks, polishing

shales on a diamond lap tends to fill the natural pore space with mud. Breaking shale samples to expose a fresh surface plucks larger grains like quartz out of the clay matrix, creating false porosity. Preparation of atomically-smooth shale sample surfaces with a focused ion beam and imaging them with an SEM was developed a decade ago at the Texas Bureau of Economic Geology and Indiana State University, and is now standard procedure at most shale core analysis and research facilities. Coal is another methane source rock that can also benefit from being milled and imaged in the same manner. Enhanced geothermal systems rely on working fluids like water or CO_2 to transport heat out of microfractures and the narrow slot pores between grain boundaries in crystalline rocks. These can best be studied using the FIB-SEM instrument.

The other laboratories and departments have uses for the FIB-SEM that range from mineral inclusion studies and the investigation of welds between two very different substrates to manufacturing the tiny components of nano-machines and devices.

Energy Security

The Pentagon has mandated that military bases invest in energy security to allow the facilities to function as "energy islands" for at least sixty days in the event of a terrorist attack or natural disaster that cuts them off from outside energy supplies. In 2017, the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE) performed an assessment of geothermal and natural gas energy options for the West Virginia National Guard training base at Camp Dawson, WV, and concluded that there is enough "indigenous" energy in the ground beneath the base to keep it operating without outside energy supplies.

The ERI is interested in conducting a similar assessment at Ellsworth AFB near Rapid City. Previous research has shown that the Niobrara Shale contains significant amounts of gas, and the geothermal resource in western SD is well-known. The Air Force Office of Energy Assurance is interested in discussing the proposed project. The ERI is working with the Sustainable Solutions research group at SD Mines to reach out to the Air Force. The role for ERI on this proposed project would be to provide knowledge about the local geology, hydrology, and indigenous resources for Air Force decision-makers. This would be a great opportunity to engage students on real-world energy issues and research, and could potentially expand to include a number of other U.S. Air Force installations.

ERI Current Research

Petroleum Potential of the Pierre Shale

The Pierre Shale is shallow and quite thick in South Dakota. It is a Cretaceous marine deposit comprised of a number of organic-rich members. Drillers frequently report oil shows when penetrating the Pierre, but published literature indicates that the thermal maturity is too low for oil production. Many drillers assume the oil has migrated in from elsewhere. However, oil shows are rarely if ever reported in the Niobrara Formation, which lies directly beneath the Pierre.

We believe the Pierre Shale is a potential petroleum source rock. Thermal maturity data published in the literature were largely collected from pyrolysis-type measurements like rock-eval or source rock analysis. Such analytical techniques are useful for assessing the oil and gas generation potential of a source rock, but the thermal maturation calculation (specifically, Tmax) is often inaccurate on shales. This has been noted on the Marcellus, Utica, Eagle Ford and other shales with a range of thermal maturities. Other approaches, such as vitrinite reflectance or conodont alteration index are needed along with pyrolysis to truly assess the thermal history of these rocks.

The ERI Graduate Research Assistant, Disha Gupta, is proposing to investigate the thermal maturity and petroleum potential of the Pierre Shale for her thesis research. The ERI is planning to respond to an upcoming DOE funding opportunity announcement with a proposal to investigate the Pierre. DOE funding could pay for fresh cores, wireline logs, and a variety of sample analyses. One goal of a DOE project would be a revision of the stratigraphic framework of the Pierre Shale, which currently is confusing and contradictory.

Once the potentially organic-rich units are identified, vitrinite reflectance and rock eval will be used to produce thermal maturity maps and asses oil potential. The Pierre Shale is typically shallow throughout the state of South Dakota, forming surface outcrops in many locations. Shallow drilling technology developed under a DOE project funded a decade ago on the Niobrara in eastern Colorado could be applicable to the Pierre Shale, allowing economical oil production using hybrid coil tubing rigs. The Pierre could literally become South Dakota's "Bakken."

Stray gas in Shallow Groundwater

Stray gas in groundwater appears to have a statistical association with shale gas wells. Although methane gas is non-toxic, if it exsolves from groundwater and accumulates in confined spaces like basements, it can reach explosive levels. SD Mines has obtained a methane sensor from DOE to deploy in the field for methane measurements in the headspace of groundwater production wells. Harding County, SD has been suffering from issues related to the deterioration of older, conventional gas wells after the company that owned them went bankrupt due to low gas prices. Maintenance on these wells over the past few years has been negligible, and wellbore integrity has become a concern.

The sensor is a commercial model that uses a laser tuned to the spectral frequency of methane. It measures attenuation of the beam as a function of methane concentration, and has proven accurate in lab tests from 10 ppm up to the lower explosive limit of 5 percent. However, the device is designed for laboratory use, not field deployment. DOE engineers at NETL began modification of the instrument for field use, but it was not completed. The equipment was transferred to the ERI, and several graduate students from the Electrical and Computer Engineering Department have worked diligently to make it operational. We expect to deploy it in the field in Harding County early in Spring Semester to collect some pilot data from a water well in the vicinity of the gas production area. This proof-of-concept test could lead to additional deployments in areas where stray gas in shallow groundwater is considered to be a concern.

