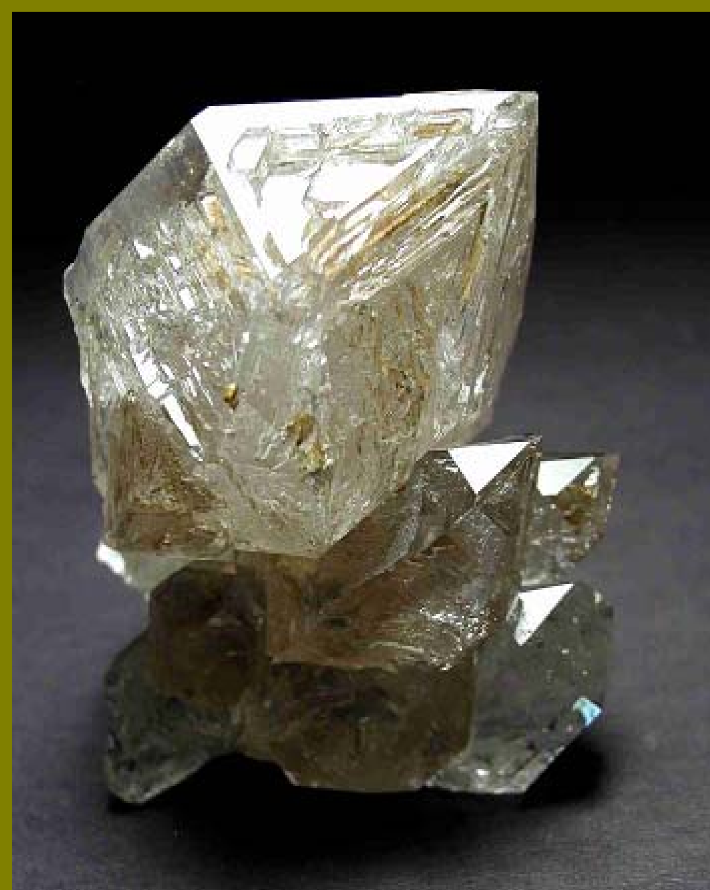
EARTH SCIENTIST

In Print Since 1980

2006 Edition



SCHOOL OF GEOLOGY & GEOPHYSICS

The University of Oklahoma

the University of
OKLAHOMA
School of Geology & Geophysics

SGG Vision Statement

The School of Geology and Geophysics shall be a preeminent center of excellence for study and research in geology and geophysics, with emphasis in applied areas such as energy. Students shall be provided with a high-quality education that stresses the fundamentals of science within a creative, interdisciplinary environment and that prepares them for success in their professional careers by instilling knowledge, skills, confidence, pride, principled leadership, and the ability to contribute to the wise stewardship of the earth and its resources.

What Do You Think .....

During this period of transition, we are seeking your opinion regarding the format and content of future issues of the *Earth Scientist*. What would you like to see more of or less of? Or do you like it the way it is? LET US HEAR FROM YOU! Send your comments to nchapin@ou.edu or mail them to Niki Chapin, School of Geology and Geophysics, 810 Sarkeys Energy Center, 100 East Boyd, Norman, OK 73019.

Editor In Chief
Roger M. Slatt

Editor and Layout Design
Nancy "Niki" Chapin

The Earth Scientist is published annually, reporting on research, activities and programs related to the OU School of Geology and Geophysics. It is prepared and distributed with private funds at no cost to the taxpayers of the State of Oklahoma. Please address all inquiries and changes of address to Niki Chapin, School of Geology and Geophysics, 100 East Boyd Street, 810 Sarkeys Energy Center, Norman, OK 73019-0628.

On the Cover: (top left) Saurophagauax displayed at Sam Noble Museum of Natural History, *photo provided by SNMNH*; (top right) Drillship Saipem 10000, designed and outfitted to explore for hydrocarbon reservoirs down to 30,000 ft. RKB, operating in water depths in excess of 10,000 ft. Its operating areas range from the U.S. Gulf of Mexico to West Africa and West of Shetlands. It was contracted to Vanco Energy Co. (President Gene Van Dyke, OU grad 1950) to drill the first deepwater well offshore Morocco, *photo provided by Staffan Van Dyke, OU grad 2003*; (bottom left) Active mud volcano (shale diaper) in Azerbaijan, *photo provided by Roger Slatt*; (bottom right) Quartz crystal, *photo provided by David London*.

EARTH SCIENTIST 2006

Table of Contents

Questions and Answers About the College of Earth and Energy 1
Director's Corner 3
Dean's Corner 5
AAC Update 6
Development Update 8
In Honor of G. Carl Hale 9
School of Geology and Geophysics Faculty and Staff 11
Faculty Profile, G. Randy Keller 15
FACULTY AND STUDENT ARTICLES 16-70
YEAR-IN-REVIEW 71
- Awards and Recognition 72
- Goodbye Claren 76
- News Release issued by OU Public Affairs 77
  - "Oklahoma Geological Survey Director Named Regents' Professor"
- Oklahoma Trailblazer Award Honoring the Lloyd Noble Family 79
- AAPG Student Chapter ~~Dileep Tiwary, President 81
- The Pick and Hammer Club ~~Ellen Gilliland, President 84
- SEG Student Chapter ~~Satish Sinha, President 86
- AAPG/SEG Spring Break Student Expo ~~Niki Chapin 88
  - Poster Contest Winners:
    - 1st Place Geology ~~John F. Ceron, University of South Carolina 92
    - 2nd Place Geology ~~Nathan Boersma, University of Idaho 93
    - 3rd Place Geology ~~Khurrum Ahmed, University at Buffalo 94
    - 1st Place Geophysics ~~Ashwani Dev, University of Texas at Dallas 95
    - 2nd Place Geophysics ~~Ahmed Alahdal, The University of Oklahoma 96
    - 3rd Place Geophysics ~~Heidy A. Correa Correa, The University of Oklahoma 97
- School of Geology and Geophysics Faculty Chairs and Special Funds 98
- School of Geology and Geophysics Degrees Awarded Fall 2005 and Spring 2006 99
- School of Geology and Geophysics Undergraduate Sponsorships 101
- School of Geology and Geophysics Graduate Sponsorships 102
- 2006 Convocation Pictures 104

ALUMNI CORNER 105
- Alumnus Profile, Jon R. Withrow 106
- Alumnus Profile, James A. Gibbs 108
- AAC Member Updates 110
- AAC Mineral Auction 112
- "A Century of Living, Giving – Mildred Frizzell" ~~article by Ann DeFrange, Staff Writer, *The Oklahoman* 114
- Alumni Births 117
- Alumni Deaths 118
- Alumni Nostalgia 119

Questions & Answers

About the new

University of Oklahoma College of Earth and Energy

The University of Oklahoma is re-shaping energy education and research by creating a new college that brings together closely related energy studies programs and facilities.

The College of Earth and Energy, which officially began Jan. 1, 2006, is composed of:

- The Mewbourne School of Petroleum and Geological Engineering
- School of Geology and Geophysics
- Sarkeys Energy Center institutes
- The Oklahoma Geological Survey

Why make the change?

After many months of study by an advisory group of industry and OU representatives, OU President David Boren approved this progressive change to better address the needs of educating students for the future and conducting research that will benefit the energy industry and the U.S. The new college will:

1. encourage more interdisciplinary research and study, provide better coordination across disciplines in the broader energy industries, and allow a more focused energy education program.
2. provide closer ties between the academic and research units and better coordinate research that will produce new technology.
3. establish interdisciplinary relationships that will carry over into the profession.

What is happening to the College of Engineering and the College of Geosciences?

As of Jan. 1, 2006, the Mewbourne School of Petroleum and Geological Engineering moved from the College of Engineering to the College of Earth and Energy. Otherwise, the College of Engineering remains unchanged. The College of Geosciences no longer exists. The School of Geology and Geophysics, the Oklahoma Geological Survey, and Sarkeys Energy Center are part of the new College of Earth and Energy. The School of Meteorology and the Department of Geography have formed the new College of Atmospheric and Geographic Sciences.

Who is serving in the leadership of the College of Earth and Energy and its units?

Larry R. Grillot was appointed in March 2006 as the new dean of the College, as well as the Lester A. Day Family Chair and Director of the Sarkeys Energy Center. Grillot brings 30 years of experience in the exploration and production division of Phillips Petroleum. Trained as a geophysicist, he has held posts supervising Phillips operations in the U.S., Asia, Africa, Europe, and Australia. He holds a bachelor's in physics from Mississippi State University and a master's and a Ph.D. in geological sciences from Brown University. Among Dean Grillot's first initiatives will be fine-tuning a research vision for the new college, examining the academic programs, and mapping a strategic plan.

Other leaders for the new college are:

- **John Ritz,** who will move from Director of Development for the College of Geosciences to the same position in the College of Earth and Energy.
- **Douglas Elmore**, Interim Associate Provost and Robert and Doris Klabzuba Professor of Geology, who is serving as Interim Director of the School of Geology and Geophysics; former G&G Director Roger Slatt returns to a full-time professorship in the school.
- **Dean Oliver**, who continues as Director of the Mewbourne School of Petroleum and Geological Engineering.
- **Charles Mankin**, who continues as Director of the Oklahoma Geological Survey and steps down as Interim Director of Sarkeys Energy Center.

How are students being helped with the change?

To smooth the transition for students, Linda Goeringer has been hired as academic counselor for the College of Earth and Energy. Goeringer's experience includes 12 years as an academic counselor at OU. She has worked closely with the College of Engineering and the former College of Geosciences to facilitate the changes for the students.

When will the College of Earth and Energy have its first graduates?

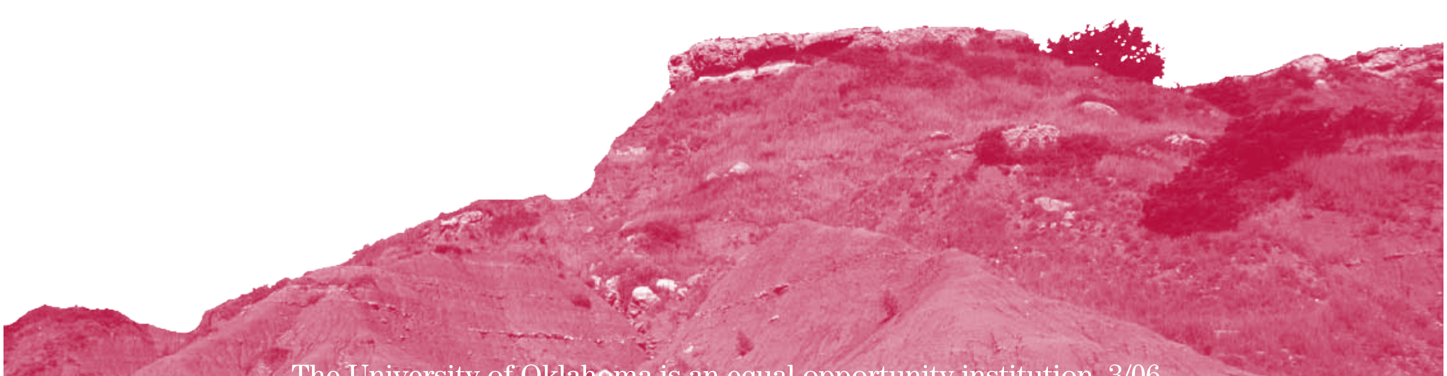
Earth and Energy will have its first graduates in May 2006.

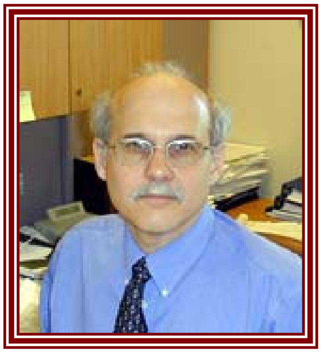
What does the change mean in terms of facilities?

The opening of the National Weather Center will allow some current tenants of Sarkeys Energy Center to move to the new facility in late spring. The space in Sarkeys will then be re-organized and remodeled. The College of Earth and Energy, as well as the Sarkeys Energy Center administration, will have offices on Floors 14 and 15. Floors 2, 3 and 10 will have College of Earth and Energy computer support, conference rooms, classrooms and offices. The Mewbourne School of Petroleum and Geological Engineering will move to Floors 11-13. The School of Geology and Geophysics will remain on Floors 7-9. Groundbreaking will occur this year for two College of Engineering facilities, Devon Energy Hall and the ExxonMobil Lawrence G. Rawl Engineering Practice Facility. These buildings will have interdisciplinary use, including by students from the College of Earth and Energy.

What does the change mean for alumni?

The University of Oklahoma is dedicated to excellence, and that is the type of service that will be provided to alumni during this transition. Beginning Jan. 1, 2006, alumni with degrees in petroleum and geological engineering, geology, and geophysics will be considered as alumni of the College of Earth and Energy. However, the university's academic records will continue to reflect both the graduate's original degree and college of origin.





