The University of Oklahoma
ConocoPhillips School of Geology and Geophysics
Mewbourne College of Earth and Energy

# EARTH SCIENTIST

Summer 2015 – Spring 2016

*The* UNIVERSITY *of* OKLAHOMA
*Mewbourne College of Earth and Energy*
ConocoPhillips School of Geology and Geophysics

**Editor-In-Chief:** R. Douglas Elmore
**Editor/Design/Layout:** Amber Roberts
**Contributors:** CPSGG Faculty, Students, and Friends

**About the Cover:** Canyonlands National Park, UT

**Pictured Above:** Grand Teton National Park, WY

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# EARTH SCIENTIST

Summer 2015 - Spring 2016

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# Director's Desk

## R. Douglas Elmore

Last year was a challenge with the drop in oil prices and the resulting impact that it has had on the school, the university, and our students. Some of our students are having trouble finding jobs, and donations to the school from oil companies have declined significantly. The state has also continued to cut funds to the university.

Despite the challenging times, the school continues to make progress. We hired two new geophysicists, Dr. Nori Nakata, who filled the general geophysics position, and Dr. Michael Behm, who filled the exploration geophysics position. More details on each of them are included in this issue of the Earth Scientist. We also hired new staff in the last year; the entire staff turned over in the last year and a half. Amber Roberts is now our events coordinator, and will handle all alumni events. We also hired Virginia "Ginny" Gandy-Guedes as our office administrative coordinator. In other staff news, Rebecca Fay, our undergraduate and graduate advisor, had her first child, a healthy baby girl, in July. Dr. Jerry Boak was also hired by the Oklahoma Geological Survey as the Director last year, and he is currently supervising a student in the school.

Last fall we had 23 companies come to the school to recruit and expect at least that many this fall. We also ran the AAPG - SEG EXPO in March 2016 and 2017. We advertised it as a networking and education event as opposed to a hiring fair. In 2016 we had 68 students and posters with 46 students in short courses taught by Slatt, Pranter, London Marfurt, and Pollock. Six companies and organizations also attended. The event was supported by a significant donation from the mid-continent section of AAPG as well as donations by some companies and individuals. The event was revenue neutral to the school.

The AAPG student chapter, with help from Amber Roberts, did a great job organizing the first ConocoPhillips research symposium with 52 of our students presenting posters. The event was supported by ConocoPhillips and their personnel were pleased with the event.

In curriculum news, the faculty agreed to reinstate Historical Geology (Geol 1124) as the second course in the curriculum. The course will be taught by Steve Westrop and Shannon Dulin next year. During the summer of 2015, Matt Pranter and I taught a study abroad course in Italy, "Geology of Italy," for 19 students. We visited Rome, Mount Vesuvius and Pompeii, turbidites in the Apennines, investigated the flooding issues in Venice, climbed a mountain in the Dolomites (northern Italy) to study Triassic carbonate deposits, and studied the geology of wine in Arezzo.

Our enrollments have declined, but remain healthy. We have 104 graduate students and 149 undergraduates. Over one hundred and eight courses were taught by geology and geophysics faculty for an average of ~ 4 courses per faculty member. This included 1,948 students in introductory general education courses as well as students from business and engineering (does not include our majors).

Last summer, we had 32 students in our geology field camp, with nine from outside OU. We did not run the geophysics camp because there were not enough students who needed the course in 2016. Dr. Shannon Dulin took over as the head of the geology field course this year. Our cook from the last two years decided to cook for a gold mining operation in Alaska and we had to find a new cook. Ginny, our receptionist decided to be the camp cook and ably helped by an ex-student, Virginia Priegnitz, as the cook's helper. The camp has become popular with outside students, and we had to turn students from other schools away because we could not

accommodate them. One of our four-person cabins had to be dismantled because the foundation was undermined by high rains last year. We had a new six-person cabin built as a replacement. I also lead the regional trip for the second year to Northern Colorado and Wyoming, where the students mapped glacial deposits in Rocky Mountain National Park, mapped around Sheep Mountain Wyoming, visited Yellowstone, camped in the Tetons, and mapped in the Wyoming over thrust belt. The University of Colorado also rented the camp in July. In 2017, Colorado and Texas Tech will rent the camp in July and August.

The students in the Pick and Hammer club continued their outreach efforts in the last year, reaching 1,000 elementary and high school students. I wrote a proposal that was funded by Halliburton for $20,000 to continue and expand the outreach efforts.

Dean Mike Stice of the Mewbourne College of Earth and Energy, who started in August of 2015, developed a college strategic plan for 2016-2025. The plan is ambitious. The college also hired a new development team: Neil Heeney and Dane Riggs.

Other news:

The faculty published 64 refereed papers, 129 conference papers and abstracts, and expended over $2.5 in external funding. Last year, the faculty did a great job acquiring new equipment: new "used" microprobe (London), new Raman system (Megan Elwood Madden, et al.), new Grain size analyzer (Lynn Soreghan and Mike Soreghan), and a new SEM (Elmore).

The student clubs continue to play an important part in the school. They sponsor talks, short courses, networking and mentoring events, field trips and seminars.

The school awarded 57 undergraduate students academic year scholarships for a total of $427,600 (average of $7,502). Field camp scholarships were awarded to 32 students for a total of $88,550.

This last year, we awarded 30 graduate teaching assistants for a total of $465,495. We also awarded $54,480 in graduate scholarships. The faculty supported 44 research assistants for total of $787,169.

The Imperial Barrel Team (Jennifer Roberts, Gabriel Machado Acosta, Joseph Snider, Lydia Jones, Rae Jacobsen; advisor, Dr. Pigott) won second place at the regional competition.

Several of our graduate students received research awards from the Geological Society of America and the American Association of Petroleum Geologists.

Despite the reduction in funds provided by companies, we have been able to find funds to continue our field trips in courses. In May, we ran the freshman field trip and stayed at the Bartell Field Camp to save funds.

At our spring picnic and honors event last year, the following students received awards:

Lauren E. McGraw – outstanding senior, MCEE, and Charles N. Gould Outstanding Senior
Stephen Marsh - the Alan Witten Award (as well as the best line drive in the geophysics/geology softball game)
Tyler Hunt - the David W. Stearns Outstanding Senior Award
Sama Khawaja - the Estwing Hammer Award
Alyse Johansen and Niles Wethington - DeGolyer Scholarships
Jing Zhang - Outstanding student, Tulsa Geological Society
Jennifer Roberts - Takken Award
Alyssa Wickard – Cunningham Teaching Assistant award
Curtis Smith – Ben Hare Outstanding MS research award

# Letter From the Dean

## J. Mike Stice

The University of Oklahoma, the Mewbourne College of Earth and Energy (MCEE), and are proud of the many accomplishments of the ConocoPhillips School of Geology and Geophysics (CPSGG) throughout the past year. The school has been, and continues to be, a leader in a number of key areas across the industry. In addition to its reputation in the industry, the school is a campus role model for service teaching, delivering high-quality general education in geology and geophysics to our undergraduates outside of the classroom. This year, I am excited about the new, cultivating research happening in imperative fields such as seismicity, reservoir characterization, paleo climate, and even planetary geology. Some specific examples of current noteworthy activities include:

Seismicity

*Dr. Doug Elmore, Dr. Xiaowei Chen, Dr. Ze'ev Reches, Dr. Matthew Pranter, and Dr. Kurt Marfurt are ramping up research on seismicity in Oklahoma. This group of faculty will be teaming up with the Oklahoma Geological Survey on basement rocks and the Arbuckle Group.*

Reservoir Characterization

*The Institute of Reservoir Characterization within the School of Geology and Geophysics, led by Dr. Roger Slatt, has been conducting an active consortium-funded research program to understand the geology of the Woodford Shale in Oklahoma, with the objective of optimizing the choice of horizontal drilling locations and depths. Sixteen M.S. theses have resulted from this research, with another 12 students currently conducting M.S./Ph.D. studies through the consortium.*

Paleoclimate

*Dr. Lynn Soreghan is studying sediments and sedimentary rocks to understand the "deep-time" Earth system, especially past climate. One of her focus areas is the geologic record of dust, specifically from the penultimate "icehouse" climate of the Late Paleozoic (300 My).*

Planetary Geology

*Dr. Megan Elwood Madden and her students are studying how minerals react with high salinity brines in order to learn more about the history of water on Mars. They are using new mineral clues to further compare the geologic context of anhydrite- and gypsum-bearing outcrops studied by Curiosity (NASA's rover exploring Gale Crater) to learn more about the history of water and salts on Mars.*

All of these efforts showcase OU's, MCEE's and CPSGG's commitment to using science to answer currently unanswered questions that will ultimately benefit the general public, private industry and society at large. On behalf of the students, faculty, and staff, I would like to thank you for your support and confidence in the Mewbourne College of Earth and Energy. I am beyond proud of the college's accomplishments over the past 10 years and genuinely excited about the college's future as we grow our legacy as an internationally recognized leader in earth sciences and engineering, energy education and research.