Potential International Opportunities

Shale gas resources are of global interest, although many nations have been hesitant to develop their shales until environmental and economic 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. The ERI helped organize and participated in a global petroleum congress in Sydney, Australia in July 2018, which provided an opportunity to meet and interact with people interested in shale gas development in Australia, Indonesia, China and elsewhere. The ERI has also been invited to participate on an expert panel and give a keynote address on fracking and groundwater at the International Forum on

Subsurface Space Utilization and Resource Exploitation, being convened in Wuhan, China by the Chinese Academy of Sciences in April 2019.

Recent ERI-Related Publications and Presentations

PUBLICATIONS

Soeder, Daniel J. and Kent, Douglas B, 2018, When oil and water mix: Understanding the environmental impacts of shale development: *GSA Today*, v. 28, no. 9 (September), p. 4-10.

Soeder, Daniel J., 2018, Groundwater Quality and Hydraulic Fracturing: Current Understanding and Science Needs: *Groundwater*, v. 56, no. 6, (November/December 2018) p. 852-858; first published online 10 July 2018 (https://doi.org/10.1111/gwat.12810).

Thomas, L., Tang, H., Kalyon, D., Aktas, S., Arthur, J.D., Blotevogel, J., Carey, J. W., Filshill, A., Fu, P., Hsuan, G., Hu, T., Soeder, D., Shah, S., Vidic, R., and Young, M.H., 2018, Toward better hydraulic fracturing fluids in energy production: A review of sustainable technologies and reduction of potential environmental impacts: *Journal of Petroleum Science and Engineering* (accepted 18 September 2018).

Soeder, Daniel J. and Borglum, Scyller J., 2019, The Fossil Fuel Revolution: Shale Gas and Tight Oil: Elsevier Publishing, Cambridge, MA (in press)

PRESENTATIONS

Soeder, Daniel J., 2018, The successful development of shale gas and tight oil resources in North America: 3rd World Congress on Petroleum Engineering and Natural Gas Recovery, July 20-21, 2018, Sydney, Australia.

Soeder, Daniel J., 2018, The Geology of Shale Gas and Tight Oil Resources in the United States, Abstract 320783; GSA Annual Meeting, November 4-7, 2018, Indianapolis, Indiana.

Soeder, Daniel J., 2018, Groundwater Quality and Fracking: Current Understanding and Science Needs: National Ground Water Association; Groundwater Summit at Groundwater Week, December 3-6, 2018, Las Vegas, NV.

From our Emeritus Professors:

Arden D. Davis
Professor Emeritus of Geological Engineering

During the past year, Dr. Kurt Katzenstein, Dr. Alvis Lisenbee, Dr. Scott Kenner, and I received a grant from the West Dakota Water Development District for a research project. Sadly, Dr. Lisenbee didn't see the completion of the work, but we are looking at future water needs for the Rapid City area and western Pennington County. Because the West Dakota Water Development District and the City of Rapid City hold future-use permits for water from the Missouri River, we're considering the eventual likelihood of a pipeline to western Pennington County. Currently, other water systems deliver Missouri River water to much of the state's population, including the Mni Wiconi pipeline in western South Dakota, and the Lewis and Clark system in eastern South Dakota, northwestern Iowa, and southwestern Minnesota.

After retirement, I'm continuing to share an office with Perry Rahn in MI 327B. During the last year, I've worked with others to publish some papers in journals:

Davis, A.D., Webb, C.J., Sorensen, J.L., and Dixon, D.J., 2018, Thermodynamic constraints on limestone-based arsenic removal from water: Environmental Earth Sciences 77:33
https://doi.org/10.1007/s12665-017-7204-6

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Hudson, R.I., 2018, Geochemical thermodynamics of lead removal from water with limestone: Water, Air, and Soil Pollution 229:177
https://doi.org/10.1007/s11270-018-3824-z

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Hudson, R.I., 2018, Geochemical thermodynamics of cadmium removal from water with limestone: Environmental Earth Sciences 77:37
https://doi.org/10.1007/s12665-017-7205-5

Li, L., Stetler, L.D., Cao, Z., and Davis, A.D., 2018, An iterative normal-score ensemble smoother for dealing with non-Gaussianity in data assimilation: Journal of Hydrology
https://doi.org/10.1016/j.jhydrol.2018.01.038

Li, L., Puzel, R., and Davis, A.D., Data assimilation in groundwater modeling: ensemble Kalman filter versus ensemble smoothers: Hydrological Processes 32:13.
https://doi.org/10.1002/hyp.13127

Along with colleagues, I'm hoping to continue work on additional papers:

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.

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 also worked on a paper with Dr. Kurt Katzenstein and others on subsidence from groundwater pumping. In the spring semester of 2018, I started writing a paper with Dr. Maribeth Price and Dr. Alvis Lisenbee on groundwater sampling for dissolved arsenic and other contaminants in Precambrian wells of the central Black Hills. I hope this can be published posthumously with Alvis.

In late May and early June, I taught my three-week environmental field camp course, GEOE 412. We had students from several different universities around the country. Dr. PT Tukkaraja, from Mining Engineering and Management, joined us during part of the course. We had projects at interesting sites in the Black Hills, including Rhoads Fork spring at the headwaters of Rapid Creek, Iron Creek dam and spillway, slope failures, Cascade Springs and Hot 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.

Last summer, my wife and I again spent most of June, July, and August at our farmstead in Minnesota. We did some work on the buildings and house, in addition to mowing lawns, pruning the orchard, and tending the gardens and windbreaks. Below is a photo from 1963.