DIRECTOR'S CORNER

DIRECTOR'S CORNER

R. Douglas Elmore, Interim Director
School of Geology & Geophysics

The 2005-2006 academic year was a time of dramatic change in the School of Geology and Geophysics. The School became part of the new College of Earth and Energy, which was chartered on January 1, 2006. In addition to the School, the College includes the Mewbourne School of Petroleum and Geological Engineering, Sarkeys Energy Center, and the Oklahoma Geological Survey. The first dean, Dr. Larry Grillot, took up his position on April 1, 2006. The plan is to make the College a center of excellence for study and research with an emphasis on energy education.

Notable events in the last year include:

- Roger Slatt stepped down as Director in December of 2005 to pursue research and teaching opportunities. He was appointed Director of the Institute for Reservoir Characterization in the Energy Center, and he will also be half time in the School. He still supervises graduate students and teaches courses in the petroleum area. At the AAPG Annual Convention in the spring, he received the Grover E. Murray Memorial Distinguished Educator Award.

- We filled the McCollough Chair in Geophysics with Dr. Randy Keller. Randy's area of expertise is in geophysics, lithospheric structure, and tectonics. He will help us to build up the Geophysics program which is particularly important since now we offer a Ph.D. degree in geophysics. Randy will bring several large grants to OU as well as five Ph.D. geophysics students. Randy also received the same Distinguished Educator Award at the AAPG meeting as Roger Slatt.

- We also received approval to begin a search for an exploration geophysicist to fill the Schultz Chair, a crucial position in our geophysics program.

- Tom Dewers resigned in December 2005, and we have received permission to start searching in Fall 2006 for his replacement in low-temperature geochemistry.

- Dr. Ze'ev Reches, Dr. Mike Soreghan, and Dr. Younane Abousleiman also joined the regular faculty this year.

- During the 2005-2006 academic year, our student numbers remained about the same as the previous year, with approximately 75 undergraduate students and 70 graduate students. Because of the breadth of our degree programs we continue to attract a diverse student body **(Figure 1)**.

- Last fall, we had 25 petroleum companies interview on campus, and based on the companies we already have scheduled, we expect another high number this fall. Our students are in high demand, with many getting multiple internship and full-time offers.

- The AAPG/SEG Spring Break Student Expo went very well, with 29 company sponsors and more than 140 students attending.

- We had a very good year at the AAPG meeting. In addition to the awards given to Roger and Randy, Dr. Lynn Soreghan received the James Lee Wilson Award from SEPM.

- Dr. Charles Mankin was also awarded an OU Regents' Professorship in the spring.

- David London received the Oklahoma Student Association Outstanding Faculty Award in the former College of Geosciences. He also received the Rocky Mountain Federation of Mineral Societies Honorary Award for 2006.

- In another major change, we joined Oklahoma State University and ran a joint field camp this summer at the old camp outside of Canon City, Colorado. Budget constraints and the projected sale of the Abbey precipitated the need for this experiment.

- We have received some generous support from our alumni as well as from companies. **New scholarships include the Harry C. Lee Memorial Scholarship Fund, the James A. Gibbs Geoscience Endowment Fund in honor of Roger Slatt, the Jon R. Withrow Graduate Fellowship, the Chris Cheatwood Scholarship, the Glenn W. Okerson Endowed Scholarship Fund, the G. Carl Hale Endowed Scholarship, and the Everette Lee DeGolyer Endowed Scholarship. Based on a generous donation by Gary Stewart (M.S., 1982), we are also in the process of setting up a graduate scholarship to honor Robert "Bob" K. Goldhammer (M. S., 1982).**

- We will be upgrading the isotope laboratory this year with a new mass spectrometer funded by the National Science Foundation. Mike Engel is busy trying to make up his mind about which of two machines to purchase. We only hope he will take less time to make a decision than he takes to purchase a new car.

Funding will be a serious consideration in the next year. Continuing to support our graduate students is an absolute must for the health of the School and crucial if we are to maintain and build on our strengths.

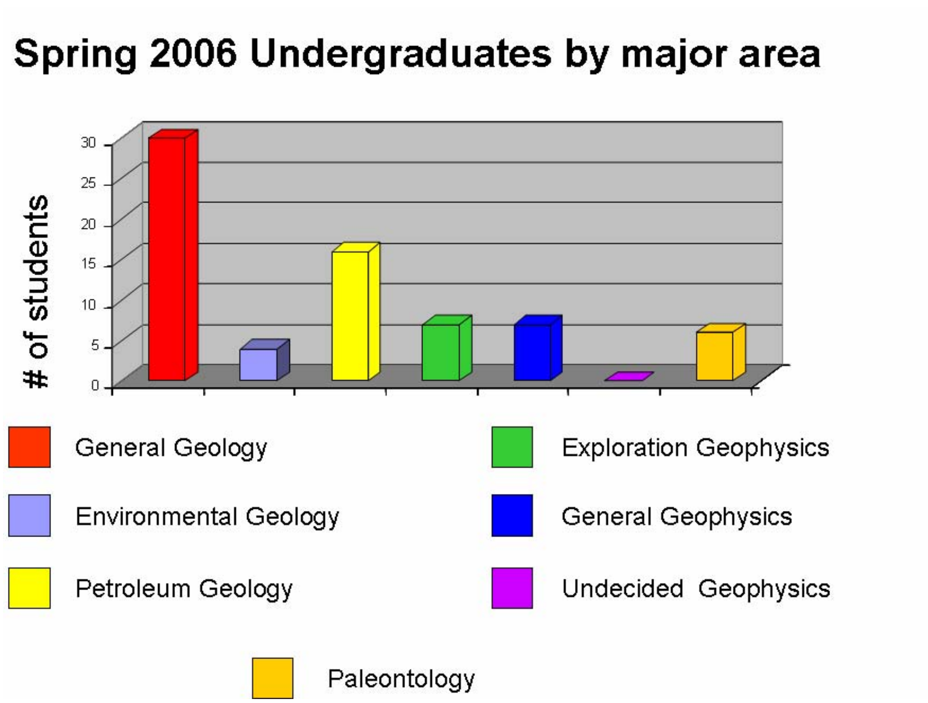


Figure 1

Larry R. Grillot, Dean
College of Earth and Energy

DEAN'S CORNER

The University of Oklahoma
COLLEGE OF EARTH AND ENERGY

To Alumni and Friends of the School of Geology and Geophysics:

As I make my first contribution to "The Dean's Corner", I would like to take this opportunity to introduce myself. First, I am very pleased to be part of The University of Oklahoma and am looking forward to continuing to meet and know the students, faculty, staff, alumni and supporters of SGG.

By way of background, I am a native of Mississippi and hold a B.S. degree in Physics from Mississippi State University. I attended graduate school at Brown University and have a Ph.D. in Geological Sciences from Brown. My wife, Judy, and I have two daughters, both of whom graduated from Baylor, and four grandchildren.

After completing my graduate studies, I started work for Phillips Petroleum Company in Bartlesville, Oklahoma and spent my entire 30-year career in the oil and gas industry with Phillips. During my career, I held a variety of technical and managerial positions, including President & Region Manager, Phillips Petroleum Canada (a subsidiary of Phillips Petroleum), International Exploration Manager, and Manager, Technology & Services (R&D). I enjoyed my career in the oil and gas business and am now looking forward to working in a university environment. OU has a strong history and heritage in the areas of Geology and Geophysics, Petroleum & Geological Engineering, and the work of the Oklahoma Geological Survey. As indicated above, I look forward to working with the students, faculty, staff, alumni and supporters to build on that history and move the University forward in the areas of earth and energy.

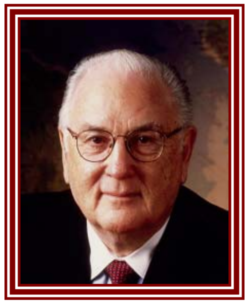
The College of Earth and Energy combines the School of Geology and Geophysics, the Mewbourne School of Petroleum and Geological Engineering, the Oklahoma Geological Survey, and Sarkeys Energy Center. The college was formed as a response to new challenges in energy and Earth sciences that require a coordinated, multi-disciplinary approach involving academic programs, research centers and institutes, and policy and service-related organizations.

I am currently working with faculty and staff to ensure that proper administrative procedures are in place for the new college as well as to develop a strategic framework that will help us realize the potential of the College of Earth and Energy. We also will be working with the College of Atmospheric and Geographic Sciences as the School of Meteorology moves from Sarkeys Energy Center to the National Weather Center. I look forward to working with all the constituents of the School of Geology and Geophysics and the College of Earth and Energy to make this a successful transition.

Finally, I want to extend my thanks to John Snow, dean of the College of Atmospheric and Geographic Sciences. He has provided strong leadership for the former College of Geosciences and has been very helpful to me during these first months in my new position. I look forward to working with Dean Snow and the many alumni and friends of the School of Geology and Geophysics to continue to build on the history and heritage of the School's teaching, research and service at the University of Oklahoma.

Larry R. Grillot
Dean, College of Earth and Energy

Emmitt Lockard
Vice President 2006-07



Gene Van Dyke
President 2005-06

AAC UPDATE

AAC UPDATE

November 3, 2005, AAC Meeting Report: Dr. Roger Slatt gave a report of the State of the School to the Executive Council. The status of the formation of the College of Earth and Energy and the future of the Alumni Advisory Council were also discussed.

In the full council meeting on November 4, 2005, Dr. Slatt presented his report on the State of the School to the Council which included an update on the status of the formation of the College of Earth and Energy, the Geophysics Ph.D. program, possibility of a budget shortfall, faculty vacancies and a Gas Shale Research Proposal submitted to industry. Linda Goeringer, the newly hired academic counselor in the College of Earth and Energy was introduced to the Council. Dr. Slatt also announced the retirement of the school's librarian, Claren Kidd. Claren was nominated and approved for membership in the AAC upon her retirement.

Kelvin Cates, AAC 2005-2006 Vice President, led a discussion of topics related to the new college that included the future of the AAC and the relationship of the Oklahoma Geological Survey and the new college.

Jennifer Eoff, a PhD student in Geology, presented a slide show of the field trip to the southern coast of New Orleans and Louisiana and, afterwards, requested funding toward a return trip in the aftermath of Katrina. Thanks to the generous donations of the following people, that trip will be possible in the fall: **James Gibbs, Chris Cheatwood, Jon Withrow, Orville Berg, and Harold Hanke.**

David Campbell and Chuck Noll shared their knowledge and experience sponsoring a successful Spring Break Exposition for students, companies and universities.

Nominations were announced and approved for the following 2006 – 2007 officers:
President – Kelvin Cates
Vice President – Emmitt Lockard
Secretary – Joe Dischinger
Director – John Dewey and Tom Rowland

Our AAC meeting on April 28, 2006, was our first formal meeting in the College of Earth and Energy. During the Executive Committee Meeting, we had an overview of the State of the School by Interim Director, Doug Elmore, and we were introduced to Dr. Larry Grillot, the new dean of the College of Earth and Energy.

Dr. Grillot talked about his previous industry experience, his vision for the new college and the need for the support of the AAC.

During the full council meeting Dr. Elmore presented the State of the School report to the Council. The highlights from his presentation were as follows:

- An increase in the stipend for graduate students.
- Five Ph. D. graduate students in geophysics will enroll at OU to continue their studies with our new geophysics professor, Dr. Randy Keller.
- Six new scholarships have been created.
- The OU & OSU field camps will be combined and held at Cañon City this year to reduce costs.
- The possibility of a budget deficit from $203K - $373K.

Dr. Grillot spoke to the AAC about his vision for the College of Earth and Energy, which included his integrated model for geology, geophysics and petroleum engineering, providing students with the skills to solve problems inside and outside the petroleum industry and building upon the history of OU. There will be four institutes within the College:

1) Institute of Reservoir Characterization
2) Institute of Energy, Economics and Policy
3) Institute for the Americas
4) Institute for Energy and the Environment

Dr. Roger Slatt will be the head of the Institute for Reservoir Characterization.

The Pick and Hammer Club conducted a silent mineral auction during lunch, which generated $3,975 to benefit their organization.

Joe Dischinger announced that a revised edition of the AAC Constitution and Bylaws will be sent to members in June for review and comment. A motion was made and approved to allow the dean of the College of Earth and Energy to pick a member of the Board of Visitors.

Dr. Doug Elmore presented a Centennial Commemorative Monument to outgoing AAC Chair, Gene Van Dyke to thank him for his leadership service to the Council for 2005 – 2006.

As you can see, we had an eventful year filled with substantial challenges and exciting changes!

~~ Emmitt Lockard and Gene Van Dyke

Dr. Elmore presenting the Centennial Commemorative Monument to Gene Van Dyke at the April 28, 2006, AAC Spring Meeting and Mineral Auction.

DEVELOPMENT UPDATE

The University of Oklahoma
COLLEGE OF EARTH AND ENERGY

John W. Ritz, College of Earth & Energy
Assistant Dean for External Relations

On January 1, 2006, President David L. Boren announced the beginning of the College of Earth and Energy, which combines the School of Geology and Geophysics, the Mewbourne School of Petroleum and Geological Engineering, the Sarkeys Energy Center Institutes and the Oklahoma Geological Survey. This new entity unites the scientific qualities of the fundamentals of geology and geophysics with the discipline of petroleum engineering to create a better prepared graduate for the petroleum industry and a well prepared fundamental geoscientist. We will use the attributes of the Sarkeys Energy Center to help the schools integrate their students into interdisciplinary research and curricula. The Oklahoma Geological Survey allows our students to provide public service to the Oklahoma community with outreach opportunities and many public seminars.