# Director of Development

## Dane Riggs

I'm excited to introduce you to the development team here at the Mewbourne College of Earth and Energy. Since it's founding, development staffing constraints in Mewbourne College limited its ability to broadly connect with our alumni; that's about to change. Last fall, Mike Stice was appointed as the new dean of the college and given the opportunity to build upon the success of the college's founding dean, Larry Grillott. Since arriving on campus, Dean Stice has shared some bold ideas on how to move the college forward, and it quickly became clear that private support would play a key part in achieving his vision. Dean Stice's commitment to development and private fund-raising for the college is strong, and we are grateful for the opportunity to work with the alumni of this college. In addition to the new development staff at the college we are also in the process of hiring a Director of Annual Giving to round out the team. We hope to have a full staff by the beginning of the academic year. Allison Richardson has formally accepted a new position as Executive Assistant to Dean Stice, but will continue to be a valuable resource for development at the college with her depth of knowledge and experience here. This is an amazing time to be a part of the Mewbourne College of Earth and Energy and the ConocoPhillips School of Geology and Geophysics.

Over the last several months, our development team has been crafting a strategy for successful fund raising that aligns with Dean Stice's recently unveiled 10-year strategic plan. Among many new objectives in the college's strategic plan, our office will play a critical role in doubling annual donor participation among alums, increasing annual giving from $4.5 million to $7 million, and growing the college's endowment by nearly 50%.

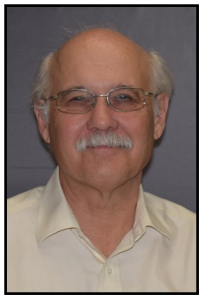
These goals are ambitious, but we are fortunate to have a solid foundation of success to build upon. In my short time at the college, I have been amazed to learn of the tremendous historic support of the college, especially from alumni of the ConocoPhillips School of Geology and Geophysics - thank you for your generous commitment to support our students, faculty, and programs. OU's Geology and Geophysics programs have a tremendous legacy, a legacy that has had both a national and international impact. Moving forward, our goal is to help the dean of the college and director of the school grow this legacy by securing the necessary private support that will be needed to propel the school to a new level of success.

A few key fund raising priorities for the school that our team will be focusing on include graduate fellowships and teaching assistantships, support for field work, new space for teaching and research, faculty support, unrestricted support for various initiatives and, of course, student support. At every turn, our goal is to make sure your gifts are translated into delivering a world-class educational experience to our students and preparing them to be the future leaders in their chosen professional fields and communities.

I hope to have the opportunity to meet many of you as we work to take the ConocoPhillips School of Geology and Geophysics to new heights. Our team is at your service and we look forward, with your help, to continue building the legacy of this flagship academic program at the University of Oklahoma. Thank you for your continued investment in the college, the school and, most importantly, our students.

Boomer Sooner!

# FACULTY



## *R. Douglas Elmore*

**Director, ConocoPhillips School of Geology and Geophysics and Eberly Chair**

Sedimentology, Paleomagnetism of Sedimentary Rocks, and Diagenesis

## *Shannon Dulin*

**Assistant Professor of Geology and Geophysics**

Paleomagnetism, Sedimentary Geology, Geologic Field Methods

## *Younane N. Abousleiman*

**Professor and Larry W. Brummett / ONEOK Chair**
**Director, integrated PoroMechanics Institute (iPMI)**

Reservoir Characterization and Mechanics of Porous Media

## *Andrew S. Elwood Madden*

**Associate Professor of Geology and Geophysics**

Nanoscale Geoscience, Low-Temperature, and Environmental Geochemistry

## *Michael Behm*

**Assistant Professor of Geology and Geophysics**

Exploration Geophysics, Solid Earth Geophysics, Seismic Imaging/ Monitoring, Seismic Interferometry and Earthquakes/Tectonics

## *Megan E. Elwood Madden*

**Associate Professor** and **Stubbeman-Drace Presidential Professor of Geology and Geophysics**

Earth and Planetary Geochemistry

## *Xiaowei Chen*

**Assistant Professor of Geology and Geophysics**

Seismology and Earthquake Processes

## *Michael H. Engel*

**Clyde Becker Chair**

Organic / Stable Isotope Geochemistry

## *David London*

**Norman R. Gelphman Professor in Geology and Geophysics**

Experimental Geochemistry, Mineralogy, Igneous and Metamorphic Petrology, and Geology of Metals

## *Richard Lupia*

**Associate Professor of Geology and Geophysics**
**Associate Curator of Paleobotany and Micropaeontology, The Sam Noble Museum**

Paleobotany, Palynology, and Paleoecology

## *Kurt J. Marfurt*

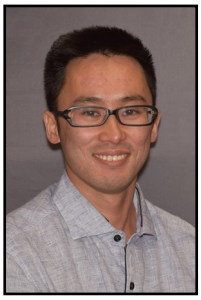
**Frank and Henrietta Schultz Chair and Professor of Geophysics**

Seismic Processing, Seismic Interpretation, and Reservoir Characterization

## *Shankar Mitra*

**Victor E. Monnett Chair in Energy Resources**

Structural Geology, Petroleum Geology, and Fractured and Faulted Reservoirs



## *Nori Nakata*

**Lissa and Cy Wagner Assistant Professor of Geology and Geophysics**

Seismology, 3D/4D Seismic Imaging, Seismic Interferometry, Microseismic, Signal Processing, Wave Phenomena, Civil Structure Monitoring, Computational Seismology

## *John D. Pigott*

**Associate Professor of Geology and Geophysics**

Ancient and Modern Carbonates, Basin Analysis, and Seismic Stratigraphy

## *Matthew J. Pranter*

**Lew and Myra Ward Chair in Reservoir Characterization and Professor of Geology and Geophysics**

Reservoir Characterization and Modeling, Sedimentary and Petroleum Geology

## *Roger M. Slatt*

**Gungoll Family Chair of Petroleum Geology and Geophysics**
**Director, Institute for Reservoir Characterization**

Reservoir Characterization, Deepwater Depositional Systems, Unconventional Shales, Clastic Sequence Stratigraphy

## *Gerilyn S. Soreghan*

**James Roy Maxey Professor**

Sedimentology, Stratigraphy, and Paleoclimatology

## *Michael J. Soreghan*

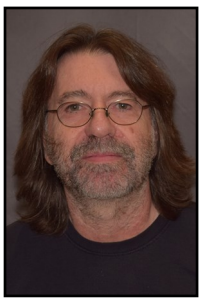
**Associate Professor of Geology and Geophysics**

Sedimentary and Environmental Geology

## *Barry L. Weaver*

**Associate Professor of Geology and Geophysics**

Trace Element Geochemistry of Igneous and Metamorphic Rocks



## *Steve Westrop*

**Willard L. Miller Professor**
**Curator of Invertebrate Paleontology, Sam Noble Oklahoma Museum of Natural History**

Invertebrate Paleontology

# Emeritus Faculty

## *Judson L. Ahern*

**Professor Emeritus**

Geomechanics, Gravity and Magnetics, and Environmental Geophysics

## *G. Randy Keller*

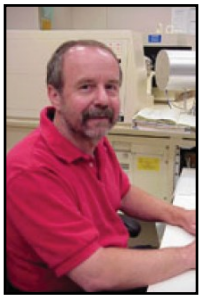
**Professor Emeritus**

Geophysics, Structure and Evolution of the Lithosphere from basins to the upper mantle, and Geoinformatics