During the past year it was enjoyable to visit with graduates, 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, Chance Costello, Mike Mahowald, Susan Ray, Jonathan McKaskey, Brad Stock, Matt Minnick, Jennifer Bednar, Steve Mezger, Neal Olmstead, Renel Hall, Greg Kipp, Joe Peterlin, Mike Buswell, Joyce Fry, Marc Macy, Crystal Hocking, Kristin Pratscher, Brian Fagnan, and many others..

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

arden.davis@sdsmt.edu

Colin Paterson

Becci and I spent January through April in Te Anau, Fiordland National Park, New Zealand, and spent much of our time biking, hiking, and backpacking, including a 9-day volunteer ranger backpacking trip on the Hollyford Track. Back in the department, I am consolidating papers and rocks in my small office – that means discarding a lot to other faculty and students. Retirement is busy!

The **Society of Economic Geologists student chapter**, headed by Alex Rogaski, is still active in the department with about 10-15 members involved in monthly meetings and field trips. Eight students (sophomore to graduate) went on the SEG-sponsored trip to the Agnico-Eagle drilling program at the Gilt Edge gold mine in the northern Black Hills. The company is collaborating with the EPA and SD DENR to determine sources of contamination and investigating the possibility of eventually producing gold, while taking responsibility of the remaining environmental issues of this Superfund site, thus removing the financial burden on the state and federal agencies. We are struggling to maintain interest by the students in the SEG student chapter because there is no faculty member in the department dedicated to promoting careers in mine geology and mineral exploration, and no acceptance of graduate students in economic geology. In spite of the efforts of Dr Kelli McCormick (Mining) and me as faculty advisors, the future of the chapter, which we established in 1999, is uncertain.

The passing of **Dr Alvis Lisenbee** leaves a huge hole in the department – since retirement, he has been very active in research and mentoring and advising graduate and undergraduate students. He hired me back in 1982, and was a wonderful mentor, collaborator, co-author, co-teacher, and friend. His dedication to the department, and his expertise and friendship will be greatly missed.

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 2019. Our home is available as a vacation rental outside those months – google “Mountain Vista on Matai”. Let me know if you are interested in geological/cultural tours of New Zealand during March 2020.

SEG Student Chapter group at Agnico-Eagle’s drill rig, Gilt Edge gold mine, Black Hills

Perry Rahn

Not guilty! Perry Rahn claims he's not responsible for the February, 2017, erosion of the Oroville Dam spillways. Although he was employed as an engineering geologist for the California Department of Water Resources when the Oroville Dam was being constructed in 1959, he was involved in the tunnels associated with the relocation of the Western Pacific Railroad, not the Oroville Dam.

Alvis was my friend and colleague. He was thoughtful about issues. He traveled and studied structural geology. I remember coming to a classroom after he had finished a lecture and his sketches were still on the blackboard. They were works of art; I hesitated erasing them so I could teach my class. Alvis would go to the mountains, measure the strike and dip of the strata, and conceptualize how they got that way. Here are some words written in 1824 by Sir Walker Scott:

"And some rin up hill and down dale, knapping the chucky stone to pieces wi' hammers, lie soe many road makers run draft. They said it is to see how the world was made."

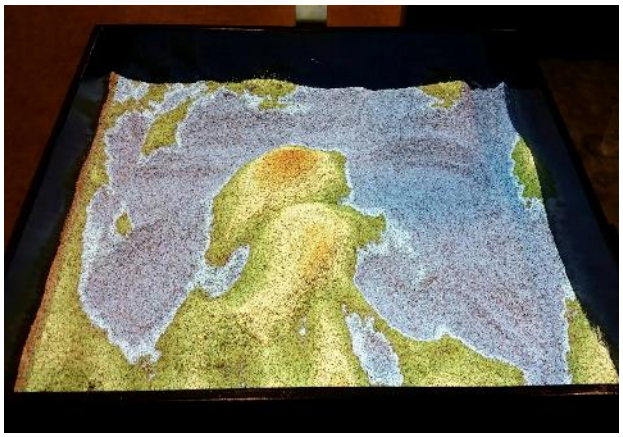
From the Faculty:

Dr. Kurt Katzenstein

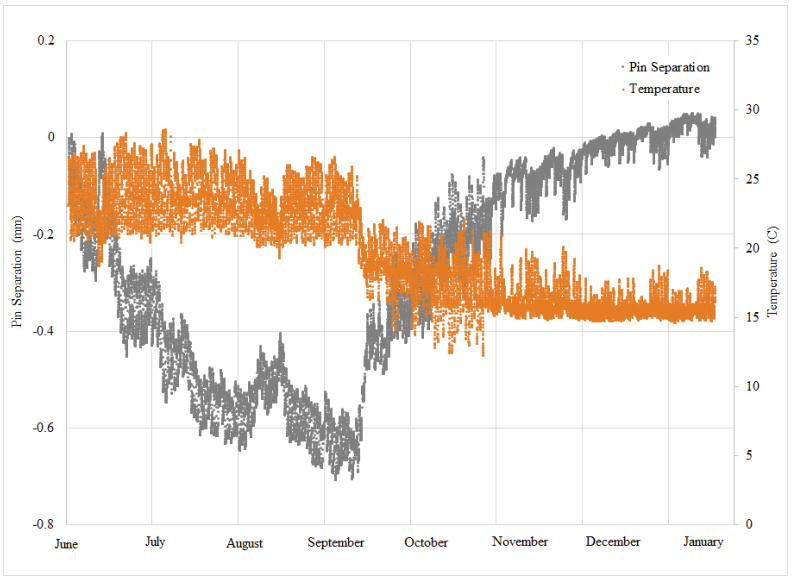
Here's hoping you and your family had a wonderful 2018! The Katzenstein Family enjoyed another banner year of family trips, recreational sports and life lessons. Dad also found time to get some work done in there too (more on that later!). Some family highlights this year include all three girls (Brianne – 8, Hannah – 7, and Leslie – 4) playing soccer with the two older girls being invited to join the tournament teams with the Black Hills Rapids. Bri and Hannah also enjoy playing basketball in the winter months and Leslie is chomping at the bit to start that next year. We also spent multiple trips visiting family, and/or exploring new places. I joined my father on our annual backpacking trip in the Sierras. This year we were "treated" to multiple severe lightning storms often accompanied by hail. While very beautiful, it is not the sort of thing that is the most comforting at 12,000 feet!