We are also delighted to announce our new dean for the College of Earth and Energy, Dr. Larry R. Grillot, former Phillips Petroleum research executive, who brings 30 years of fundamental research and executive administration to the University of Oklahoma.

Twenty-seven years ago the President's Associates laid the foundation for OU's overall private-giving program, which today, under the leadership of President Boren, yields more than $85 million a year for the University of Oklahoma. As has been the case since the program began in 1980, Associates funding is channeled directly into the academic enterprise – creating new opportunities, adding vitality to existing programs, and addressing academic needs as they arise.

The School of Geology and Geophysics continues to recruit the top undergraduate and graduate students, but we also continue to need additional scholarship and fellowship opportunities from our alumni and industry friends to compete with our peer institutions. Our number one development goal is to provide financial support for our students. We encourage each of our alumni to join us on campus and see what a wonderful facility, faculty and student population the University of Oklahoma possesses.

We would especially like to thank Lew and Myra Ward, G. Carl Hale, Gene Van Dyke, Chris Cheatwood, ConocoPhillips, James A. Gibbs, Amerada Hess Corporation, Mrs. Jeanette A. Reynolds, Jon Withrow, Shell Oil Company, Fusion Petroleum Technologies, Inc., BP Corporation North America, Inc., TotalFinaElf E&P USA, Inc., Devon Energy Corporation, Berry Petroleum Corporation, Dorothy L. Henderson, and the Oklahoma Energy Resources Board for their special contributions in 2006.

We would also like to thank our many sponsors of our 2006 Spring Expo: AAPG, Amerada Hess Corporation, Baker Atlas, Chesapeake Energy, Chevron, Chuck Noll, ConocoPhillips, Crawley Petroleum, David Campbell, DeGolyer & MacNaughton, Devon Energy, Dominion E&P, H.W. "Dub" Peace, ExxonMobil, geoPlus, Jon Withrow, Kerr-McGee, MAP Exploration, Marathon Oil, Mewbourne Oil Company, MicroSeismic, Inc., Mineral Management Service, OGS/PTTC, Pason Systems USA, Petroleum Mud Logging, Schlumberger, SEG, Shell Oil, and TOTAL E&P USA, Inc.

Another thank you is due to our many corporate recruiters who came to campus during the past school year to interview and recruit our students for internships and permanent positions: Amerada Hess, BP, Burlington Resources, Chaparral Energy, Chesapeake Energy, Chevron, ConocoPhillips, Devon Energy, Dominion E&P, Encana, EOG Resources, ExxonMobil, Fronterra Geosciences, Hunt Petroleum, Marathon Oil, Mewbourne Oil Company, Newfield, Nexen, Noble Energy, Oxy Petroleum, Pioneer Natural Resources, Schlumberger, Shell Oil Company, Unit Petroleum and Vintage Petroleum.

The Class of 1956 and 1957 will hold their class reunions on Homecoming weekend, Friday, October 20, 2006. We encourage each of these graduates to join us for a special celebratory weekend.

Additional information concerning annual giving, the President's Associate Program, endowed gifts and planned gifts is available by contacting: **John W. Ritz, Assistant Dean for External Relations, (405) 325-3821, or jwritz@ou.edu.**

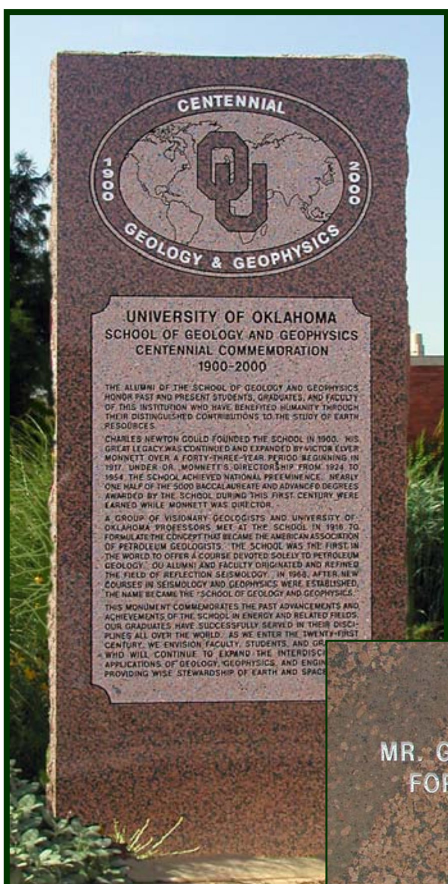
In Honor of G. Carl Hale

The School of Geology and Geophysics and the SGG Alumni Advisory Council would like to dedicate this edition of *Earth Scientist* to the memory of our good friend and colleague, G. Carl Hale.

George Carl Hale

George Carl, born April 12, 1922, in Okmulgee, Oklahoma, and deceased June 21, 2006, in Tulsa. Carl attended The University of Oklahoma, achieving degrees in Petroleum and Geological Engineering. While in the Navy during WWII, he commanded an LCI ship. He spent his career working in the oil and gas business in Kansas, Oklahoma, and Texas. He was past chairman of OIPA and OERB Boards and served on the OU Alumni Advisory Board for the Schools of Geology & Geophysics and Petroleum Engineering. He is survived by his daughter, Claudia Landrum and her husband, Tony of Collinsville, Oklahoma. Also surviving are two grandchildren, Carla and Thom Landrum of Collinsville, Oklahoma; two brothers, James Hale and wife, Barbara of Plainview, Texas, and Adrian Hale and wife, Carole of Tulsa, Oklahoma; and numerous nieces and nephews. Carl was preceded in death by his wife, Ikey, a sister, Marian, his mother and father, Alice and Adrian Hale.

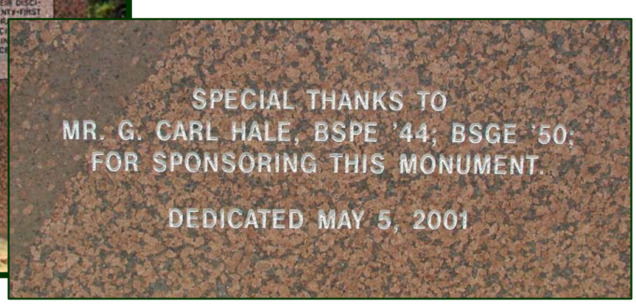
Published in The Oklahoman on 6/23/2006.



G. Carl Hale has left a lifetime legacy to the University of Oklahoma. He has provided two endowed undergraduate scholarships, with the first endowed scholarship to the College of Earth and Energy, School of Geology and Geophysics and his initial gift to the Mewbourne School of Petroleum and Geological Engineering. Mr. Hale also was an original founder of the Sarkeys Energy Center and contributed to the University of Oklahoma Associates, The Pride of Oklahoma, LKOT activities, athletics, memorial funds, alumni events, fraternity support, and many other numerous funding opportunities.

But, G. Carl will not be missed for his monetary support to the University of Oklahoma; G. Carl will be missed as a creative engineer and geologist, for his friendship, his leadership, and his quiet humanitarian support to the state of Oklahoma energy community.

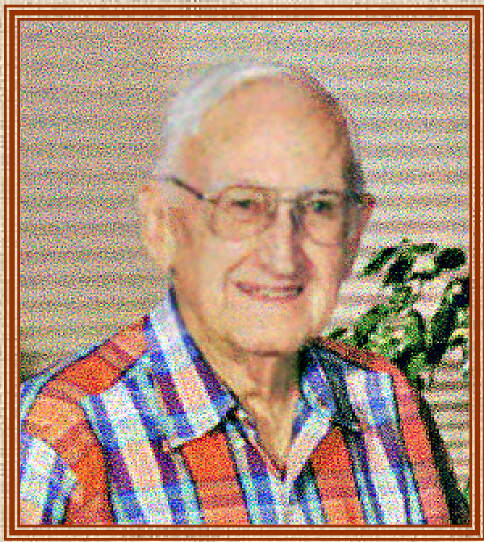
~~ John W. Ritz
College of Earth and Energy
The University of Oklahoma



Inscription on back of monument

IN REMEMBRANCE

Reprinted from the 2004 Earth Scientist



G. Carl Hale Elected to Life Membership in the Alumni Advisory Council

By David Campbell

During the recent 2004 spring meeting of the Alumni Advisory Council (AAC), G.Carl Hale was unanimously elected to life membership in the council. Carl is an enthusiastic longtime member of the AAC, who has received numerous awards and honors in the fields of Geology and Engineering. As if to place an exclamation on Carl's many contributions throughout his illustrious career, Carl has also been recognized as only the second life member chosen by the prominent industry group, the Oklahoma Independent Petroleum Association (OIPA).

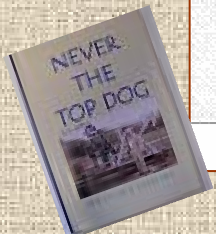
Carl holds a B.S. in Petroleum Engineering, received at the University of Oklahoma in 1944. After his distinguished Navy service, he again enrolled at OU to earn a B.S. in Geological Engineering . . . and the rest is history.

To all who know him, Carl has a "can do" personality. His unwavering and total commitment to his chosen fields is legendary.

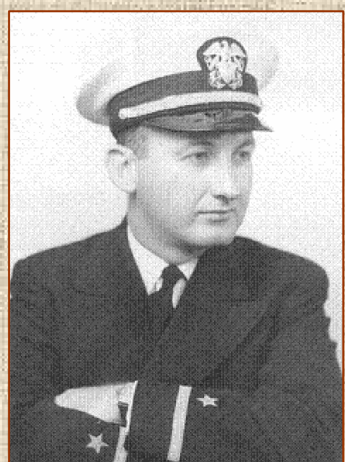
Carl — we, the members of the Alumni Advisory Council and fellow OU alumni, are most fortunate to have had your generous support and incisive input throughout the years. We salute you for a job exceedingly well done!

(Carl's myriad accomplishments have also been reported by Bob Cowdery in the spring 2002 *Earth Scientist* and by Deborah Bradley in the Mewbourne School of Petroleum and Geological Engineering's Fall 2003 issue of *Discovery.*)

Carl let us swipe these three photographs from his autobiography, "Never the Top Dog: the Life of G. Carl Hale" (Independent Digital Printing Company, 2002)



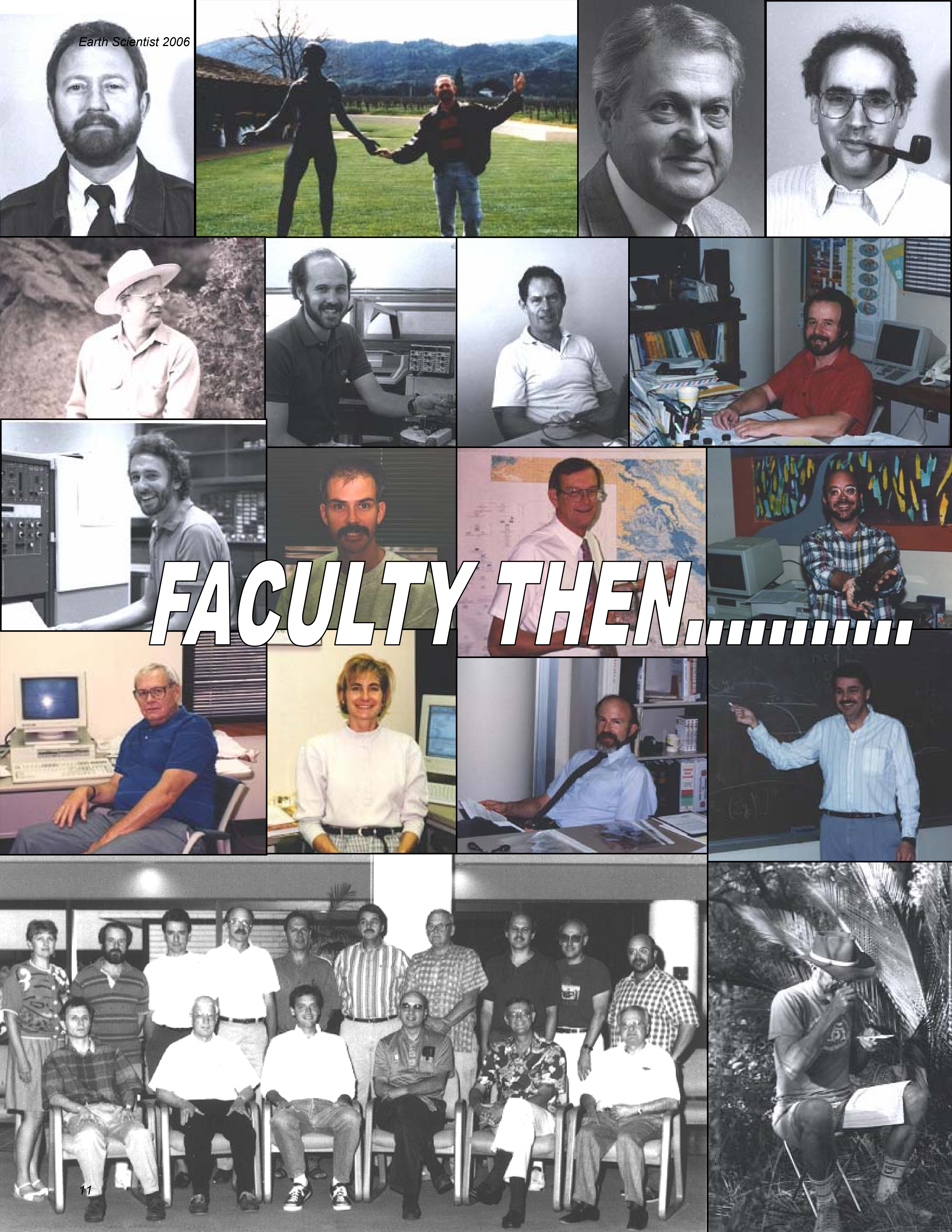
G. Carl, age 18



G. Carl Hale, 1944

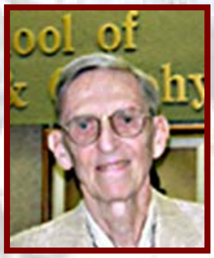
G. Carl & Ikey, 1974

FACULTY THEN...........