## *M. Charles Gilbert*

**Professor Emeritus**

Igneous and Metamorphic Rock Systems



## *R. Paul Philp*

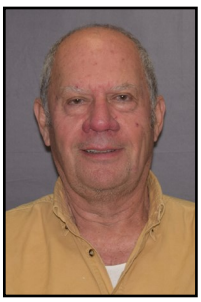
**Professor Emeritus**

Petroleum and Environmental Geochemistry

## *Charles W. Harper, Jr.*

**Professor Emeritus**

Paleontology



## *Ze'ev Reches*

**Professor Emeritus**

Structural Geology, Earthquakes, and Rock Mechanics

# Research Staff

## *G.B. Morgan, VI*

**Adjunct Professor**
**Research Scientist**

Electron Microscopy and Microanalysis, Igneous Petrology, Experimental Geochemistry, Materials Science

## *Brad Wallet*

**Adjunct Lecturer**
**Research Scientist**

Crustal Imaging Facility

# Administrative Staff

*Rebecca Fay*
**Coordinator of Academic Student Services**

*Leah Moser*
**Manager of Operations**

*Ginny Gandy-Guedes*
**Administrative Coordinator**

*Amber Roberts*
**Events Coordinator and Donor Relations**

*Gail Holloway*
**Instructor and Undergraduate Recruiter**

*Robert Turner*
**Lab Technician**

*Ginger Leivas*
**Budget and Account Representative**

# Connect With Us

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# New Faculty

## Michael Behm

### Assistant Professor for Applied Geophysics

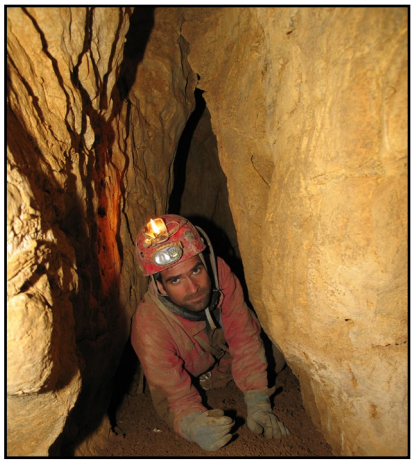
I graduated from Vienna University of Technology (TU) with a MSc in Geodesy (2002) and a PhD in Geophysics (2006). My PhD research focused on processing and interpretation of continental 3D seismic refraction data and also resulted in the discovery of a new tectonic plate fragment in the Eastern Alps of Europe. A following tenure as faculty member at TU enabled me to broaden my activities to crustal seismology, tectonic interpretation, and near-surface geophysics with an emphasis on Ground Penetrating Radar (GPR). We use this technology to map glacier thickness, imaging of ice bodies in caves, and for studies in karstified areas. My academic research and teaching included many field trips and blended well with my passion for mountains and cave exploring.

In 2011 I followed the call of the Rocky Mountains and became a visiting scholar at Colorado School of Mines. There, I worked with Roel Snieder in a project initiated and funded by ExxonMobil. We investigated how we can use 'ambient' seismic energy, which is otherwise unwanted noise (e.g., road traffic) for imaging the subsurface. We also applied the same method for monitoring the integrity and eventual failure of a dam structure. Most importantly, I met my wife in Colorado who currently is also an Assistant Professor for Near-Surface Geophysics at the University of Kansas. Last year we had a baby daughter born which gives us a lot of joy.

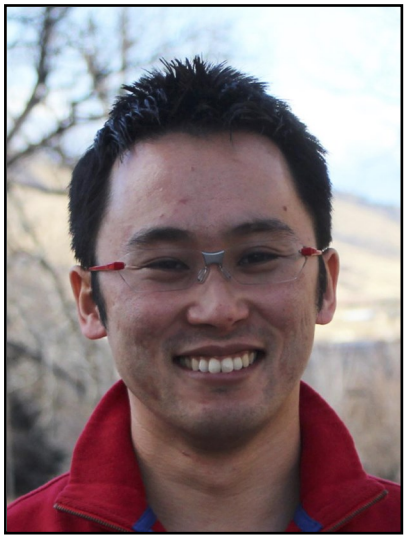
In 2013 I returned to Austria and took up a new position in the E&P segment of a mid-sized oil and gas company (OMV). There, I was responsible for seismic acquisition design, microseismic monitoring, gravimetry/magnetics and CSEM applications. I further coordinated our R&D activities and had the opportunity to steer our cooperation with different universities. I consider these three years outside the academic arena as very important and fruitful for my professional and personal development.

At OU, I'm looking forward to cooperation with other disciplines. I also see a lot of mutual benefit in close interaction between academia and industry. My initial research will focus on passive seismology for seismic imaging and time-lapse monitoring at different scales and for different application scenarios. These include reservoir monitoring, imaging of subsurface structures (crustal features, basement, near-surface), and geotechnical applications (e.g., seismic while drilling). This research program will be facilitated by 60 mobile seismic recording stations, which can be used in both active and passive settings.

I further want to continue to work in the fields of seismic acquisition design and non-seismic methods (gravimetry/magnetics, GPR, CSEM). I'm a strong believer in diversity and think that many challenges in geoscience can be tackled best when looked at from different perspectives. I'm very excited to get engaged and work with students and faculty at OU, and hope to make good and lasting connections in the geoscience community in Oklahoma!



Photographed: Michael Behm at doing what he likes best – exploring and mapping the subsurface!



# Nori Nakata

## Lissa and Cy Wagner Assistant Professor

Nori Nakata is an assistant professor studying seismology. He received his Bachelor of Engineering (2008) and Master of Engineering (2010) degrees from Kyoto University, and his PhD degree at Colorado School of Mines in 2013. He was awarded the Mendenhall prize from the Colorado School of Mines for his PhD thesis. He joined the University of Oklahoma in 2016 after serving as the George Thompson Postdoctoral Research Fellow in the geophysics department at Stanford University in 2013–2016. Nori's research interests are extensive and include crustal/global seismology, exploration geophysics, volcanism, and civil engineering.

Dr. Nakata's research aims to gain a better understanding of natural and manmade structures by analyzing seismic waves. Although the laterally averaged (i.e., 1D) Earth's seismic-velocity structure has been known accurately since the 1940s, subsurface is heterogeneity in 3D, even 4D, and understanding these heterogeneities is key to understanding Earth dynamics. Among the topics in which he is interested are predicting ground motion caused by large earthquakes, understanding earthquake source physics, discerning the history of the Earth, anticipating volcanic eruptions, and imaging the distribution of natural resources (e.g., petroleum, mines, geothermal). Seismic waves sample Earth's interior, and hence we can obtain information of the Earth in 3D. Temporally repeating these measurements opens a window into the dynamics of the Earth. To extract such information, Dr. Nakata uses manmade seismic sources, earthquakes, microseismic, and natural and anthropogenic background noise (aka ambient seismic noise).

# Pick and Hammer

## ConocoPhillips School of Geology & Geophysics
## The University of Oklahoma

It has been a wonderful year for the Pick and Hammer club. There have been new strides in outreach and social events due to a new set of officers and our faithful club membership.