The “Geology Rocks” youth camp was a success once again this year. We had a total of 20 campers this year and with th exception of a few unwelcomed evening thunderstorms, we had a great time! We spent four days exploring geologic localles throughout the Black Hills and then topped each day off with a nice evenign feast at our group campsite at Sheridan Lake.

It was another active year of outreach events with our augmented reality sandbox and sediment flume. This is something that I particularly enjoy and these two hands-on visual aids always go over well with a wide range of age groups.



I participated in research associated with two projects this year. We completed our fourth year of a major ($1,250,000) grant to investigate complex ventilation and radon mitigation in block-caving mining operations. I helped Robert Huber, one of my M.S. students, graduate with his M.S. His project 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 has been a fun project and I hope to continue to play a part in crack monitoring there in the future.



I wish you the very best and hope that your 2019 is enjoyable!

Sarah W. Keenan

Hi Alumni—I am excited to join the GGE Department as an Assistant Professor in geology, specializing in paleontology and geochemistry! Previously I was a postdoctoral researcher at the University of Tennessee in Knoxville (UTK) in the Department of Biosystems Engineering and Soil Science. I conducted research on decomposing animals to evaluate how their nutrients are recycled in the environment. Because these early stages of decomposition also impact an animal's bones, this is a critical time for understanding how bones ultimately become fossilized—or are completely degraded. I also had the opportunity to conduct research at "the Body Farm," a human decomposition facility.

While I was sad to leave the Appalachian Mountains, UTK, and Knoxville, I am loving the Black Hills, Mines, and Rapid City. I've been busy teaching Quantitative Methods in Paleontology, preparing to take over a course on Aqueous Geochemistry, and developing a new course on Geomicrobiology. In addition, I've been busy setting up a biogeochemistry and geomicrobiology laboratory space for studying decomposition, vertebrate bone geochemistry, and the microorganisms that are involved in altering bones post mortem. This fall I started two projects with undergraduate students focusing on modern taphonomic processes impacting fossil bones in the Cretaceous Pierre Shale as well as faunal assemblage composition and taphonomy from sites within Wind Cave National Park. This spring I will be starting an animal decomposition experiment at Kenny Brown's ranch near Hermosa, SD, the first of many experiments in the field and the lab.

I've also recently published some previous research from my postdoctoral appointments at UTK and Saint Louis University, and both include student co-authors (graduate (GS) and undergraduate (UG)):

Keenan, S.W., Emmons, A.L.[GS], Taylor, L.S.[GS], Phillips, G., Mason, A.R.[GS], Mundorff, A., Bernard, E.C., Davoren, J., and DeBruyn, J.M. (*in press*). Soil physiochemistry and microbial ecology of a multi-individual grave. *PLoS One*.

Odegard, D.T.[GS], Sonnenfelt, M.A.[UG], Bledsoe, J.G., **Keenan, S.W.,** Hill, C.A, and Warren, D.E. (2018). Changes in the material properties of the shell during simulated aquatic hibernation in the anoxia-tolerant painted turtle. *Journal for Experimental Biology*, DOI:10.1242/jeb.176990.

This past summer on my way from Tennessee to South Dakota I took a brief detour to visit my undergraduate alma mater, the University of St. Andrews in Scotland, and had the opportunity to hike and explore the geology of the Isle of Skye (photo at right). I was fortunate to be so close to world-class geology localities as an undergraduate, and I'm excited to be able to incorporate local Black Hills geology into my future courses!

Outside of Mines, I've been hiking (and birding) throughout the area, and I don't think I will ever get tired of seeing bison at Custer State Park.

Wishing you and yours a happy and healthy holiday season!

Liangping Li

Alumni and friends, Happy New Year and Merry Christmas! In 2018, I continued teaching Groundwater course for undergraduate students in fall and spring semesters. It was my first time to teach Senior Design I course for undergraduate students. In this course, a couple of projects related to uranium mining near Dewey-Burdock area are assigned to students. I also invited several guest lectures including Dr. Arden Davis, Dr. Perry Rahn, Randy Taylor, Dr. Jim Stone, and Curtis Price to share their knowledge for the projects.