AND NOW........ School of GEOLOGY and GEOPHYSICS FACULTY / STAFF

R. Douglas Elmore
Interim Director, SGG
Associate Provost
Robert & Doris Klabzuba Professor
Research interests are focused on sedimentology and testing/developing a paleomagnetic/geochemical approach for dating diagenetic events.



Robert DuBois
Professor Emeritus
Research interests are in paleomagnetism and archeomagnetism.

Younane Abousleiman
Director, Rock/Poromechanics Consortium
Larry Brummet/ONEOK Chair Professor
Consortium focuses on research areas such as reservoir compaction & subsidence, inclined boreholes, simulation of naturally fractured reservoirs, acoustic emission in rocks, poroelastic media, and sanding.

Michael H. Engel
Willard L. Miller Professor
Research interests include the application of stable isotopes to assess the diagenetic history of organic matter in fossils and sediments and to determine the origins of organic compounds in carbonaceous meteorites.

Judson L. Ahern
Professor Emeritus
Retired June 1, 2005. Research interests are in Geomechanics, Gravity and Magnetics, and Environmental Geophysics.

Jody Foote
Acting Geology Librarian
Interests include library instruction, reference, collection development, online searching, and international libraries.

Evgeni Chesnokov
Clyde Becker Sr. Chair Professor
Director, Institute for Theoretical Geophysics
Main areas of emphasis are petrophysics, computation sciences, pure & applied geophysics, and pure & applied seismology.

James M. Forgotson, Jr.
Kerr-McGee Centennial Professor
Research interests are in subsurface stratigraphy, basin analysis, petroleum geology, petroleum reservoir characterization, quantitative geological mapping and statistical analysis of geologic data.

Richard Cifelli
Adjunct Professor, Zoology Professor
Curator, Vertebrate Paleontology, Sam Noble Museum of Natural History
Research interests are in the paleontology, systematics, and evolution of mammals.

M. Charles Gilbert
Professor
Research interests include: Stability relations of the rock-forming ferromagnesian minerals, especially amphiboles, pyroxenes, and micas; processes active in the evolution of igneous and metamorphic rock systems; and petrology and tectonic development of rifts, particularly as exemplified by the southern Oklahoma Aulacogen.

Charles Harper
Professor Emeritus
Research interests include paleontologic principles and methods, quantitative methods in paleontology and paleoecology, and the taxonomy of Paleozoic brachiopods.

G. Randy Keller
McCollough Chair Professor
Research and teaching interests stress geophysical applications that span a variety of techniques and scales.

David London
Professor
Research focuses on the origin and chemical evolution of felsic magmas that solidify as granites, pegmatites, and rhyolites and on the properties of crystalline and melt phases that regulate the transfer of volatile and lithophile trace elements from deep to shallow crustal reservoirs.

Richard Lupia
Assistant Professor
Assist. Curator of Micropaleontology and Paleobotony, Sam Noble Okla Museum of Natural History
Research integrates field collecting, lab research including light and scanning electron microscopy and literature surveys to examine and test paleoecology.

Charles Mankin
Director, Oklahoma Geological Survey
Professor
Interests focus on geoscience & public policy and Oklahoma/U.S. natural resources.

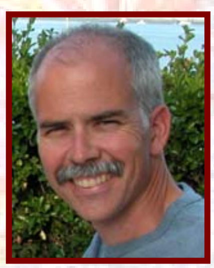
Shankar Mitra
Monnett Chair in Earth Resources
Monnett Professor of Energy Resources
Research interests: two main hydrocarbon exploration and production themes: 3D analysis and modeling of structures in sedimentary basins, and analysis of minor and microscopic-scale mechanisms of deformation including faulting, fracturing, cataclasis, and pressure solution.

R. Paul Philp
Joe and Robert Klabzuba Professor
George Lynn Cross Research Professor
Research interests are centered on the study of organic material as it is deposited in the sedimentary environment and undergoes a number of changes resulting from diagenesis, microbial degradation, and thermal maturation at higher temperatures in older sediments.

John Pigott
Associate Professor
Research interests focus on basin analysis and seismic stratigraphy to evaluate the tectonic evolution and hydrocarbon potential of sedimentary basins worldwide.

Ze'ev Reches
Professor
Research and teaching interests focus on Structural Geology, Earthquakes, and Rock Mechanics.

Roger M. Slatt
Carl E. Gungoll Chair Professor
Director, Institute of Reservoir Characterization
Research interests are in the petroleum geology of deepwater (turbidite) depositional systems and on applied reservoir characterization.



Michael Soreghan
Associate Professor
Research interests are in paleolimnology with a focus on lakes of East Africa & paleoclimatology with a focus on terrestrial deposits of the Quaternary and the late Paleozoic.

G.S. "Lynn" Soreghan
Associate Professor
Research interests focus on using sedimentary records to improve improve our understanding of climatic trends & transitions, tectonic behavior, & distributions of source, reservoir, and seal facies, with a focus on the late Paleozoic Earth System.

David Stearns
Professor Emeritus

Research interests focus on the application of rock mechanics principles (experimental and theoretical) to field problems in the structural geology of layered crustal rocks including the classical mechanisms of faulting & folding, macroscopic flow laws, structural alteration of fluid in reservoirs, experimental modeling of natural structures and stress and/or strain analysis of natural deformation features.

Steve Westrop
Professor, Curator of Invertebrate Paleontology, Sam Noble Oklahoma Museum of Natural History

Research interests lie at the intersection of paleontology, ecology and evolutionary biology, specifically patterns & processes of mass extinction, with special reference to Lower Paleozoic trilobite faunas of North America, and evolutionary radiations following mass extinctions in Paleozoic marine communities.

Neil H. Suneson
Adjunct Professor, Assistant Director of Geological Programs in OGS

Research interests include all aspects of Oklahoma geology, with an emphasis on the stratigraphy, structural geology, and resource evaluation of the Arkoma Basis and Ouachita fold-and-thrust belt. Teaching interests focus on geologic mapping and field techniques.

Roger Young
Associate Professor

Research interests focus on applying reflection seismology and ground-penetrating radar techniques to determine sedimentary structures and lithology at the outcrop scale and on the imaging of complex structures at the petroleum reservoir scale.

Barry Weaver
Associate Professor

Research interests include the application of X-ray fluorescence and instrument neutron activation techniques to the analysis of geological materials, and the interpretation of these data in terms of the origin & evolution of igneous and metamorphic rock suites.

SGG STAFF

Jon Allen
Lab Equipment Technician

Taylor Brown
IT Specialist

Niki Chapin
Recruiting and Public Relations

Jan Dodson
Manager of Geophysical Computing Labs

Nancy Leonard
Financial Administrator & Office Manager

Rick Maynard
Equipment Operations Maintenance

G.B. Morgan, VI
Electron Microprobe Operator

Donna Mullins
Coordinator, Admin. Student Services & Corporate Recruiting

Therese Stone
Accounts Specialist

Robert Turner
Lab Supervisor and Maintenance

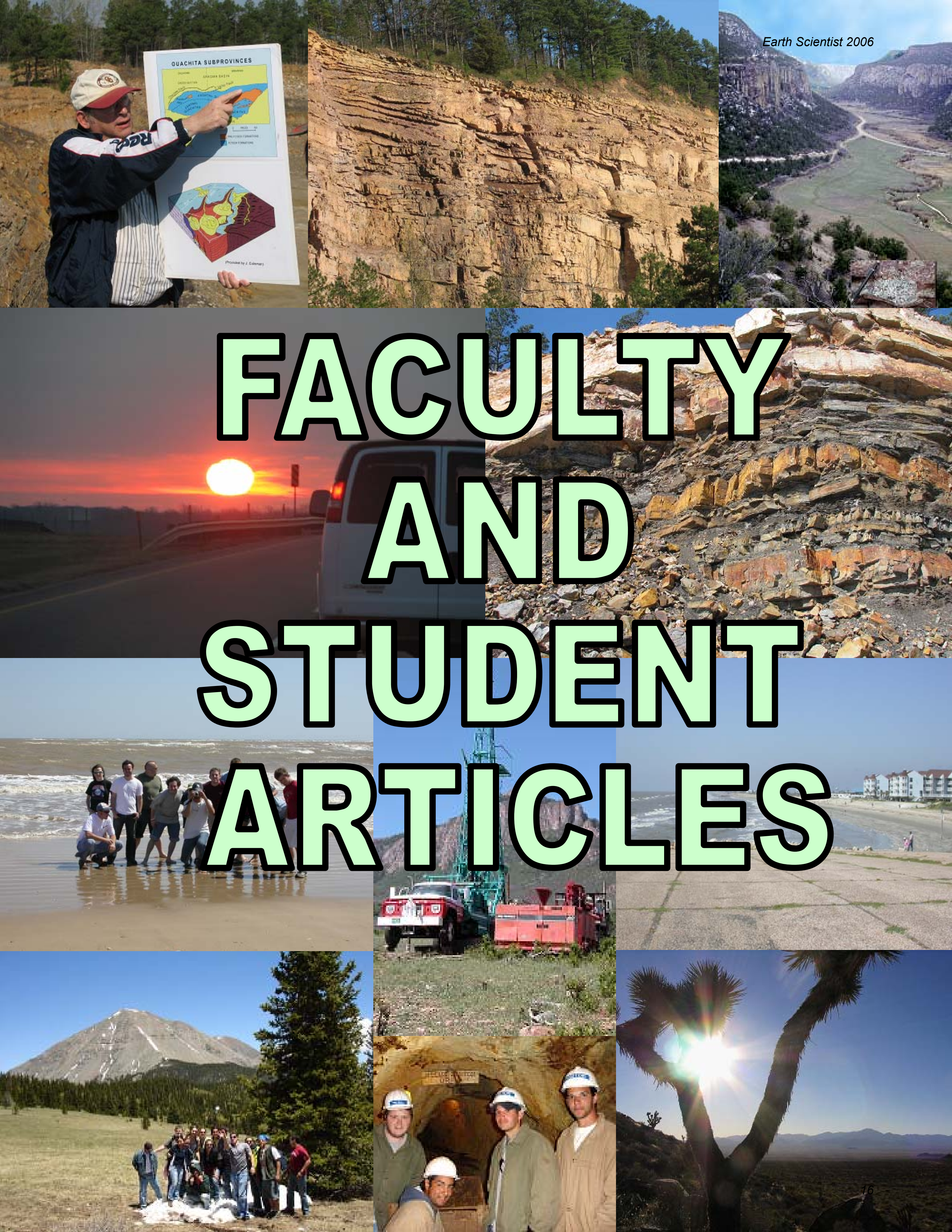
FACULTY PROFILE

G. RANDY KELLER NAMED AS NEW McCOLLOUGH CHAIR
School of Geology and Geophysics
The University of Oklahoma

G. Randy Keller has recently been appointed as the new holder of the **McCollough Chair**. His research and teaching interests stress geophysical applications that span a variety of techniques and a variety of scales. He and his students have conducted many studies of the structure and evolution of basins and deeper features in the lithosphere around the world using seismic, gravity, and magnetic measurements integrated with geological data. He has also regularly used geophysical methods to study issues such as ground water resources, earthquake hazards, and characterization of sites for sensitive facilities. He has been very involved in the Geoinformatics initiative and is interested in the development of geophysical databases, techniques that foster data integration, software tools, and web services. In addition, he has helped organize numerous large international cooperative research efforts and has regularly received funding from sources that include the National Science Foundation, NASA, U.S. Department of Energy, U. S. Geological Survey, U.S. Department of Defense, and industry. Dr. Keller has published almost 250 scientific papers and book chapters as well as many maps and reports. He also has directed 22 doctoral dissertations and 63 master's theses and has mentored and advised many undergraduate students. He has served numerous governmental agencies, professional societies and scientific bodies as an officer and committee member. He has received several awards including the George P. Woollard Award of the Geological Society of America and the Grover E. Murray Distinguished Educator Award of the AAPG. Randy is bringing several students and research projects with him to OU and is looking forward to working on new projects with OU colleagues and students.