It has now been four years since the public school outreach program began, and since its inception the program has grown to become something that we are incredibly proud of. The Pick and Hammer outreach program has continued to allow our club members to educate younger students using geoscience curricula focused towards each group while also providing schools and teachers with the knowledge and resources to continue teaching the material without us. Through our elementary school outreach. We have had the opportunity to host both field trips to Sarkeys Energy Center as well as visit the schools ourselves, where the younger students learn through various hands-on activities and lectures. We have also assisted in the regional and state Science Olympiad competitions by training the Whittier Middle School Science Olympiad team, writing test materials, and supervising competitions. On the high school level, we have done a series of talks discussing various subjects in the geosciences, including geophysics, petroleum and climate. We have not only aided local elementary, middle, and high school teachers, we have also participated in community wide events such as Science in Action, hosted by the Sam Noble Oklahoma Museum of Natural History, and a Boy Scout merit badge event alongside Alpha Phi Omega. These events allowed members to show off their identification skills and educate participants from all over Norman. Due to a generous donation from Halliburton, we have not only been able to reach out to even more students within the community, but we have also created an extensive rock, mineral, and fossil collection to be used for Science Olympiad training and many other outreach events. This year, we made new strides on a global level, and for the first time, our outreach expanded to more than just our community. Sama Khawaja, our outreach coordinator, taught a geology workshop in Pakistan, where she was able to expose a new group of students to the aspects and potential that the geosciences can provide. Additionally, students from Texas, Pennsylvania, and Florida contacted the club in search of local rocks and geological information; each of these students was sent one of our rock and mineral kits and a couple of local rose rocks and selenite crystals. President Lauren McGraw, in conjunction with past officers, presented a talk at the Geologic Society of America in Baltimore on “Student-Led Outreach at the University of Oklahoma” in hopes of educating and motivating similar groups at other universities.

Club fun at the White Sands National Monument

Officers at the Tucson Gem and Mineral Show

Our outreach program is the reason that the club has become the successful community that it is now. Because of our work in Norman and the surrounding areas, we have been awarded generous donations from companies like BP, Marathon Oil, and most recently, Halliburton. As a club, we have always strived to teach our community about the geosciences, and now thanks to those donations, we can do so without using club funds! This means that all club money can be used for meetings and social events.

Pick and Hammer lending a hand at The Big Event.

One of the best aspects of Pick and Hammer is that it is largely a social club that allows students at all levels of geologic study and interest to meet and participate in events that not only reinforce our bond as a club, but that also build on our love of the geosciences. We have had social events like Game Night and Movie Night where students gather to enjoy movies like *Jurassic Park* while enjoying food and the geologic commentary of their peers. We've hosted Climb Up and mini golf events, and taken multiple rockhounding trips. In October, we took a group to Colorado, where students were able to try their luck at mineral exploration in search of smoky quartz, feldspars, fluorite and goethite. In the spring, a small group was taken to hunt for fossils, and participants were able to find brachiopods, trilobites, and much more. Of all the events, perhaps the most popular has been our student mineral auctions, which feature both a silent auction as well as a "buy it now" table. These events have provided students with the opportunity to view and obtain a variety of quality mineral specimens that they otherwise might not have the opportunity to purchase.

2016 has been a great year, and we know that there will be many more to come. With an ever increasing group of geoscientists, the Pick and Hammer club is a great way to meet like-minded people, participate in outreach that can help empower future students, and have fun.

Club on mineral collecting trip in the pegmatite-bearing rock of the Pikes Peak Batholith (Colorado)

# AAPG Student Chapter

## 2015-2016 Officers

Gayln Adams - President
Brandon Spencer - Vice President
Ryan Rosal - Treasurer
Cecilia Lopez-Gamundi - Secretary
Gabby Galvez - Undergraduate Liaison

Our student chapter currently consists of more than 80 members at any given point, and there is always a good mix of geologists, geophysicists and petroleum engineers from both undergraduate and graduate programs. Our main goals are to promote fellowship within the department, as well as giving our members various skills that they can transfer over into their professional fields.

This year, the AAPG student chapter has organized many beneficial events, including guest lecturers and short courses, networking and recruiting opportunities, and social gatherings. Our continued participation in events is inspired by our set goals. These goals include: promoting fellowship, stimulating collaboration and sharing knowledge between geoscientists—from students to oil and gas companies. Through these activities, we afford supplementary opportunities for geology and geophysics students to develop a regard for community, a sense of teamwork, a stronger technical skill set and a larger network base—all essential for success in the petroleum industry. Reaching these goals would not be possible without the continuous cooperation with other groups, such as the SEG student chapter and the Pick and Hammer club.

# SEG Student Chapter

## 2015-2016 Officers

Gabriel Machado - President
Bryce Hutchinson - Vice President
Abdulmohsen Alali - Treasurer
Joseph Snyder - Secretary

Society of Exploration Geophysicists
*The international society of applied geophysics*

The SEG student chapter empowers students to participate and spearhead projects that address issues, challenges, and opportunities related to the SEG's mission of promoting the science of geophysics. The SEG student chapter has more than 60 members that include master's and doctoral students from geology, geophysics and petroleum engineering. This diversity allows us to maintain an active presence throughout the college and to promote fluid communication between majors.

Aside from the main events in which our members participated, we also sponsored many geophysical-themed lunch-and-learns. We collaborated on a number of events with the other student associations within the Mewbourne College of Earth and Energy such as Pick and Hammer and the AAPG student chapter; thus strengthening the camaraderie and bonds among students working in different specialties in the ConocoPhillips School of Geology and Geophysics.

# Laurence S. Youngblood Energy Library

## Annual Update

The George and Cecilia McGhee Collection of rocks and minerals is now on display in the Youngblood Energy Library. The collection was part of a generous gift from the McGhee Foundation of Middleburg, Virginia, to the University of Oklahoma.

George C. McGhee was a 1933 graduate of OU with a degree in geology. He grew up in Waco, Texas, with a passion for collecting rocks and minerals that would last throughout his life. In his early career, he worked for the legendary Texas geologist and oilman Everette DeGolyer. He married the boss' daughter, Cecilia; they were married for 63 years, until her death in 2001. McGhee had an illustrious career with the U.S. State Department, including serving as U.S. Ambassador to Turkey from 1951 to 1953 and to West Germany from 1963 to 1968. His travels with the State Department gave him the opportunity to collect rocks and minerals from around the world. Cecilia was an avid collector of seashells. The McGhees retired to their Farmer's Delight Plantation in Middleburg in 1969. George died in 2005 at the age of 93. He was the author of several books, some of which are included in the Youngblood Library display.



McGhee's Oxford University gown and a ceremonial sword presented to McGhee by a Saudi Arabian king were among the gifts donated to OU's Western History Collections. The Fred Jones Jr. Museum of Art and the Sam Noble Oklahoma Museum of Natural History also received gifts from the McGhee Foundation.

In other library news, Jody Bales Foote, geology librarian at the Youngblood Energy Library, retired on July 31. She began work at the Youngblood Library in January 2005 and led a major renovation of the library in 2010. James Bierman, currently the engineering librarian at OU, will also serve as interim geology librarian beginning August 1. The Youngblood Library welcomed staff assistant Larry Austin in summer 2015. Larry previously worked in Bizzell Memorial Library's Acquisitions Department and at the Oklahoma Geological Survey Core and Sample Library.

# Geology of Italy - Study Abroad Summer 2015 (Geology 4970)

## R. Douglas Elmore

In the summer of 2015, I, along with Matt Pranter, led 19 students to Italy for a study abroad course. We started in Rome and toured the sites, including the Coliseum, Forum and the Vatican. We provided an overview of the geology of Rome and discussed how the hills are made of ash and tuff, which were used as building material (building stones, aggregate for cement). We also discussed the origin of the marble floors at St. Peters Basilica.


Itinerary for the trip

On our way to Sorrento, we visited Ostia Antica, a large archaeological site that was the location of the harbour city of ancient Rome. Due to avulson of the Tiber and silting up the site is now 3 km from the Mediterranean. The site is noted for the excellent preservation of its ancient buildings, magnificent frescoes and impressive mosaics. In Sorrento the students enjoyed the seafood and nightlife. While staying in Sorrento, we visited Pompeii and Herculaneum, which were fantastic.

The class at Herculaneum

In Ostica Antica

Some of the group in the Coliseum

Pompeii with Vesuvius in the background

In Sorrento

The next day on our way to Arezzo, we went up Mount Vesuvius and walked around the crater. We stayed five nights in Arezzo, where we lectured on the geology of Italy and gave the students a quiz on what we had seen so far on the trip. We spent two days in the Apennines examining classic turbidite locations. We went to a winery in Arezzo and discussed the geology of wine. We also spent one very hot day in Florence and saw David. After a bit of a hiccup with the trains, we all made in back to Arezzo.