For the research, I have four funded projects:

- Single PI on an NSF proposal, entitled "*Track-4: Inverse Methods of Hydraulic Fracturing for Enhanced Geothermal Systems in a Deep Mine*"
- Single PI on a proposal to SD BOR Competitive Research Grant, entitled "*Inverse Methods of Hydraulic Fracturing in Geothermal Applications (Year 2)*"
- PI on a proposal to SD NASA EPSCoR Research Initiation Grant entitled "*Detection and monitoring of brine spills in rangeland using remote sensing*" (Co-PIs: Drs. Bruggeman - SDSU, Stone, Capehart and Sieverding)
- PI on a proposal to SD NASA EPSCoR Tribal Research Collaboration Grant entitled "*Groundwater and Surface Water Interactions Modeling along the White River near Oglala, South Dakota*" (Co-PI: Dr. Sawyer)

Liangping Li, Bill Roggenthen, Colton Medler, Fleford Redoloza at the 4850 level of Sanford Underground Research Facility

In addition, I published two papers:

- Li, L., Stetler, L., Cao, Z, and Davis, A., (2018) An Iterative Normal-Score Ensemble Smoother for Dealing with non-Gaussianity in Data Assimilation, Journal of Hydrology (in press)

Li, L., Puzel, R., and Davis, A., (2018) Data Assimilation in Groundwater Modeling: Ensemble Kalman Filter versus Ensemble Smoothers, Hydrological Processes (in press)

Tim Masterlark

This past year was exceptional in many ways. I began 2018 by traveling to Chile to deliver a keynote presentation at the *AGU Chapman Conference* held at the Hotel Termas Hot Springs Resort on the flanks of the Laguna del Maule volcanic field. Alas, the weapons-grade obsidian that I brought back from the volcano was immediately claimed by my daughter upon my return to Rapid City. A few months later, I traveled to Washington D.C. to serve on a review panel for NASA. This was an important opportunity to guide the scope and focus of the next generation of NASA-supported research.

Running across the SD Badlands at sunset, Summer 2018.

Thanks to the genius and dedication of Dr. Sui (Jay) Tung and the rest of my amazing research team, I published 5 journal articles, 1 book chapter, and 1 white paper. This publication rate greatly exceeded expectations and, much to my chagrin, my allocated budget for publication expenses. I continued my service to the professional community and reviewed 11 proposals for NASA and NSF, as well as 11 manuscripts for a variety of prestigious scientific journals, including *Nature*.

On the personal side, I married the lovely Scyller Borglum in September (and I am pleased to report her successful election to SD State Representative, District 32), bought and moved into a house in Rapid City's District 32, and am finishing preparations to get my old house ready for sale. In honor of my 50th birthday, I woke up at 5:50AM and did a series of 50 pull-ups, 50 push-ups, 50 sit-ups, 50 dips, 50 lunges, and 50 atomic burpees with a 50-lb sandbag. All of this was immediately followed by a 50 minute nap. The challenge is set for my upcoming 51st birthday in February, 2019.

Darrin Pagnac

Happy Holidays!

2018 proved to be a phenomenally busy yet successful year for me. I moved forward on a number of important projects and saw impressive progress from my students as well.

By far the most important event in my professional life this year was the successful convening of the FIELD Institute in October. For the last three years I have been working on an NSF funded grant project entitled FIELD, Fieldwork Inspiring Expanded Leadership and Diversity. The project goal is to examine the culture of field geoscience in order to make field activity more accessible for underrepresented groups, including women, minorities, and individuals with disabilities. In October the research team gathered with thirty field-oriented geoscience faculty to discuss inclusivity issues in field geoscience and devise potential solutions. The three-day workshop was an amazing success; all participants were very, very pleased, and the leadership team was thrilled with the positive outcome of three years of preparation. Be on the lookout for future iterations of this workshop as the team will work to get additional sessions implemented.

Participants from over a dozen institutions at the FIELD Institute, held at the Colorado State University Mountain Campus in the Rockies above Fort Collins.

Field paleontology camps were also quite successful and productive this year. For the second season in a row we collaborated with the North Dakota Geological Survey on their public paleontology dig program. I took three graduate students to work sites southwest of Dickinson, ND, in the Oligocene White River Group with the North Dakota State Paleontologist and former

SD Mines Haslem Postdoc Dr. Clint Boyd. For two weeks we worked in the extremely productive outcrops of the Chadron and Brule Formations in North Dakota to document and excavate Oligocene-aged fossils. Several projects are coming out of this collaboration, including a Master's thesis on a productive amphibian fauna from the Brule Formation, and comparative Eocene stratigraphy of White River outcrops in North Dakota and those at Reva Gap in northwest South Dakota.

Students excavating a fossil rhino from the Brule Formation near Dickinson, ND.

As usual, I spent late July and early August on the Missouri River near Chamberlain, SD, conducting fossil surveys for the US Army Corps of Engineers. Normally, the team does this via boat, accessing outcrops from the water. However, in 2017 our boat hull was damaged, and we have been without water-borne transport ever since. Despite this setback, we still conducted a productive survey with about a half-dozen students from around the country. We spend time excavating a partial mosasaur skeleton, surveyed several miles of river shoreline, and even found a gorgeous shark tooth. The students had a fantastic and educational experience, and the Army Corps received necessary information about fossil occurrences along the river and important fossils were salvaged. Additionally, I get a special Christmas present this year, a new boat and outboard motor that will be ready to go for next season!

My students and I have been very busy this year completing numerous projects. In May my Master's student Scott Kottkamp finished his thesis on the evolution of bone-crushing dogs from the Miocene. Scott is headed for great things as his thesis project turned out very well. I will also see two-or three additional Master's students finishing their theses this spring and graduating. My students have worked on varied projects, from Cretaceous marsupials to the effects of fluvial transport on microwear of vertebrate teeth. I've enjoyed yet another year working with them all.