Dr. Keller in Ethiopia…………."Beam me up, Scotty!"

Prior to joining the faculty at The University of Oklahoma, Dr. Keller was the L.A. Nelson Professor at the University of Texas at El Paso.



FACULTY AND STUDENT ARTICLES

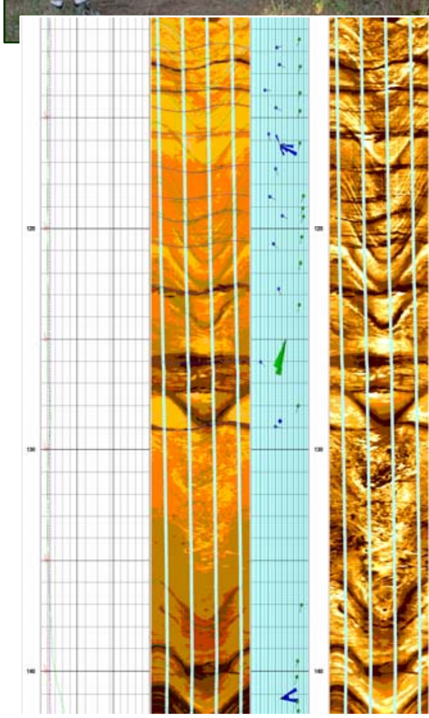
Roger M. Slatt, Gungoll Chair of Petroleum Geology and Geophysics
School of Geology and Geophysics, The University of Oklahoma

"Reservoir Characterization in the School of Geology and Geophysics"

Characterization of oil and gas reservoirs, with emphasis on deepwater reservoirs, remains a major component of research by Roger Slatt and his graduate students, often in collaboration with other faculty from the Mewbourne School of Petroleum and Geological Engineering and School of Geology and Geophysics.

A considerable portion of the research program involves quantitative characterization of outcrops for application to subsurface reservoir analogs. A recent graduate of the program, M.S. student ***Camilo Goyeneche*** presented a poster at the 2005 Calgary AAPG Convention which characterized the 3D geometry and architecture of a stratigraphically and structurally complex quarry in Arkansas, which exposes Pennsylvanian Jackfork turbidites. His characterization was followed by building a 3D geologic model in GoCad, which he then imported into Eclipse™ for fluid flow simulation under a variety of stratigraphic and structural scenarios. For his efforts, he won the SEPM Best Poster Award, which was presented at the recent Houston AAPG Convention. Camilo now works for Total in Aberdeen.

In the same quarry, ***Aaron Rothfolk*** has combined outcrop LiDAR measurements with behind-outcrop coring and borehole image logging to quantify fracture type and frequency along one quarry wall. The intent is to not only incorporate the fractured area into Camilo's 3D model, but also to document any significant borehole image features that can be utilized to predict fracture occurrence away from a wellbore.



Adam Shear is also studying the Jackfork in a nearby area for his M.S. thesis. Here, the steeply dipping Jackfork has developed a thick paleosol upon which lies horizontally bedded Cretaceous fluvial conglomerates. The goal of Adam's thesis is to document this angular unconformity as an outcrop analog to an unconformity hydrocarbon trap (the paleosol has excellent porosity). He has employed GPS and field mapping to outline the extent of the unconformity and is now conducting petrographic studies to evaluate the transformation of highly-cemented Jackfork strata to highly porous paleosol strata beneath the unconformity.

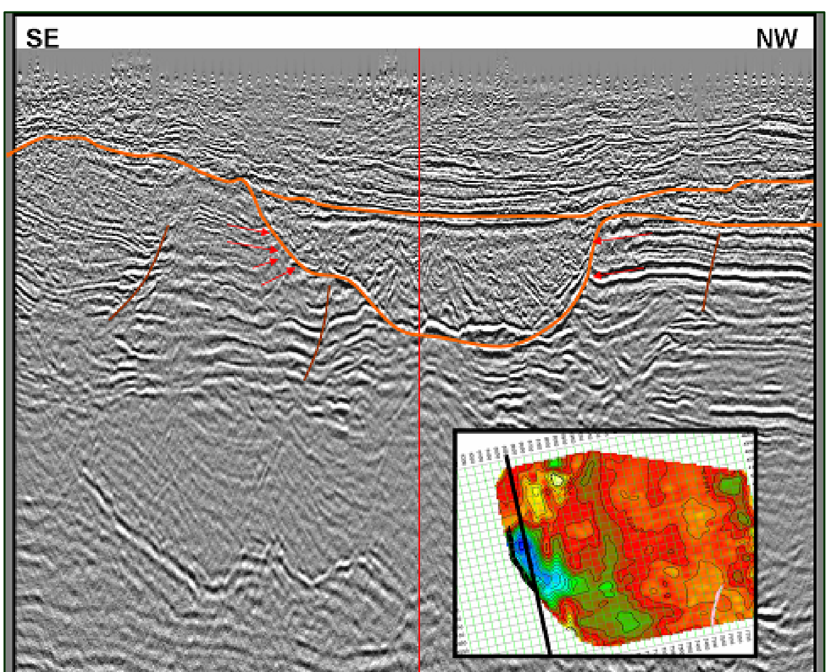
Another key outcrop area that has been studied for several years by Slatt and students is the Dad Sandstone member of the Cretaceous Lewis Shale in the Washakie Basin of Wyoming. M.S. student ***Matt Boyce*** is completing his thesis studies by field mapping of deepwater sheet sandstones.

Top Left: ***Aaron Rothfolk*** *supervising the drilling of a behind-outcrop well at Hollywood Quarry, Arkansas.* **Bottom Left:** *Borehole image log taken from borehole showing bedding planes and fracture planes.*

*Distance and close-up photos of turbidite sheet sandstones being studied by **Matt Boyce.** Close-up photo shows amalgamation surface separating two turbidite beds.*

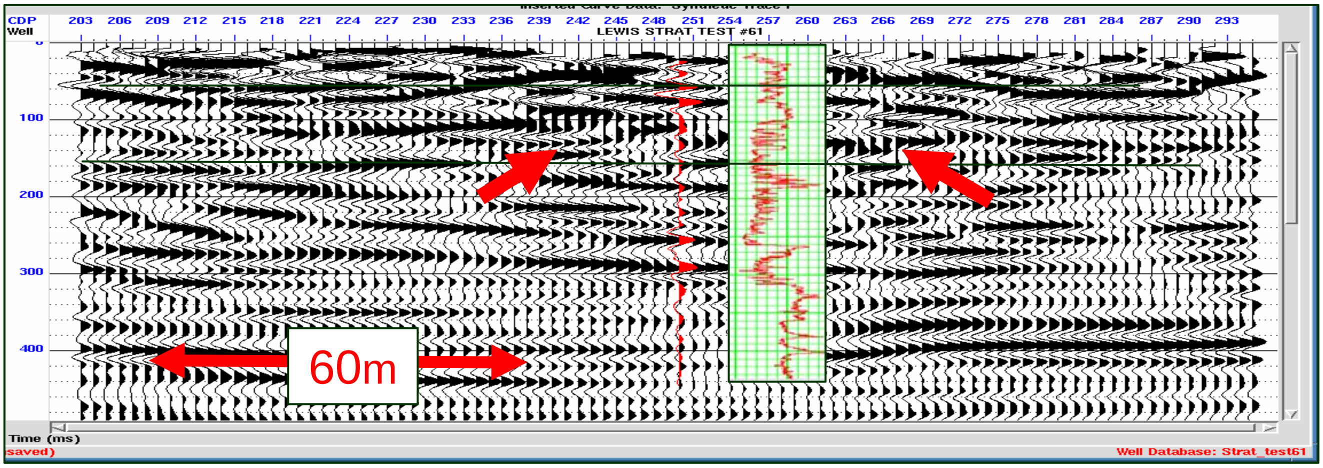
Prior research by students of Slatt has led to characterization of the updip part of the Dad Sandstone as leveed channel facies, and Matt is correlating these facies in time and space with the downdip sheet sandstones.

Bukky Ojo recently completed her M.S. degree by mapping the 3D geometry and trend of a subsurface leveed-channel deposit in the western Gulf of Mexico. The internal stratigraphy of the channel was interpreted from a 3D seismic data set by using the Dad Sandstone outcrops of channel facies as an analog. While a student, Bukky presented her research at an AAPG international conference in Nigeria and at a SEPM conference in Houston on the geomorphology of deepwater sediments. Bukky now works for Schlumberger in Denver. Bukky's seismic interpretation is currently being refined and expanded by Simon Bolivar undergraduate transfer students ***Romina Portas*** and ***Roderick Perez*** for their B.S. theses.



*Seismic line and time-depth converted isopach map of canyon fill in the Gulf of Mexico, mapped by **Romina Portas** and **Roderick Perez.** Cooler colors are thicker portions of canyon fill.*

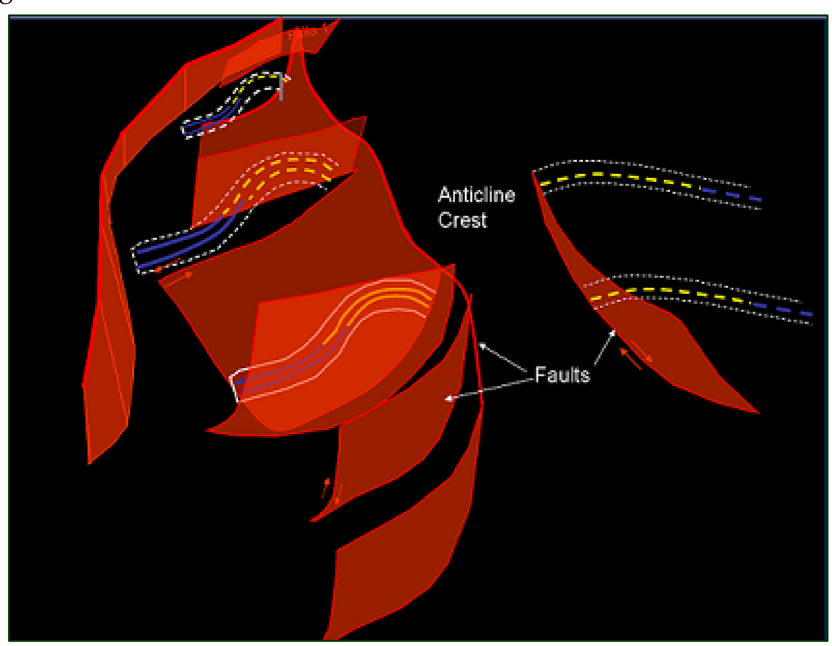
Carla Valerio completed her M.S. thesis on the Granite Wash Formation, which produces hydrocarbons in west Texas. She utilized some sophisticated geophysical techniques developed at OU by former professor John Castagna to improve resolution and interpretive capabilities. Carla's thesis was related to one completed a few months earlier by ***Matt Poole***, who did a subsurface facies analysis of the Granite Wash utilizing some new and traditional well log correlation techniques. Carla now works for Oxy in Houston, and Matt works for Pioneer Resources in Dallas.



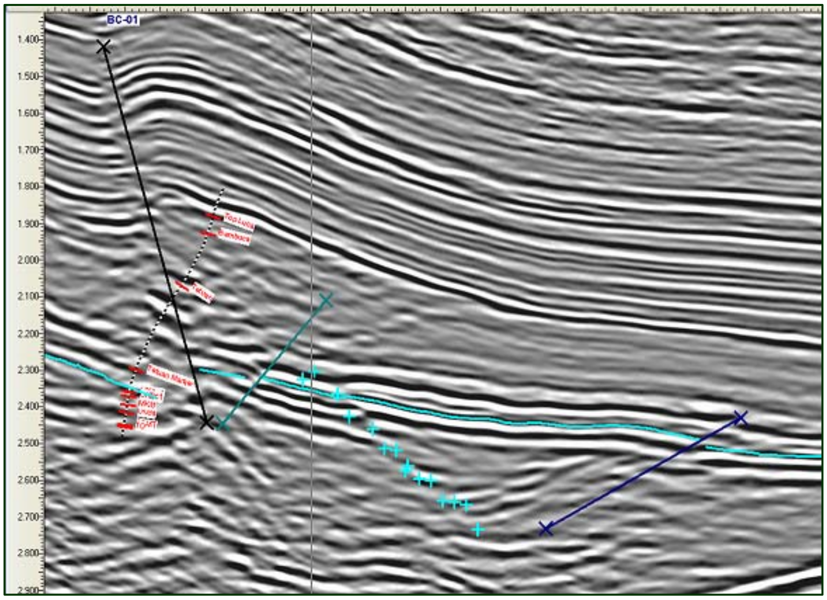
Shallow seismic line across a leveed-channel complex observed in outcrop of the Dad Sandstone Member of the Cretaceous Lewis Shale, Wyoming. Synthetic seismogram and the behind-outcrop well log from which it was derived is superimposed on the line. Red arrows point to base of a master channel that, during deposition, funneled other channel sands into this area.