The Vesuvius crater

Examining turbidites in the Apennines

It was hot in the Apennines, and I found a pool with a rope swing to cool off. The ledge the students are standing on is a turbidite.

Too much gelato in Florence

From Arezzo we went to Venice and took a boat tour of the Venice lagoon and visited the 'MOSE," which are the gates that will close off the inlets into the lagoon and should solve the flooding problems in Venice. In addition to the tourist sites in Venice, we visited the Lido, which is the barrier island that separates the Adriatic from the Venice lagoon. Everyone got to take a swim in the Adriatic. From Venice we went into the dolomites and climbed the Latemar buildup, where the students measured carbonate cycles. After two days in the Dolomites, we went to Milan and flew back the next day. Each student made a presentation on a topic from the trip that interested them, were responsible for the trip blog for one day, wrote several short papers, measured a section on the Latemar, kept a journal, and took a slide show test in Arezzo.

Lecture on the boat during a tour of Venice lagoon

The class on the boat touring the Venetian lagoon and the MOSE project

Hiking up the Latemar

Measuring the carbonate cycles at the Refugio

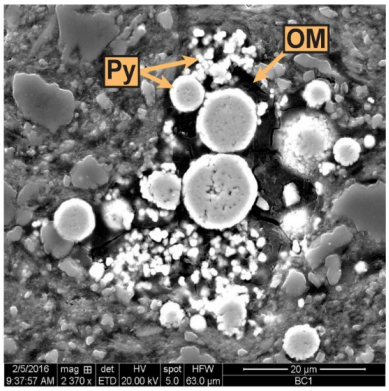
# I Spy With a Scanning Electron Microscope

By Alyssa Wickard and Douglas Elmore

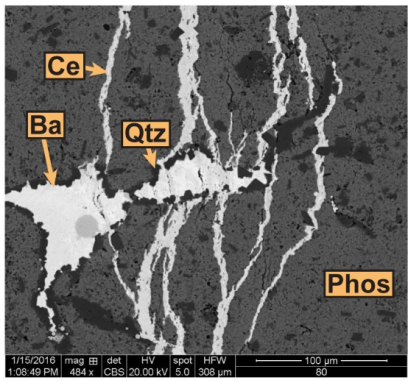
Shales and mudstones account for approximately 70% of the sedimentary rock record, and yet, shale diagenesis is not well understood. Fundamental issues that remain to be resolved include whether shales behave as open or closed systems, how diagenesis controls migration pathways, and how to connect scales of observation from basin-scale to the micro/nano-scale. It is important to understand the effect of diagenesis on a shale, because it can affect the reservoir quality of unconventional reservoirs through influencing fracability, porosity type and distribution, and fluid-flow pathways. To study diagenesis in shales and construct a paragenetic sequences it is necessary to utilize petrographic methodologies, such as our new Scanning Electron Microscope (SEM) to analyze mineralogical textures.

The Wolfcamp Shale off the eastern margin of the Midland Basin is comprised of organic-rich mudstones interbedded with carbonate turbidites and debrites that host platform derived carbonate lithoclasts. With extensive analysis of samples in an SEM, authigenic mineral phases can be relatively placed in relation to one another.

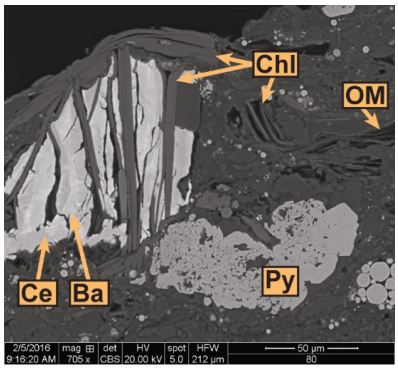
Investigating the diagenetic stages in the Wolfcamp Shale better constrains which mineral phases can hamper or improve reservoir quality with respect to fracability, porosity distribution, and potential fluid-flow pathways. Further study can also address whether shales are open or closed systems. Other unresolved questions, such as, relative and absolute timing of diagenetic events, role of fractures, authigenic mineral distribution, and the nature of altering fluids, can also be explored.



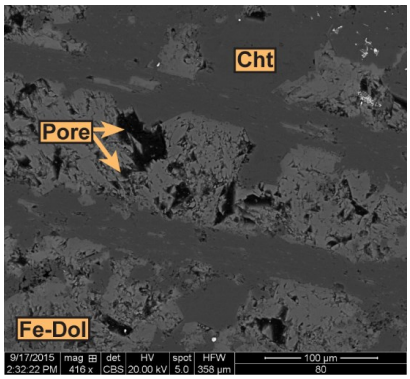

In mudstones, framboidal pyrite (Py) are seen to contain intercrystalline porosity filled by organic matter (OM).




Within a phosphate concretion (Phos), barite (Ba) is found within the concretion, rimed by quartz (Qtz), and cross-cut by celestine (Ce) fractures.




Celestine (Ce)/barite(Ba) related to fracture-filled, refractured, and was later filled by authigenic chlorite (Chl). The chlorite is also found with organic matter (OM) between clay sheets.




Chert(Cht), followed by ferroan dolomite (Fe-Dol) selectively replaced carbonate turbidite facies. The chert replacement occluded primary porosity, while dolomite replacement generated secondary porosity (Pore) within these intervals.

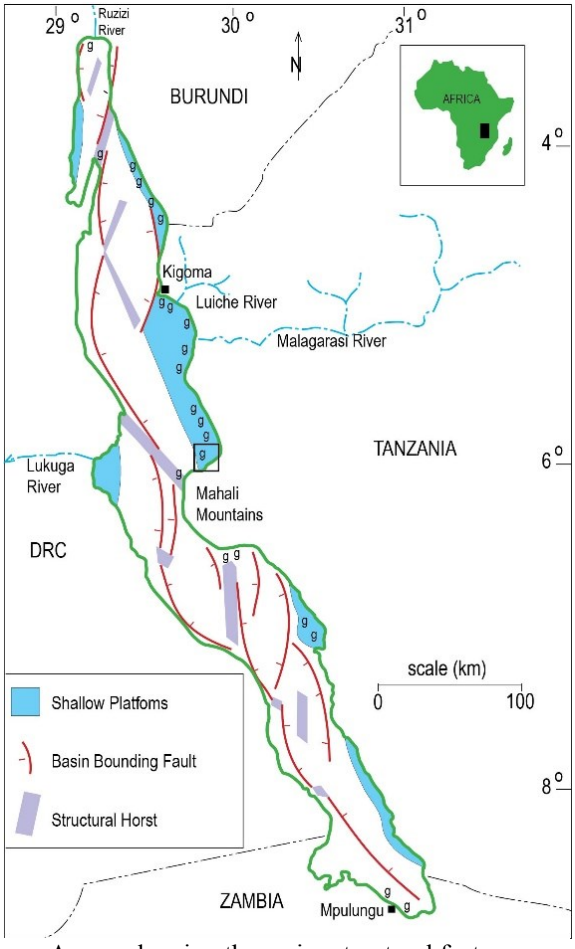
# A research excursion to the other side of the world to investigate Lake Tanganyika….and meet Kevin the Pelican

***James Busch, M.Sc. Candidate, Geology, University of Oklahoma***

Only a couple of weeks removed from my undergraduate graduation, I found myself speeding across Lake Tanganyika, somewhere between Tanzania and the Democratic Republic of the Congo, in a flotilla of overloaded outboard motored vessels, wedged in between SCUBA equipment and chickens. It was certainly an exciting way to begin graduate school, working with a star-studded group of esteemed scientists in an exotic location on the other side of the world.