Best wishes for a happy and healthy holiday season and a great 2019!

Curtis Price

Lecturer in Geospatial Technology

Warm wishes to all for a turning of the year filled with good things.

I'm new. (Well, new to you.) In January last year, I retired from a 30-year career applying geographic information systems to a wide variety of projects to take up a new Lecturer position at SD Mines, teaching geospatial technology. I do miss my colleagues at the USGS, but I have always admired and appreciated the SD Mines GEE faculty since I moved to Rapid City in early 1995, and never imagined I would find myself among them in the MI building and sharing coffee in the Faculty Lounge!

I am teaching the three GIS classes (Intro, Databases, and Advanced Spatial Analysis), Remote Sensing, and Surveying for Mineral Engineers (MEM 201L, soon to be cross-listed with GEOE). Fortunately, I had a running start: since 2016 I have been filling in as an adjunct for Dr. Maribeth Price while she was on sabbatical (and after she took up her Dean position). Also, new colleagues have supported me a great deal; I especially appreciate the help of Dr. McCormick with Surveying, and Drs. Stetler, Duke, and Katzenstein with my first run of the Into to Remote Sensing course this fall. The Intro to GIS class in 2018SP was taught using a manuscript of Dr. Price's new Mastering ArcGIS Pro book using Esri's new ArcGIS Pro desktop software. Dr. Anderson and Cleo have been very helpful with me as I learn the ropes of my post-Fed life.

This year, I have taken the reins from Dr. Price (she seemed way too happy about this) of the state-wide Esri (ArcGIS software) consortium contract. This mostly involves nagging people around the state to send money once a year, though I am pushing for more coordination among the participating GIS programs at our South Dakota universities, tribal colleges, and Voc-Techs. In this role I decided to rejoin the Black Hills Digital Mapping Association board; this group held another successful meeting in October at Surbeck Center. I also provide local GIS tech support, provisioning software licenses for the campus, and helping faculty and students with GIS-related project support (notably, faculty getting set up to use HEC-RAS and students using GIS "for real" for the first time in Senior Research and Senior Design projects).

Last summer was not much a break, as I have continued with USGS under an intermittent appointment (which has just been renewed through the end of 2019). This allowed me to return to the Dakota Water Science Center office across town in June to help with integration of elevation and hydrography information for the *National Hydrography Dataset – Plus* high-resolution data package. I was very happy to hear that the production process is well on track, with beta release of the data on schedule (http://nhd.usgs.gov). Also, Dr. Benning from Civil Engineering tapped me to help a student EPICS team develop GIS time-of-travel analysis to

support the siting of emergency services stations in Oglala Lakota County, modeling the time it takes first responders to reach the site of a fire or medical emergency (way too long, it turns out). In July, I received a Faculty Travel Grant from SD Mines to attend the Esri International User Conference in San Diego to learn about new research and software capabilities. Hoping next summer is a bit less hectic.

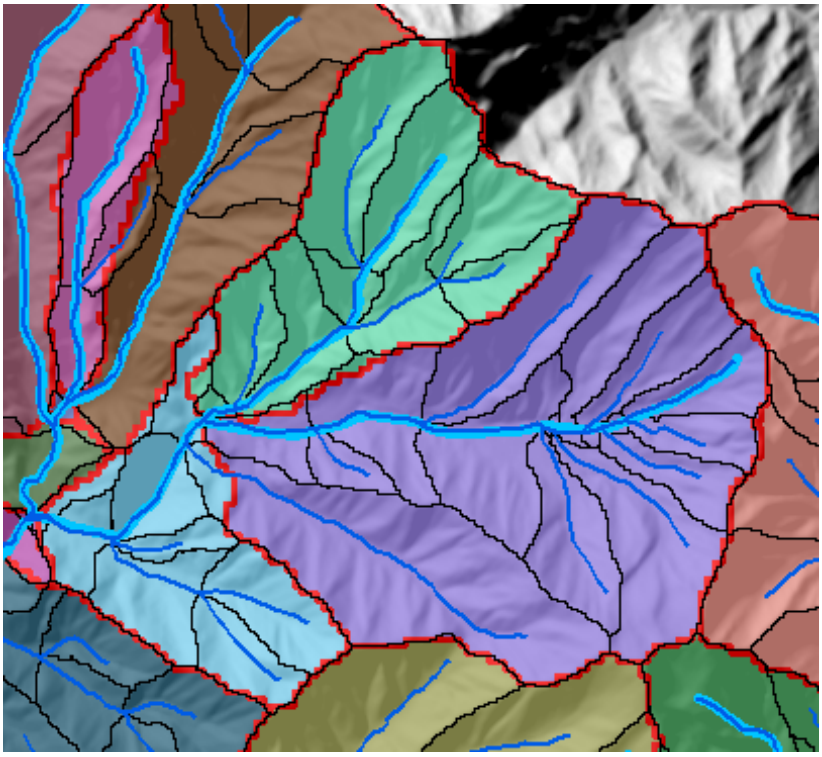
All in all, it has been a great adventure so far. I'm happy to be here, and strongly believe that our geospatial technology program adds a very useful skill set to our student's portfolio, giving them an edge as they head out in service of, well, Hardrocker world domination.

Feel free to send me students!!