Nichole Buckner, a new M.S. student, began her coursework this Spring with a research project aimed at improving imaging of a shallow, high-resolution seismic line shot over the Dad Sandstone two years earlier by Alan Witten and Roger Slatt. Nichole, Carla Valerio, Bukky Ojo, and Computer Specialist ***Jan Dodson*** combined their processing skills to develop an accurate image of the shallow subsurface and to tie a behind-outcrop well to the seismic line. The end result is a good image of a series of stacked, lenticular channel sandstones sitting atop a master channel at the location predicted from prior outcrop studies. Nick Gregg (student of Roger Young; now working at Devon Energy Company in Oklahoma City) completed his M.S. degree by also developing a processing scheme for shallow seismic lines shot by Witten and Slatt in Hollywood Quarry. Both of these studies have led to recognition of deep master-channels which focused on deepwater turbidite sand deposition.

Not all of the reservoir characterization research is related to outcrop studies. As part of a large research project on the prolific gas-producing Barnett Shale of north Texas, Ph.D. student ***Prerna Singh*** has been interpreting the depositional history from several long, continuous cores. She has recognized a variety of carbonate and siliciclastic shale facies within the Barnett, making for a very complex stratigraphy. These types of rocks have not been well studied (in detail), so Prerna is breaking new ground in some of her observations and interpretations. Two M.S. students, ***Javier Perez*** and ***Gabriel Borges***, have joined the Barnett program. Javier is utilizing a cluster analysis program to build a log-facies model for correlation of shale facies regionally, using only conventional well logs. Visiting Professor ***Mohammed Rezaee*** is doing similar work with a neural network program. Gabriel is beginning a seismic sequence stratigraphic analysis of a 3D seismic survey over part of the Barnett area. All of this research is aimed at ultimately developing a regional sequence stratigraphic correlation framework of the Barnett.



Geologic model of the reservoir studied by ***Carlos Bahamon.***

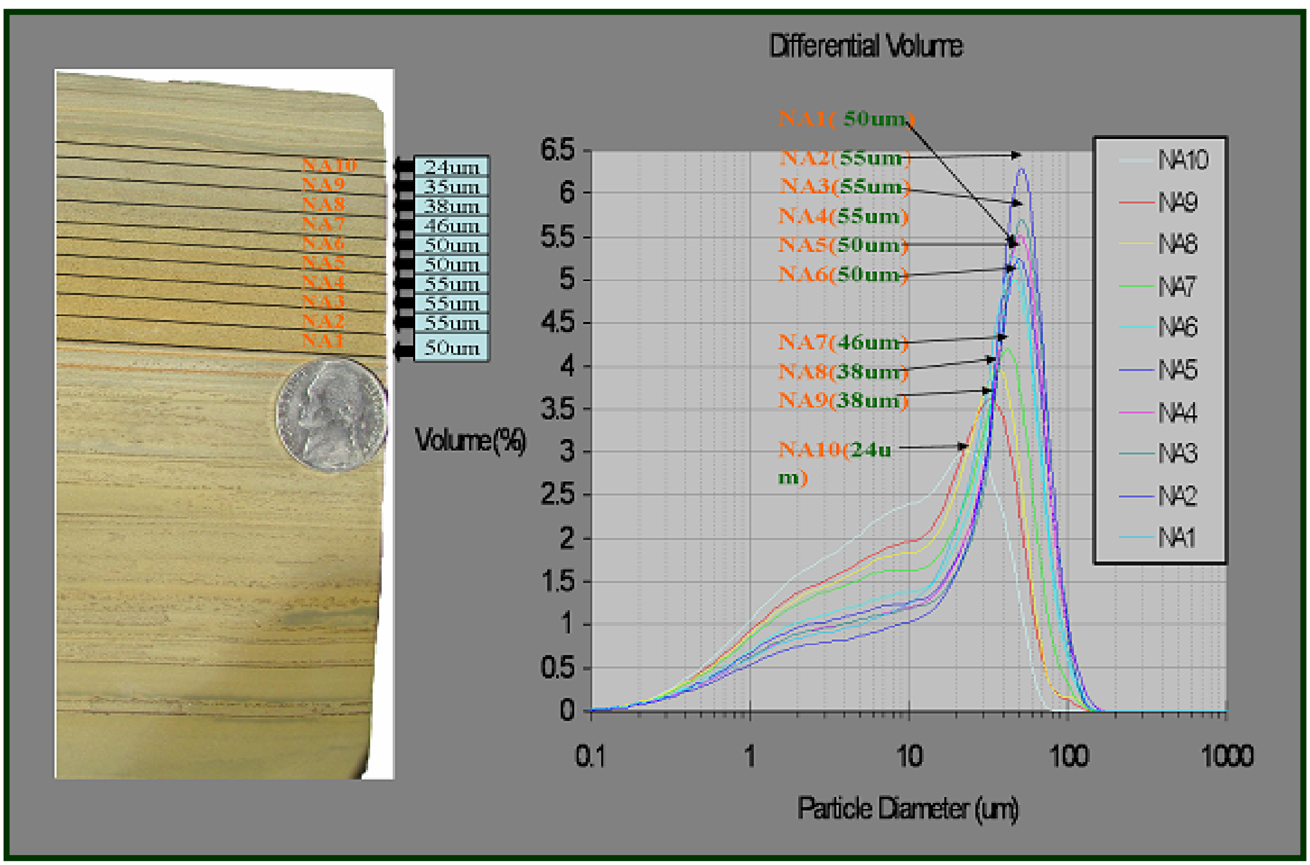


Structural compartmentalization in a reservoir studied by ***Rodrigo Bastidas.***

Also, in the subsurface, ***Carlos (Tex) Bahamon*** and ***Rodrigo (Pepe) Bastidas*** just completed M.S. theses on reservoirs in Mexico and Colombia, respectively. Both individuals integrated diverse data sets (3D seismic, logs, cores, biostratigraphy, geochemistry) to develop their geologic models and were able to answer a variety of exploration and production issues posed by operators of the fields. Carlos is now working for Oxy in Bakersfield and Rodrigo for Marathon in Houston. Ph.D. student ***Efrain Mendez*** is carrying Carlos' work forward by integrating P-wave and S-wave seismic to develop advanced imaging capabilities in complex subsurface terrain (utilizing Carlos' thesis area as a testing ground).

Walter Sebastian Bayer is completing an M.S. thesis under the dual guidance of Roger Slatt and Shankar Mitra on a structurally and stratigraphically complex field area near Bakersfield, California. He is applying his results to nearby subsurface exploration plays.

Justin Lynch is also completing a subsurface M.S. thesis in a Permian Brushy Canyon reservoir in West Texas. His research is aimed at understanding reservoir heterogeneity for infill drilling opportunities. Justin works for Devon, Inc.



Laser grain size analyses of size graded silt turbidite from ***Demola Soyinka's*** *thesis*

Gloria Romero continues her Ph.D. studies and has begun examining sidescan sonar imagery of the deep sea floor off Colombia. Her goal is to develop an understanding of deepwater sedimentary processes in this tectonically active area, and then to extend her findings into the subsurface, where there has been recent exploration activity by major oil and gas companies. To accomplish her goals, Gloria recently completed a month-long course on seafloor imaging geophysics in Southampton, England. She also recently completed a study of seafloor instability in a drillable area offshore west Africa utilizing a shallow-hazards, high resolution 3D seismic survey.

Late last year, four other students formally completed their M.S. degree requirements. ***Walter Doyle*** developed a seismic sequence stratigraphic framework from a 3D seismic survey from an exploration area in the northern Gulf of Mexico. Walter currently works for BP in Houston. ***Demola Soyinka*** completed a study of the levee facies and hyperpycnites in the Dad Sandstone member of the Lewis Shale. Demola is currently completing a paper for publication on the results of his thesis. He currently works for Kerr-McGee. ***Sarah Hamilton*** also completed an M.S. thesis on the Lewis Shale by extending regional subsurface cross sections to the south, and by making recommendations related to the cause of lost circulation in Lewis wells. She now works for Dominion in Oklahoma City. ***Sonia Bradley*** completed a M.S. thesis on the deep Springer in part of Oklahoma. The Springer here was identified as being deepwater sandstones, unlike prior interpretations of much of the Springer in the area. Sonia now works for Exxon-Mobil in Houston.

All of these students in the Reservoir Characterization program have graduated fully-educated for successful careers in the petroleum industry. Most have had a mix of coursework in geology, geophysics and petroleum engineering, which allows them to readily integrate into, and thrive within the industry. In this current time of great demand, the students are highly recruited by companies, and often receive multiple employment offers up to a year ahead of their graduation date. Those who are already employed, and those soon to be employed, will bring credit not only to themselves, but to OU and the School as they advance in their chosen profession. As a professor, I have found working with such dedicated and achieving students to be extremely rewarding. ■

NEW DEVELOPMENTS AT THE SAM NOBLE MUSEUM

By Professor Steve Westrop
Curator of Invertebrate Paleontology

The Sam Noble Oklahoma Museum of Natural History
May 16, 2006

Following the opening of the new building, the paleontology program at the Sam Noble Oklahoma Museum of Natural History has grown significantly. We are now among the larger concentrations of paleontologists in North America. In addition to four curators, there are three full-time collection managers (invertebrate paleontology, paleobotany and vertebrate paleontology) and an additional staff paleontologist split between vertebrate paleontology and the exhibit design department. Students in both Geology and Geophysics and Zoology use the Museum's labs and collections for their thesis and dissertation research, and many have been employed as part-time curatorial assistants. We are well on our way to developing a major program of paleontological research and teaching.

The most exciting new development involves the public face of the Museum. We are now in the midst of planning a major expansion of the **Ancient Life Gallery.** Visitors to the Museum are surprised to learn that many of the exhibits are temporary. In the **Ancient Life Gallery**, only the Mesozoic exhibits and the Pleistocene mammoth exhibit are permanent, and the remainder will be replaced over time. Production of permanent exhibits is a time-consuming business, and the initial phase involves design and layout of the gallery. This is a critical first step because it is difficult to raise funds for construction without a detailed vision for the gallery. To ensure scientific accuracy, curators are responsible for the content and story lines for each exhibit. A committee of curators and staff, including Rick Lupia and myself, has been working on this part of the project for almost a year. A professional exhibit design company, Chase Studios, has turned our ideas into a detailed floor plan, as well as the *concept drawings* shown in **FIGURE 1**. Our general philosophy is to develop exhibits that will not only educate the public on the history of life, but also provide teaching resources that can be used by K-12 teachers and OU faculty. Rick Lupia and I already make use of the Museum for several labs in our freshman "History of the Earth and Life" course. It is far easier to get students to

FIGURE 1

Introductory exhibit dealing with plate tectonics and other geological concepts

Diorama reconstructing a Pennsylvanian coal swamp

appreciate things like dinosaurs when you can show them complete, mounted skeletons.

Our current work involves design for exhibits that span the origin of the Earth to the great extinction at the end of the Permian, an interval of more than 4 billion years. There's a lot to cover, and some of the most momentous episodes in the history of life, including the "Cambrian Explosion" of life in the oceans and the conquest of land by vertebrates in the Early Devonian, are not preserved in Oklahoma. We'll use examples from Oklahoma wherever possible, but we'll have to venture outside our state to fill in the gaps.

There are about 40 individual exhibits planned for the gallery expansion, and I have space only to mention some of the highlights. The gallery will begin with a geology lesson. The first exhibit covers the formation of the Earth, as well as basic concepts like geological time and plate tectonics. An artist's impression of this exhibit is shown in one of the *concept drawings*. From there, we move to life in the Precambrian, from bacteria in the Archean and Proterozoic to the appearance of complex life in the oceans during the Ediacaran Period. Other exhibits will feature the Cambrian and Ordovician radiations of marine animals, with Oklahoman content focusing on trilobite extinction events recorded in the Honey Creek Formation, and a diorama that reconstructs an Ordovician marine community based on the Bromide Formation. Two major themes for the Silurian and Devonian exhibits will be the rise of fishes and the movement of life onto land. A major diorama featuring a Pennsylvanian coal swamp from eastern Oklahoma, shown here in a *concept drawing*, is sure to become a favorite with visitors. It's designed to be a nature trail through a swamp, complete with large trees, some of which will be built around existing pillars in the gallery. If it goes as planned, visitors will feel like they are part of the forest. The gallery will round out with Oklahoman vertebrates from the Permian, including an exhibit based on the famous Richard's Spur locality, and another that deals with the mass extinction at the end of the Permian.

The design phase should be complete by the end of this year, and we'll start construction as soon as sufficient funding is acquired. It is an ambitious plan, but if we are to remain a nationally significant, university-based museum, we must continue to think **BIG**. ■

~~ Steve Westrop

Carisa Bomberger, MS in Vertebrate Paleontology
School of Geology and Geophysics, The University of Oklahoma

"Who Is SUE, and Why Is Everyone So Excited About Her?"