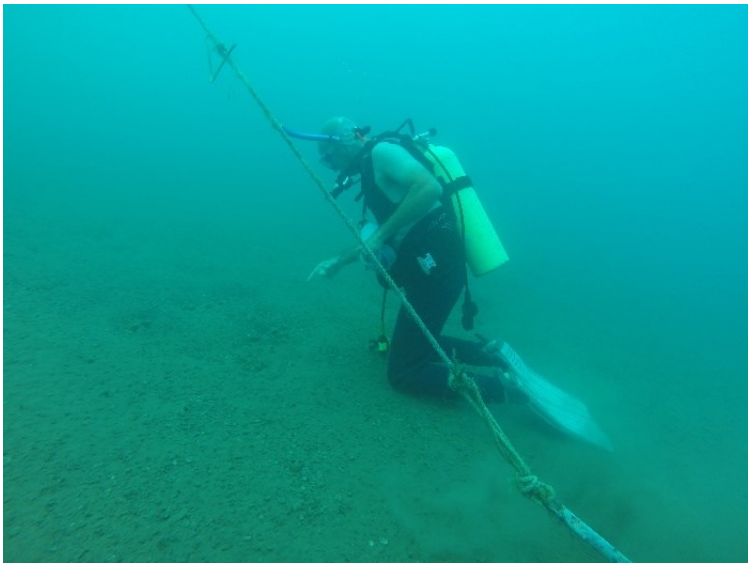
A group picture at The Nature Conservancy (TNC) field station in Buhingu, Tanzania

The team consisted of Mike Soreghan (Assistant Professor of Geology, OU), myself (first-year M.S. student, Geology), a team of geologists from the University of Kentucky, a pair of geologists from the University of Arizona, a group of aquatic biologists and ecologists from the University of Wisconsin-Madison, and researchers from the Tanzania Fisheries Research Institute (TAFIRI). The collaborative goal of the different group's research is to understand the relationship between the shell beds of Lake Tanganyika, modern anthropogenic land use change, incipient increases in sedimentation rates, and the current status of native fish species diversity, abundance and health.




A map showing the major structural features and location of Lake Tanganyika (created by Mike Soreghan)

The largest of the East African tropical rift lakes, Lake Tanganyika is both an ecological treasure hosting some of the most numerous and diverse endemic taxa on Earth and a significant resource to a large and growing population of people in four countries that border the lake. Dwindling fish stocks and observed changes in lake sedimentation as a result of anthropogenic land use change have put an emphasis on studying one of the most important ecological niches of the lake, the shell



Mike Soreghan collecting sediment samples near the Mahale Mountains in Lake Tanganyika.

beds. Although the shell beds of Lake Tanganyika cover several hundred square kilometers of the shallow nearshore environment, it is still not known how these vast carpets of dead shells were formed and why there are few observed live mollusk populations living in or near the shell beds (Kidwell, 2007; Kidwell, 2009).

Mike and I are focusing on the shell beds for our research, and most of our data collection consisted of collecting sediment and shell samples on SCUBA at different depths and in varying proximity to several towns and river deltas. Historical satellite imagery will also be interpreted to quantify land use change and progradation rates of the major river deltas for the past 50 years. The principal goals of our research include establishing a causal link between anthropogenic land use change, progradation rates of the river deltas, modern distribution of shell beds and sedimentary facies, and abundance of fish nests and benthic aquatic species.

One of the most exciting parts of the trip included discovering some of the few remaining live *Neothauma tanganyicense* snails (the main constituent of the shell beds) observed in the lake during the last 40 years. And then, of course, there was Kevin the pelican. This monstrous bird, almost as tall as me when standing upright, had quite the notoriety among locals and foreign tourists, who had traveled across the world to visit the Mahale Mountains National Park. The park is home to some of Tanzania's famous native chimpanzees, which was why we had taken the three hour boat ride through choppy conditions to venture into the southern reaches of the peninsula. What we didn't know was that the park is also home to this displaced, lonely pelican, who we affectionately named Kevin.

Kevin the Pelican standing next to myself and Michael McGlue, Professor of Geology at the University of Kentucky

The bird, apparently not native to this part of Lake Tanganyika, had presumably been displaced during a storm and landed on the beaches of the Mahale Mountains National Park. Lacking both feathered companions and an ability to fend for itself, the staff have been taking care of it for quite some time.

The amicable relationship that Kevin has developed with humans is immediately apparent, as his massive expandable bill and 6-foot wingspan saunter up the beach to greet the very pale westerners decked out in goofy hats and copious amounts of sunscreen. Although intimidating, some British tourists later demonstrated that Kevin really just wants your snack food that he has become accustom to receiving.

After a month doing research in the remote reaches of Lake Tanganyika, Tanzania, I had learned many lessons and seen many incredible sights, guided by true veterans in African rift lake research. Those holes in the ground surrounding your tent are from palm-sized tarantulas….. The picturesque sunsets across the lake never get old. And Kevin the pelican is fit to be an African celebrity.

A classic sunset looking across Lake Tanganyika towards the DRC.

# Atmospheric Dust from the Pennsylvanian Copacabana Formation (Bolivia): a high-resolution record of climate and volcanism from northwestern Gondwana

Carlos P. Carvajal and Gerilyn S. Soreghan

Atmospheric dust from ice, oceanic, and continental (e.g., loess) records is a valuable climatic archive. Loess deposits of the late Paleozoic Ice Age (LPIA) are well known from tropical Pangaea, but less studied in extra-tropical regions. This study documents dust from Pennsylvanian carbonates of the Copacabana Formation, recovered in core (the "Manuripi X-1") from the Madre de Dios basin (Bolivia), located within southern mid-latitudes of western Gondwana. The Copacabana Formation spans Pennsylvanian and Early Permian time, and thus formed coeval with ice centers and associated glacial deposits located at more southerly paleolatitudes in adjoining regions of Gondwana (e.g., the Parana and Tarija basins of Brazil). In Pennsylvanian time this carbonate unit formed isolated from fluvial-deltaic influx, and thus siliciclastic material here is interpreted to reflect atmospheric input. The 27.5 m study interval comprises open-marine fossiliferous wacke/packstone to restricted carbonate mudstone arranged in apparent upwardly shallowing intervals 1 – 3 m thick. Green volcanic ash horizons also occur, and new U-Pb zircon dating (Hamilton et al., 2016) on one especially thick bed has yielded an age of 316 Ma. Cycles are bounded by surfaces recording either an abrupt basinward facies shift, or inferred subaerial exposure surfaces marked by, e.g., reddened microkarst, with a commonly silty matrix. Siliciclastic material extracted at 20 cm intervals (avoiding ashes) varies from ~1 – 43 wt % in carbonate facies and ~5 – 64 wt % in clastic facies. The extraction process removes carbonate, organics, pyrite, and iron; any authigenic silica was removed manually. Grain-size modes range from <1 to 97 μm, with coarser intervals generally correlating to peak dust content (wt%), and inferred sequence boundaries. Ash-rich samples exhibit an inverse relationship between K/(Fe+Mg) and Na/K ratios, with very elevated K/(Fe+Mg) and very low Na/K; relative to reddened silt-rich samples. These data, together with relative proportions of La-Th-Sc enable discrimination of ash-rich dust reflecting an arc source from continental (cratonal-sourced) dust inputs. Dust influx generally increases at inferred high-frequency sequence boundaries, recording glacial lowstands of the LPIA, and thus suggest peak atmospheric dustiness at these times.

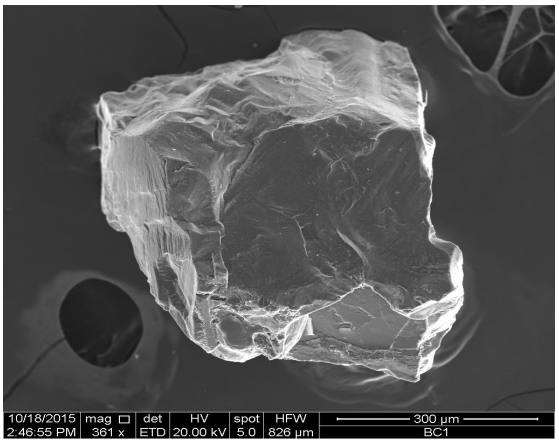
**Figure 1** Dr. Linda Hinnov (George Mason University) and Carlos P. Carvajal making a lithological description of the Manuripi X-1 core.