Determining where it's at (with one of our handheld GPS devices) on our on-campus survey course

Dr. Katzenstein demonstrating UAV data collection to the Remote Sensing class this fall

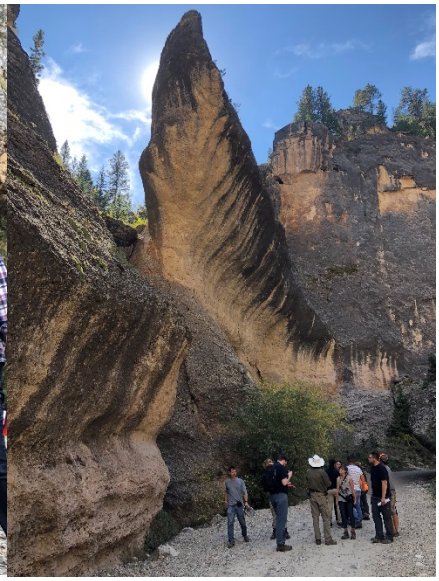
Dr. McCormick helping us with lidar (iSite) in Mineral Survey lab (long johns are also required equipment in the spring!)



NHDPlus integrates USGS elevation and hydrography data

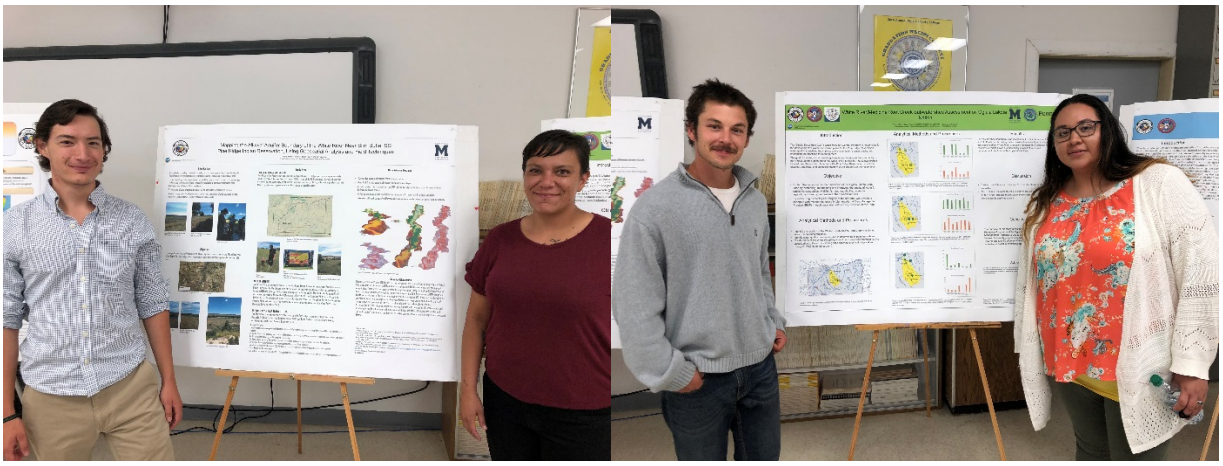
Foster Sawyer

Season's greetings and warm regards to the students, alumni, and friends of the Department of Geology & Geological Engineering! It has been a busy year as usual around the Department with lots of student functions, field trips, seminars, and many other activities. As you probably know, we lost Dr. Alvis Lisenbee, Emeritus Professor, this fall after a long and distinguished career at SDSM&T. Alvis will be greatly missed by everyone in the Mines community, and we will cherish our memories of him and celebrate the incredible life that he led. The photos below are from a field trip to the Bighorn Mountains in September, 2018, led by Dr. Lisenbee, Dr. Zeynep Baran, and myself.



Left: Dr. Alvis Lisenbee discusses the geology of the Bighorn Mountains with students. Right: The Bighorn Dolomite in Crazy Woman Canyon, Wyoming.

Student research continued to be a highlight for me this year within both the Pre-Engineering Education Collaborative (PEEC) program as well as in other arenas. The PEEC program focuses on reservation-based research on topics including ground water hydrology, affordable housing, sustainable food production, and other societally relevant issues. We had seventeen student posters at the PEEC poster session held at Oglala Lakota College in August, 2018. Significant progress on graduate research also occurred with Ryan Puzel's thesis (under the direction of Dr. Li) on modeling ground water and surface water interaction along the White River, Andrew Clift's dissertation on stratigraphic architecture and facies modeling of the Niobrara Formation in Wyoming, and Dale Malinzak's dissertation on Late Cretaceous biopaleogeography of non-avian dinosaurs in Laramidia. Dale Malinzak will receive his Ph.D. in December, 2018, and Andrew Clift and Ryan Puzel will complete their degrees in May, 2019.



Left: Zachary Darling and Elisha Yellow Thunder with Elisha's poster on digital mapping of the alluvial aquifer along the White River near the South Dakota-Nebraska border. Right: Ryan Puzel and Erica Lafferty with Erica's poster on watershed assessment on the Pine Ridge Reservation.

We also had a very good year with respect to the fields of petroleum geology and energy, hosting our 10th New Horizons Energy Conference in October, 2018, under the guidance of Mr. Dan Soeder, Director of the Energy Resources Initiative. Conference speakers and field trips were outstanding, including a field trip to the Sanford Underground Research Facility at the former Homestake Mine in Lead, South Dakota. Another important achievement in the petroleum field this year was acquisition of renewed licenses for Schlumberger software platforms such as Petrel, Eclipse, TechLog, and PIPESIM, collectively valued at approximately $103,000,000. Finally, the SDSM&T Society of Petroleum Engineers (SPE) Student Chapter was honored to be awarded the national SPE Outstanding Student Chapter Award for their exemplary accomplishments and activities.