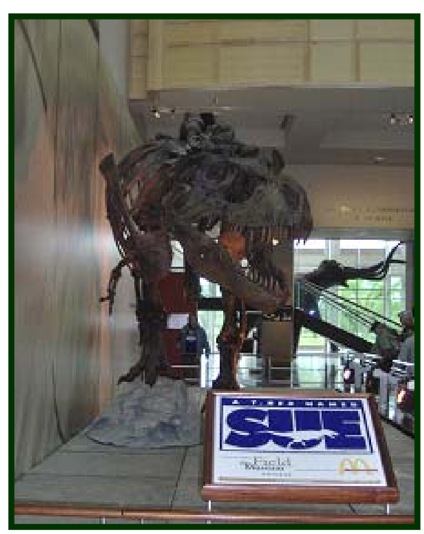
Though *Tyrannosaur rex* is probably the most popular dinosaur and favorite of almost anyone young and old alike, since its first discovery in 1900, only seven skeletons that are more than half complete have been found of this giant meat-eater. At 42 feet long and 13 feet high at the hips, **Sue** is the largest *Tyrannosaurus rex* ever discovered; 90% of her skeleton is complete, making her the most complete *T. rex* fossil as well. The excellent preservation of the bones also makes it possible to study the anatomy of *T. rex* in greater detail. This "queen" of dinosaurs has 58 teeth that range from 7½ to 12 inches long. She is estimated to have weighed 7 tons. The fossil skull weighs 600 pounds and has a braincase large enough to hold a quart of milk[1].

Sue is on exhibit at the Sam Noble Oklahoma Museum of Natural History from May until the end of July. The exhibit is a cast or copy of the original fossils. It allows the public who has not been to Chicago Field Museum an opportunity to enjoy **Sue** in this traveling exhibit that has been touring the country. Also, real fossils are too heavy to mount as well as too fragile for transporting around the country. The exhibit includes many wonderful interactives for children as well as adults who are still kids at heart. You can compare how you would see as a *T. rex* or a Triceratops, how it would be to have such short arms, how strong a nose it had, as well as other interesting facts, activities, and things to touch.

Despite the fossil being named ***Sue,*** no one knows what sex this *T. rex* is. **Sue** was named after Sue Hendrickson, the woman who discovered her while fossil hunting near Faith, South Dakota on August 12, 1990. Hendrickson was working with a team of fossil hunters on a dig in South Dakota. On the morning of this fantastic discovery, their team found that their jeep had a flat. While it was being fixed, she decided to hike over some hills to an outcrop of the same rock her team had been finding fossils in at their dig. What she discovered there would make her famous. She saw some bone fragments at the base of the outcrop and while trying to determine where they had eroded out from she looked up and saw large dinosaur bones[1].

The bones were found in the Upper Cretaceous age Hell Creek Formation[1]. This is a fluvial deposit of mudstones and sandstones that were deposited by fluctuating river channels and deltas. The iridium layer that separates the Cretaceous from the Cenozoic occurs as a distinct thin marker bed that is present discontinuously in the uppermost strata of the Formation. The Hell Creek Formation is present in portions of North and South Dakota, Wyoming, and eastern Montana. The Formation is rich in various fossils such as mammals, amphibians, reptiles, fish, invertebrates, and plants. It also contains a few birds. The most abundant fossils are Triceratops and a duckbilled dinosaur, Edmontosaurus[2].

Sue went on display at the field museum in Chicago in 2000. The ten years between the discovery and its unveiling at the museum were spent in a legal battle over who the find belonged to and preparing the fossil for display. **Sue** was found in the Cheyenne River Sioux Reservation on land belonging to a rancher whose land was held in trust by the government. A judge found in favor of the rancher, and so **Sue** was sold at an auction in 1997 for *$8.4 million* to the Chicago Field Museum with the help of corporations and individuals[2].■



(1) http://www.fieldmuseum.org/SUE/

(2) http://en.wikipedia.org/wiki/Hell_Creek_Formation.

Hell Creek Formation From Wikipedia, the free encyclopedia

Richard Cifelli, Adjunct Professor & Curator of Vertebrate Paleontology
School of Geology & Geophysics and Sam Noble Oklahoma Museum of Natural History

Story by Diane Clay
Staff Writer, *The Oklahoman*
Reprinted from January 31, 2006

"Species Name Honors Oklahoman"

Paleontologist was pioneer in research

A worker at the Sam Noble Oklahoma Museum of Natural History ran down the hall carrying a printout of a Web page. There, in the second paragraph of a research letter sent to the journal Nature, was the name of a new species, "Akidolestes cifellii", recently found in the fossil-rich region of northeastern China.

The museum's curator of paleontology, Richard Cifelli, read in disbelief. The furry rodent, which lived with the dinosaurs 125 million years ago, had without his knowledge been named after him.

"It was a surprise. It happened to come out on my birthday, too," Cifelli said.

"It's a form of immortality, because scientific names will persist forever. The species lives on. It's very nice, and I'm very flattered."

Researchers in China and Pennsylvania chose the name to honor Cifelli's contribution to the study of these animals in recent years. The extra "i" at the end of the name is the Latin version of Cifelli's name, and "akido" is Greek for the animal's long, pointed snout.

"I just happen to have a long, pointy nose myself," Cifelli said.

The mammal's fossil was found in a region of China that is yielding so many dinosaur-era fossils, scientists nicknamed it Dinotopia.

The rodent was about four inches long, with forelimbs and shoulders of a mammal that gives birth to live off-spring, and a backbone, pelvis and hind limbs of a much more primitive, egg-laying animal.

Researchers do not think the creature laid eggs, since evidence found in the Yixian formation of China suggests it is part of an extinct group of mammals known as symmetrodonts. Scientists said the group is more closely related to live bearing mammals than it is to the monotremes, which are a group of egg-laying mammals that includes the platypus.

Cifelli said the rodent is an earlier version of rodents found in North America. The fossil found in China is the best one yet for this type of animal. Scientists typically find only the teeth. Cifelli said researchers found a complete skeleton of the Akidolestes cifellii, including impressions of fur and carbonized fur.

"It's as flat as a pancake, but it's really exceptionally preserved."

Cifelli said the fossil is another piece of an emerging puzzle that seems to show a migration of animals from Asia to North America. Until recently, scientists did not know these ancestors of North American animals existed in Asia.

"When animals jump from one continent to another, it's an interesting experiment in ecology and evolution," Cifelli said. "It's a natural experiment." He said most likely the rodents arrived in North America at some point much like many other species now living here.

"It gives us a long-term idea of the effects of this perturbation," he said. "So, there is some application to the modern world."

40th Annual Meeting of the South-Central Section

Neil Suneson, Oklahoma Geological Survey
Rick Lupia, School of Geology and Geophysics and Sam Noble Oklahoma Museum of Natural History

The 2006 meeting of the Geological Society of America's South-Central Section was hosted by OU's School of Geology and Geophysics and the Oklahoma Geological Survey. The welcoming party took place Sunday evening, March 5 in Sarkeys Energy Center and all of the technical sessions over the next two days were held at the College of Continuing Education on the south part of campus. A number of field trips and workshops preceded the meeting.

These kinds of conferences do not just happen. Well … they could because they are scheduled at least two years in advance. But the chaos that would ensue at a conference in which committee chairs did not volunteer hours and hours of pre-conference e-mails, phone calls, letter-writing, and meetings can only be imagined. Just ask Rick or Neil what things were like in the weeks and months leading up to the GSA meeting.

Early on there were field trips and workshops to solicit. Given the conference's location in Oklahoma and association with the School, we decided that petroleum geology would feature prominently. Normally, GSA meetings are more "academic" and student-oriented than, say, an AAPG meeting. GSA meetings typically are where professors and their students present their research, and for many students this is their first opportunity to talk about their work in front of a professional audience. We also decided that the Norman conference would feature other Oklahoma issues such as water resources, Tar Creek Superfund Site, and the on-going battle over teaching intelligent design in the science classroom. In most cases individuals stepped forward to chair a symposium or theme session that interested them; in other cases some *Sopranos*-esque discussions were necessary.

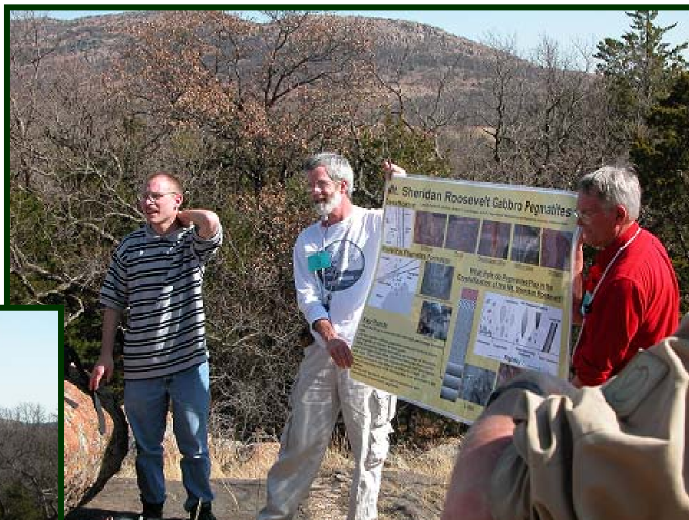
After the field trips and workshops were set and the call for papers had been published by GSA, anxiety set in as we waited for abstracts to be submitted. The number of abstracts gives you an idea about how many people may be coming to the meeting. No abstracts, no people, no meeting. Two days before the abstract deadline only 11 abstracts had been submitted. Nevertheless, we optimistically chose not to underestimate procrastination. Thanks to the electronic wizardry of GSA's website, an additional 104 talks and posters appeared in the last 48 hours, filling the program. The next step was reading all of them to see if they made sense and then organizing them into the different sessions. Where would *you* put the one oral paper on Himalayan gneiss domes?

OU Professor David London discussing a pegmatite pod in a polished slab of Reformatory Granite at the Willis Monument Works in Granite, OK. Dr. London maintains a website on pegmatites (http://pegmatopia.ou.edu) and is currently finishing a book titled **Pegmatite**, to be published by the Mineralogical Association of Canada as a Canadian Mineralogist Special Publication to be released by May 2007. *(Photograph courtesy of John Hogan, University of Missouri, Rolla)*

A fun project involved designing the cover for the program. Normally, the covers for GSA section meeting programs are extremely vanilla – no pizzazz at all. Neil, with the help of Jim Anderson, Manager of Cartography at the OGS, conceived of a cover that would feature Oklahoma geology. Why not feature the State Rock, State Crystal, and State Fossil? Dr. David London, SGG mineralogy professor and (not coincidentally) author and designer of the "OK Rocks" display at the Sam Noble Museum of Natural History, provided beautiful photographs of a barite rose (State Rock) cluster from Noble, selenite (State Crystal) cluster from Jet, and quartz crystals from near Broken Bow. The Museum provided a photograph of *Saurophaganax maximus* (State Fossil), a Jurassic carnivorous theropod from the Morrison Formation near Kenton.

Fortunately, various people at the School volunteered their time and expertise to make this meeting a success. A number of student volunteers agreed to help work the registration desk; babysit the always-finicky never-really-works-right laptops, powerpoint software, LCD projectors, lapel mics, and laser pointers; and lead tours of the Sam Noble Oklahoma Museum of Natural History. This GSA meeting could not have been run without the able assistance of Henry Badra, Nicole Baylor, Aaron Bell, Greg Dean, Jennifer Eoff, Quinn Floch, Matt Hamilton, Rika Hood, Jason Moncrief, Evan Noble, Matt Totten, Raina Waskiewicz, and Brooke Wilborn.

Drs. David London and M. Charles Gilbert, assisted by Dr. George Morgan, organized and ran a one-day pre-meeting trip titled "Interpreting Textures of Granitic and Gabbroic Rocks, Wichita Mountains, Oklahoma". The trip was based on Gilbert's extensive field mapping in the Wichitas and London's long-standing interest in granitic melts. The trip was very well-attended by many southern mid-continent igneous petrologists and only partly because southern Oklahoma is one of the few places geologists can view "the basement". This trip was a twist on the more-common history and stratigraphy of the Wichitas; it was designed to assist geologists in using textures to interpret crystallization sequences. Drs. London and Gilbert also convened a theme session "Igneous Petrology: What the Rocks are Telling Us". Twelve papers covered subjects ranging from the extremely large eruptions on the Ontong Java Plateau to $(\Diamond P)(M^{+}Sl)_{-1}$ substitution in feldspars.