**Figure 2** Microbreccia horizon showing angular limestone clasts in a red silt matrix. These types of horizons constitute "abnormal" subaerial exposure common in icehouse intervals.

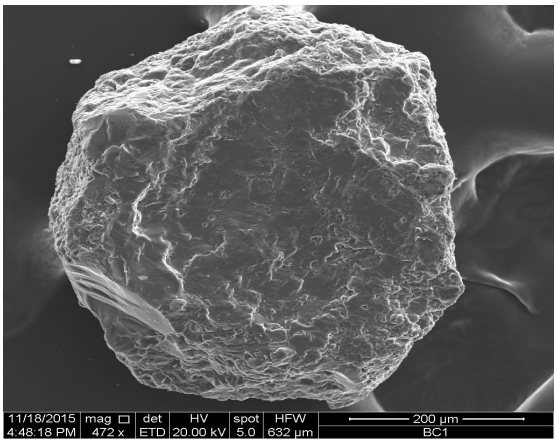
# Reading Climate in Grains of Sand

Curtis Smith and Gerilyn Soreghan

Coarse-grained clastic deposits are notoriously ambiguous climate recorders, and few techniques exist to aid in interpretation of their paleoclimatic settings. Quartz microtextural analysis has been used to study Neogene depositional and climatic environments. Previous researchers have described numerous micro-scale textures from grain surfaces and have concluded that many can be used to shed light on transportation history, depositional environment and, potentially, paleoclimate. For example, microstriae have been linked to grains formed in glacial settings, while v-shaped percussion cracks have been linked to transportation by saltation. Our research entails analysis of first-cycle fluvial quartz grains from various "end-member" modern climate systems to determine, under double-blind conditions, if these discrete environments inscribe unique suites of microtextures that can be used as paleoclimatic indicators for samples in Earth's deep-time record. Samples were collected from Puerto Rico (hot-humid), California (hot-arid), Norway (cold-humid-proglacial), and Peru (cold-semiarid-proglacial). All grains were analyzed using the new Devon SEM. We found trends demonstrating more chemically induced textures on the grains from the more humid locations, whereas grains from arid locations exhibit textures more indicative of aeolian transportation. Overall, our results suggest that climate does influence grain microtextures, and might be applicable for paleoclimatic investigations of deep-time strata., Further research will be done to add observations from modern till from Norway and Peru.




Norwegian grain exhibiting microstriae.




Puerto Rican grain exhibiting silica precipitation.

The research group in Puerto Rico.

# Mudrock Chemostratigraphy:

## Theory, Techniques, Applications, and Cautionary Tales

Bryan W. Turner, Institute of Reservoir Characterization, The University of Oklahoma

### What Is Chemostratigraphy

Chemostratigraphy is a method that is capable of highlighting, and simultaneously quantifying, geochemical variations within core, outcrop, plugs, and even cuttings. At its simplest, chemostratigraphy can be defined as using the variability of the chemical elements to evaluate the stratigraphic relationships within a succession due to changes in bulk chemical composition, isotopic composition, or organic geochemical composition. Where lithostratigraphy is based on petrologic variation within a succession, chemostratigraphy is based on geochemical variation within a succession.

### What Are the Benefits of Chemostratigraphic Analysis

As unconventional plays have become economic, there has been a general realization that the phrase "Homogenous Shale" is an oxymoron. Mudrocks in general are just as variable as their coarser-grained counterparts in conventional reservoirs, but mudrocks are considerably more subtle. As an example, Figure 1 shows a 10ft section of mudrock that could reasonably have fit the description of "Homogenous Shale". There are a few horizons where the careful geologist would note a color change, indicative of mineralogical variation, but on the whole this core does not appear to contain any significant variation.

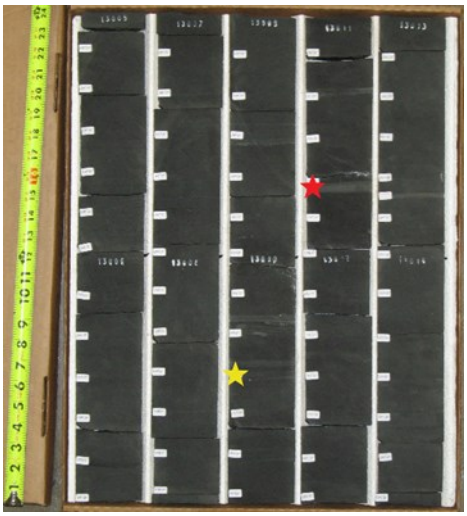


Figure 1: A 10ft succession of mudrock that, upon visual inspection, shows minimal variation. The white stickers represent depths that were analyzed in order to develop a chemostratigraphic profile for this unit. The chemostratigraphic sample spacing is 2in. The most significant horizon, geochemically speaking, is highlighted with the red star. The yellow star is the horizon with the highest composition of biogenic quartz, and potentially the most brittle horizon, within this interval.

Within this same 10ft section of core, elemental composition was measured every 2in. The chemostratigraphic profiles reveal a high degree of variability within this 10ft interval (Figure 2). There are three distinct chemofacies and over two-dozen chemofacies shifts. The chemofacies are defined using hierarchical clustering analysis (c.f. Güler, 2002) based on the 23 elemental profiles measured in this core. The chemostratigraphic profiles also reveal that the most significant horizon in this interval occurs at MD 13011'08". This interval is a local minimum for Al, K, Ti, and Zr (all of which are derived from terrestrial sources) and represents the approximate position (+/- 01in) of a chemo-sequence stratigraphic flooding surface. This is the chemostratigraphic equivalent to the top of a sequence stratigraphic parasequence.

# An Icehouse Dust Record From the Upper Paleozoic

(Asselian-Artinskian, Moscovian) Akiyoshi Limestone (Japan)

M.S. Student Xiao Qi (Supervised by Lynn Soreghan)

Atmospheric dust has been recognized as a key component of the climate system as it influences Earth's energy balance directly and indirectly. Furthermore, eolian dust deposits form high-resolution climate archives, and have been extensively used to aid climate reconstructions of Earth's recent (late Cenozoic) icehouse. Analogous to the late Cenozoic, the late Paleozoic was also an icehouse period, with repeated, high-magnitude, high-frequency glacial-interglacial climate shifts at the $10^5$-yr scale, as well as longer-term fluctuations consisting of several-My intervals with more ice separated by intervals of less ice. This research targets reconstruction of a dust record from the Late Paleozoic of the Panthalassic Ocean. The Akiyoshi Belt is a Permian subduction-generated accretionary complex in southwest Japan that comprises Viséan to Guadalupian atoll-type limestone underlain by basaltic rocks of a seamount origin. The oceanic rock assemblage of the carbonates, siliceous rocks, and basaltic rocks were formed in low latitudes of the Panthalassic Ocean far removed from any terrigenous siliciclastic influx, excepting that related to eolian delivery (atmospheric dust). Limestone of the Akiyoshi atoll archives climatic and eustatic changes during Early Carboniferous to Middle Permian time, spanning the onset, peak, and demise of the Late Paleozoic Ice Age (LPIA).

This research focuses on constructing a dust record for the Akiyoshi system, to investigate links between atmospheric dust (flux, size, composition, provenance) and icehouse- and glacial-interglacial climate modes. This research expands the growing dataset on dust of the Carboniferous-Permian greatly in space-to the far reaches of the Panthalassic Ocean, to shed light on atmospheric dust loading at the glacial-interglacial resolution, possible dust transport pathways, and to assess climatic implications.


Fig. 1 Akiyoshi limestone pinnacles and sampling location

Fig2. Akiyoshi Dai national park.

Fig 3. Akiyoshi Dai national park.