Additional highlights for me this year included teaching field geology in Turkey with Alvis Lisenbee for a second season, co-leading a field trip to the Bighorn Mountains with Alvis and Zeynep Baran for about thirty department members, and most of all watching our students grow and mature into competent geoscientists as they prepare for their future careers and exciting new challenges.

I wish everyone a successful, healthy, and enjoyable year in 2019!

Sincerely,

Foster

Kevin M. Ward

Greetings and happy New Year! I am excited to be starting my first semester with the department and making the Black Hills my home. As a new faculty member, I have kept myself busy getting my research lab setup, putting the finishing touches on a few papers I've had on my desk for a while, and getting new classes with a strong field component ready for our students. It's an exciting time to be a seismologist as the public and funding agencies are showing an increased interest in our science. In early 2019, several undergraduate students from the department will travel with me to Alaska where we will deploy over 400 seismometers! Looking forward, my research group is working on even larger seismic deployments for the summer of 2020 with two separate projects targeting the Cascadia Subduction Zone and the Yellowstone Hotspot. In the coming semester, my focus will be split between recruiting interested undergraduate and graduate students to work on these pioneering seismic data sets and building local collaborations to explore research projects right in our own beautiful backyard. As someone who loves the snow and cold weather, I have not been disappointed thus far and am looking forward to the coming year in my new home.

On a sadder note, the department lost a committed and capable educator in Dr. Alvis Lisenbee. Although I did not get to spend much time with him, I did get to share his company while traveling from Rapid City to Buffalo, Wyoming for a short weekend field trip in the Big Horns. The roughly four-hour car ride included many topics of conversation ranging from helpful insights to a new faculty member, his views on leadership and vision, and of course geology all along the way. From that short conversation, it was clear to me that Alvis greatly valued his time out in the field on the outcrops with his students and colleagues. It was my privilege to talk about geology with Alvis and am glad I made the time to attend the optional field trip.

Bill Roggenthen

Bill Roggenthen has continued work this year at the Sanford Underground Research Facility (SURF) in Lead, SD. The current experiment is called the EGS Collab Project and involves eight national laboratories and six academic institutions, including SDSMT. The experiment currently being conducted on the 4850 Level (1.5 km below the surface) involves hydraulic fracturing of a limited-expanse test bed that is in the range of tens of meters. The fracturing, funded through the DOE Geothermal Technologies Office, is being done in close coordination with modelers from the labs and academic institutions who are making predictions regarding fracture orientation, interactions with natural fractures, and heat extraction. Sterling Richard, a geological engineering undergraduate, worked closely with the underground experiment crew during the past year, and Colton Medler, graduate student, is working up information from an active source seismic tomography project on data collected during a fracturing experiment in a nearby set of boreholes.

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

This has been an extremely difficult year for me. A mentor, big brother, best friend and field companion for 35 years in no longer with us. I met Alvis in 1983 at my hometown university in Trabzon, Turkey where he was a Fulbright visiting professor. He recruited me to come to SDSM&T for my graduate studies. In 2006, he convinced me to stay on as the field station director. Since then we have travelled to world together and set up amazing field camps.

Alvis began teaching structural geology at SD Mines in 1972. He loved both teaching and field geology and the opportunities it gave him to explore new places around the world. After "retiring" in 2006 as an emeritus professor, he continued teaching field courses including a five-week field camp he and I established in Taskesti, Turkey. At this camp in June 2018, Alvis celebrated the 50th anniversary of his first visit to the land he considered his second country.

There are two separate scholarships set up in his honor.

1. One can send checks to the Foundation (https://foundation.sdsmt.edu/) with a note designating which fund is to be supported.
2. Alternatively, one can make a donation online at (https://foundation.sdsmt.edu/lisenbee-memorial-gifts). After clicking on this link, look for the pull-down menu under "Designation" to direct your gift to either the scholarship or the Turkish field camp. (See image of this below.)

The Alvis Lisenbee Scholarship *is awarded to a full-time SD Mines student majoring in geology. Recipients are outstanding, top-performing juniors or seniors selected by a scholarship committee within the Department. This scholarship already exists, so gifts made to this fund will augment the amount of the scholarship.*

Turkish Field Camp "scholarship" *is a new fund being established to support SD Mines students in attending a summer field camp in Turkey. How the funds will be allocated depends upon the amount raised, but all funds will go to SD Mines students. Nuri Uzunlar will be the responsible party for managing gifts to the field camp until or unless inter-department structures are established for this.*

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 2018, 288 students from 103 institutions across the USA mapped geological environments ranging from volcanoes to fault zones in Hawaii, Turkey, France, Spain, Morocco, New Zealand Iceland, Nepal, Ecuador, and the Black Hills of South Dakota. We are getting ready for the winter camps in Hawaii, New Zealand and Death Valley. All three camps will start after Christmas.

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 Indianapolis and AGU in Washington DC, where the field station and the department had an exhibit.

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


The Alps, Southern France, Summer 2018


Project scouting trip, Turkey
08/15/2007

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

Galapagos Islands

Best friends

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