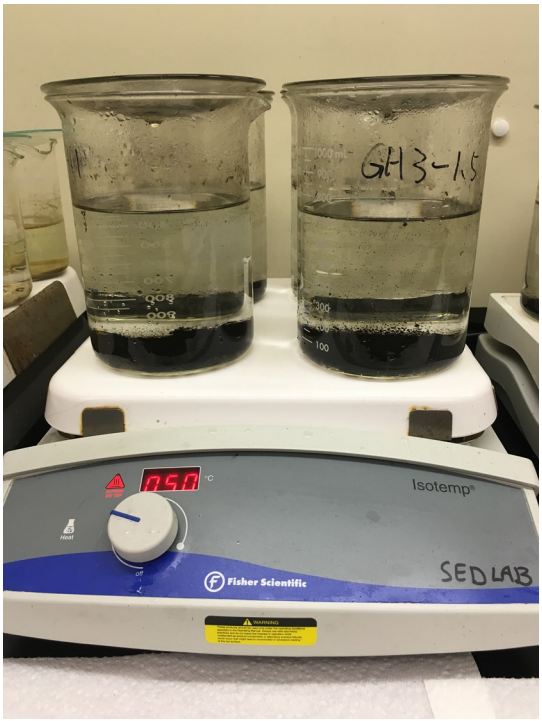



Fig 4. Samples under HCl dissolving process.

# Year at a Glance 2015-2016

## Welcome Back Party

## Holiday Party

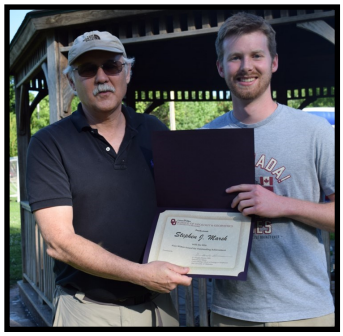
## Annual Softball Game


# Spring Picnic and Awards Ceremony

*Stan Cunningham Award*
Alyssa Wickard and Rae Jacobsen

*Everett DeGolyer Award*
Niles Wethington and Alyse Johansen

*Staff Rock Award*
Bryce Hutchinson and Gabriel Machado



*Alan Witten Award*
Stephen Marsh

*Ben Hare Award*
Curtis Smith

*David Stearns Award*
Tyler Hunt

*Charles Gould Award*
Lauren McGraw

*Outstanding Senior* ~ Lauren McGraw

Amy Bailey and Dr. Lynn Soreghan

# AAPG/SEG Student EXPO

Geology Research
1st Place – Lennon Infante

Geology Research
2nd Place – James Maner

Geology Research
3rd Place – Emilio Torres

Geophysics Research
1st Place – Gabriel Machado

Geophysics Research
2nd Place – Gerhard Heij

# ConocoPhillips Research Symposium

Undergraduate Research
1st Place – Christina Hamilton

Undergraduate Research
2nd Place – Stephen Marsh

Undergraduate Research
3rd Place – Amy Bailey

Masters Research
1st Place – Yifang Cheng

Masters Research
2nd Place – Jake Elder

Masters Research
3rd Place – Jianjun Li

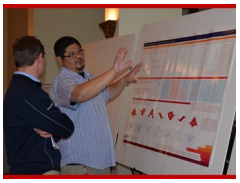
PhD Research
1st Place – Emilio Torres

PhD Research
2nd Place – Gerhard Heij

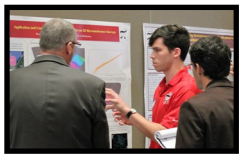
PhD Research
3rd Place – Jefferson Chang

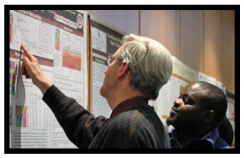
Best Research Group
1st Place – Dr. Reches Group

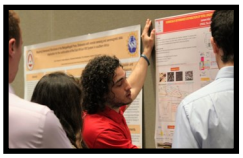
Best Research Group
2nd Place – Dr. Elmore's Group



# GeoTech Fest







# Field Trips

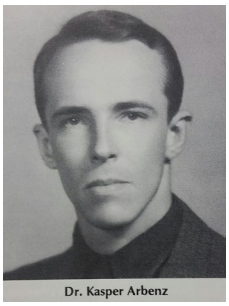

IRIDIUM LAYER


Integrated Reservoir Modeling
& Simulation Field Trip - Fall 2016


Bartell Field Camp


Gjelder hele
Svalbard

# Johann "Kaspar" Arbenz (1918 - 2016): A Tribute


Dr. Kasper Arbenz

J. Kaspar Arbenz, former professor in the School of Geology at OU, life-long friend of the Oklahoma Geological Survey, and "Dean of the Ouachita Mountains," died on June 7, 2016, on Cape Cod, Massachusetts; he was 97 years old. Kaspar was born on August 27, 1918, in Bern, Switzerland to Paul and Martha Arbenz. He served as a 1st Lieutenant in the Swiss army during World War II. Kaspar then graduated from University of Bern, Switzerland, with a PhD in geology in l945. He married Maria 'Mieke' Plas on Dec. 16, 1947, and they moved to the United States in January of 1948 where he accepted a teaching position at OU.

During his tenure here from 1948 to 1955, he taught popular courses in structural geology and sedimentology. He was on 53 thesis and dissertation committees, many focusing on the Arbuckle, Wichita, and Ouachita Mountains and the Ardmore and Arkoma Basins. Kaspar supervised 17 theses, and the subject of several of those – the Ouachita Mountains – became one of his research passions for the rest of his life. He published many papers on the Ouachitas, three of which have become seminal works – two in 1989 by the Geological Society of America in their Decade of North American Geology series, and one in 2008 by the Oklahoma Geological Survey (Circular 112A). Any modern work on the Ouachita Mountains will include references to those three works.


Kaspar Arbenz at the 2004 Ouachita Field Conference.

Kaspar was instrumental in developing the Oklahoma – Arkansas COGEOMAP project in the mid-1980s. In Oklahoma, the project resulted in 22 new 7.5' geologic quadrangle maps of the frontal belt of the Ouachita Mountains. In 2004 he attended an OGS-sponsored workshop that included field trips to Arkansas and Oklahoma to see for himself the results of some of the research he was so instrumental in promoting.

In l955 Kaspar joined Shell Oil Company from which he retired in l983 as an exploration geologist, and continued to work as a consulting geologist for the next twenty years. Shell Oil brought Kaspar and his family to many different states over the years, finally ending up in the Houston office. After retiring from Shell Oil, Kaspar continued to act as a geological consultant, traveling to Turkey, Israel and China at the request of their governments. In his retirement, he was also able to teach short courses in geology for many oil companies and organizations.

After retirement, he returned to the mountains and lived in Boulder for the next 28 years. In 2010, he moved to Cape Cod to be closer to his family.

A true Renaissance man, Kaspar is most remembered for his love of music, the outdoors, and his art. Music was a constant in his life; he played cello from the age of 9 on and continued to play quartets and quintets with friends well into his 90s, both in Boulder and on the Cape. Kaspar became involved with the annual Boulder Bach Festival and wrote their program notes for many years. He brought his love of hiking in the Swiss Alps to Boulder, where he most enjoyed hiking in the Rocky Mountains, especially Rocky Mountain National Park, and continued to hike into his 90's. Kaspar was a prolific painter and his paintings of the Rocky Mountains adorn the walls of his family and friends across the continent and provide a lasting memory.

Kaspar is survived by his son Andrew Arbenz and his wife Alison of New York City; daughter Antonia Kenny and grandson Daniel Kenny of Sandwich, Massachusetts, and daughter Elisabeth Tycom and her husband Jim and sons Nicholas and Colin of Plano, Texas. He was preceded in death by his wife Mieke and grandson Kyle. A celebration of his life will occur in the fall in Boulder when he is returned to the Rocky Mountains.

Kaspar had a wonderful life, full of art, music, geology, friends and family.

Neil H. Suneson*
Oklahoma Geological Survey

*A note of credit and word of sincere thanks goes to Kaspar's two daughters, Elisabeth and Antonia, who wrote much of this tribute to their Dad and that I copied word-for-word.

# *In Memory of Our Friends Who Have Passed*

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