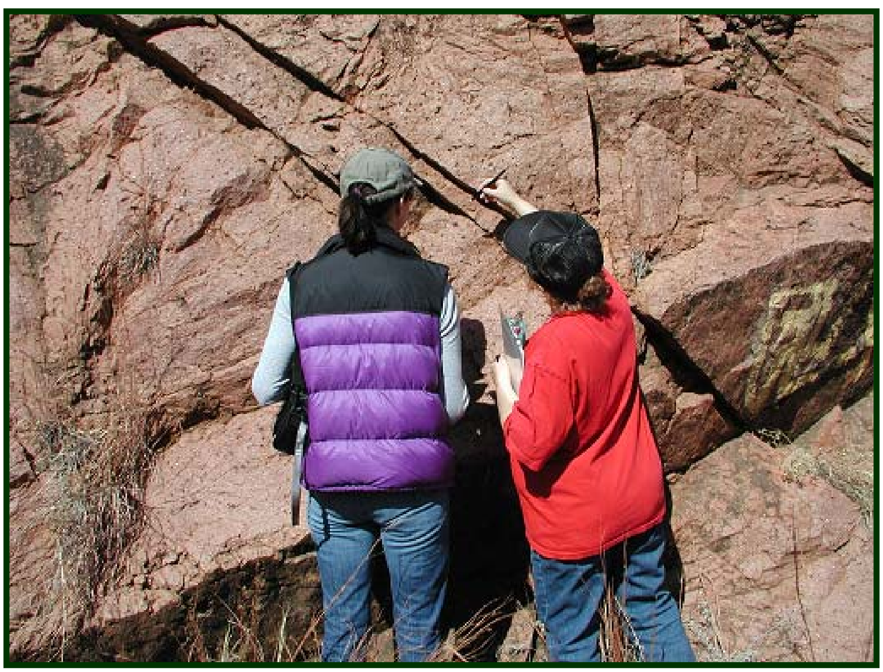
Professor John Hogan (holding poster on left) and OU Professor M. Charles Gilbert (holding poster on right) at Mt. Sheridan in the Wichita Mountains. Dr. Gilbert's research on the granites in the Wichitas has resulted in many OU theses and dissertations, innumerable field trips (including this one, run as part of the South-Central Geological Society of America), and a wealth of published information. *(Photograph courtesy of Melanie Barnes, Texas Tech University)*

Professor John Hogan, University of Missouri-Rolla, discussing the crystallization of the Mt. Sheridan Gabbro at the foot of Mt. Sheridan in the Wichita Mts. Wildlife Refuge on Sunday, March 5, 2006. Dr. Hogan was a post-doc with Dr. Gilbert in the 1990's, and his wife, Karen, worked in SGG's thin-section lab. *(Photograph courtesy of Melanie Barnes, Texas Tech University)*

The "official" start of the meeting was the icebreaker Sunday evening. Dr. Roger "Party-Animal" Slatt, who volunteered to be social chair for the meeting, decided to show GSA attendees how to party AAPG-style. Thanks to the generosity of a number of OU alumni and the coordination efforts of Niki "I'm-a-Party-Animal-too" Chapin, music, food, and drink flowed freely for several hours, facilitating the renewal of old friendships and the establishment of new ones. GSA meetings, and particularly section meetings, are typically rather frugal affairs, but not the Slatt/Chapin icebreaker. SGG alums and local petroleum companies—Jack Taylor (Hiawatha Exploration), Potts Exploration, Jon Withrow, Gene Van Dyke (Vanco Energy), Bill Red (Viola, Inc.), Denny Bartell (Legends Exploration), Lew Ward (Ward Petroleum), and Bob Allen—made the event one to remember and to be copied at future meetings.

The technical sessions (oral and poster presentations) were held at OCCE on Monday and Tuesday. In addition to the igneous petrology session described above, SGG Ph.D. student Devin Dennie co-chaired the sedimentology/ stratigraphy / paleontology / paleomagnetics session on Tuesday morning and Dr. Ze'ev Reches chaired the volcanology / structural geology/ tectonics session Tuesday afternoon. During the meeting, those out-of-town geologists who were tired of sitting or looking at posters had the opportunity to visit the Sam Noble Oklahoma Museum of Natural History right across the street for free and/or tour the collections. Rick organized a number of small-group "behind-the-scenes" tours. The good eatin' and drinkin' (sans alcohol) that began on Sunday evening continued at the technical sessions thanks to the generosity of some more local organizations. Devon Petroleum, GLB Exploration, the Oklahoma City Geological Foundation, and the Oklahoma City Geological Society made sure that far more than just coffee appeared at the "coffee bars" during the breaks. There was no excuse for any of the starving students to go home hungry.

Almost 250 geology students and professionals attended the Norman GSA meeting. The School and co-host Oklahoma Geological Survey put their best foot forward; the field trips, workshops, talks, posters, exhibits, and social events were superb and came off, for the most part, without a hitch. Would co-chairs Neil and Rick volunteer to do it again? Nope, no way, not-a-chance (which is to say, not until our memories turn to nostalgia).



To the Left: Oklahoma State University Professor Elizabeth Catlos (on left) and undergraduate student Treva McClung (on right) using a wax pencil to outline and connect miarolitic cavities in the Long Mountain Granite along old U.S. Highway 62 just west of North Fork Red River. By delineating the last 10 – 15 volume percent of melt, they are gaining insight into the solidification pattern in this magma body. *(Photograph courtesy of Professor David London, University of Oklahoma)*

For the full program, visit www.geosociety.org/sectdiv/southc/06scmtg.htm. Click on Technical Program Schedule in the upper right to view the abstracts. **Following is a list of the papers presented by SGG students and faculty at the meeting:**

Pamela Tañeza and **Paul Philp—Occurrence of Polycylic Aromatic Hydrocarbons (Pahs) in Lloilo River, Philipines**

David London, George Morgan, and **Joseph Evensen—Reading Textures in Granitic Rocks**

George Morgan, Kerry Paul, Katie Gunderson, and **David London—The Elusive ($\lozenge$P)(M^{+}Sl)$_{-1}$ Substitution in Potassic Alkali Feldspar**

Raina Waskiewicz, Stephen Westrop, and **Jonathan Adrain—Cambrian (Steptoean – Basal Sunwaptan) Trilobite Biostratigraphy of the Honey Creek Formation, Wichita Mountains, Oklahoma**

Stephen Westrop and Richard Lupia—Stratigraphy, Sedimentary Facies, and Palynology of a Temporary Exposure of the Seminole Formation (Pennsylvanian, Missourian), Tulsa County, Oklahoma

Sohini Sur, Gerilyn Soreghan, and **Sabata Pereira—Variations in Atmospheric Dust Flux Recorded in Upper Pennsylvanian Carbonates of Horseshoe Atoll, Midland Basin, Texas**

Brooke Wilborn—Macroflora Assemblages of the Cloverly Formation, Bighorn Basin, Wyoming

Jennifer Eoff and **Stephen Westrop—Facies Anatomy of Late Cambrian (Steptoean – Sunwaptan) Sandstones, Tunnel City Group, Upper Mississippi Valley**

Stephen Westrop and **Jonathan Adrain—Cryptic Microbial Buildups and Hardgrounds in a Lower Ordovician Shallow Subtidal Carbonate Succession, Southern House Range, Utah**

Devin Dennie, R. Douglas Elmore, and **Shannon Dulin—Preliminary Paleomagnetic Results from the Deformed and Dolomitized Late Devonian Alamo Breccia, Delamar Range, Central Nevada**

Michelle McCarthy—Paleomagnetic Analysis of the Apache Canyon Formation, Arizona: Implications for Tectonics of the Bisbee Basin

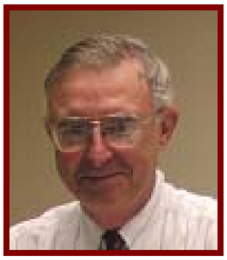
Matthew Totten, Jr., Vanessa O'Brien, and **R. Douglas Elmore—Origin of the Magnetization in Cretaceous Sediments, Disturbed Belt, Montana**

Carlos Russian and **Roger Young—Fracture Characterization by the Correspondence Between Geologic Mapping and Ground Penetrating Radar Imaging**

Joni Verrett, Vincent Heesakkers, and **Ze'ev Reches—Structure and Composition of the Fault-Zone of the San Andreas Fault in Tejon Pass, California**

Gerilyn Soreghan and **M. Charles Gilbert—The End of the Ancestral Rocky Mountains**

Judd Ahern and **M. Charles Gilbert—Unusual Circular Structures in Southern Oklahoma**



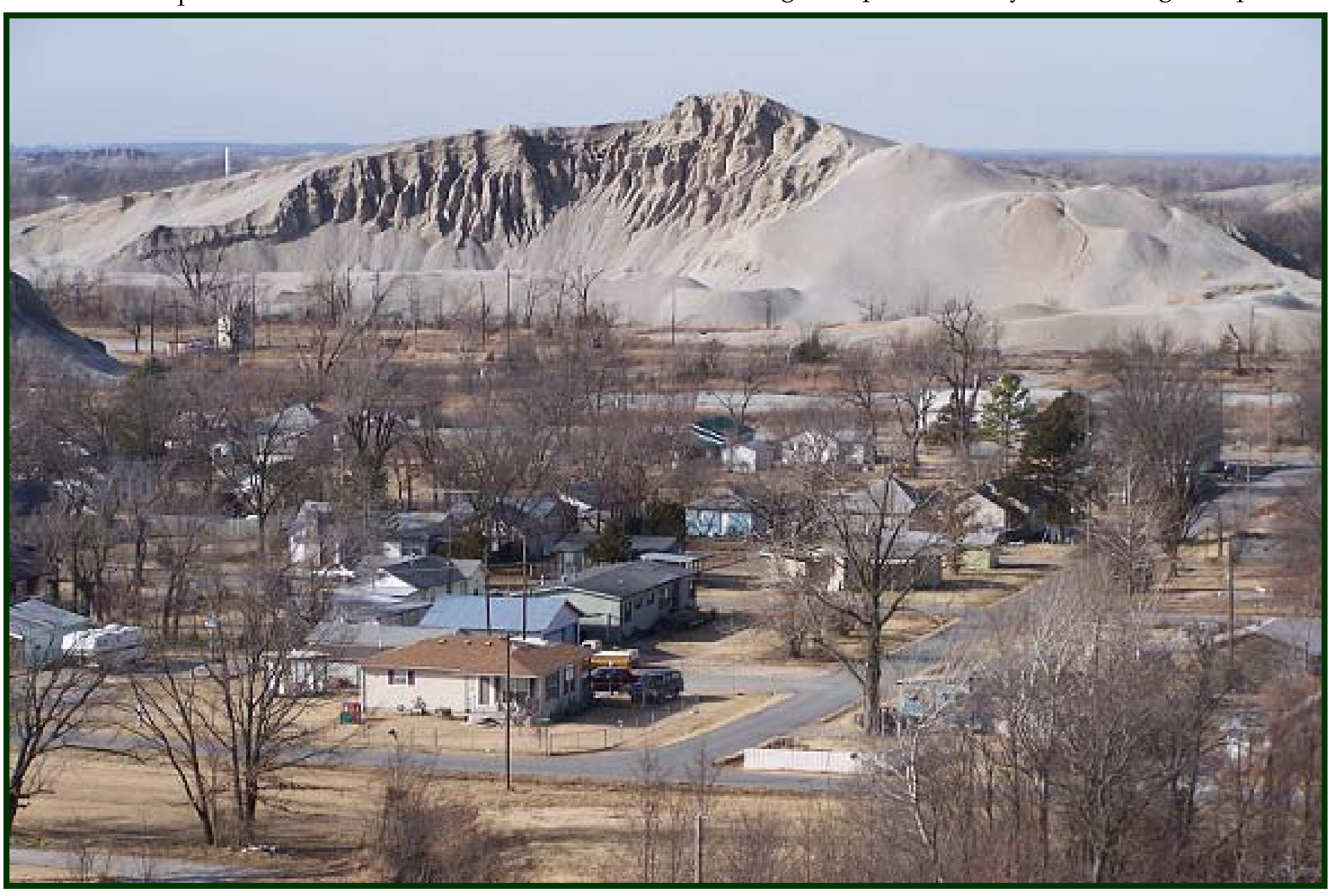
Kenneth V. Luza, Geologist
Oklahoma Geological Survey, The University of Oklahoma

"The Picher Mining Field and Its Post-Mining Legacy"

The Picher Mining Field is located in northeastern Oklahoma and southeastern Kansas and was part of the Tri-State Mining District (OK, KS, and MO). The Tri-State Lead-Zinc District was one of the foremost mining districts in the world. The productive life of the district began with the discovery of lead near Joplin, Missouri, in 1848. A later discovery in Peoria, Oklahoma in 1891 led to the expansion of mining into Ottawa County. The eventual depletion of high-grade ore deposits in the 1930s and the consequent lowering of the grade of mine-run ore caused a gradual and then marked decline in the Tri-State District's output of lead and zinc until the early 1970s when the mining field closed. In most of the intervening years the Tri-State District produced more zinc than any other field in the United States and it generally ranked third or fourth in lead production.

The rock formations exposed at the surface in the Picher mining field include Mississippian and Pennsylvanian units that are nearly flat, with a low regional northwest dip of about 20-25 ft/mi. At a few places, sharply defined structural features are accompanied by appreciable dips (up to 70^{o}). The Miami Trough, Bendelari Monocline, and Rialto Basin are three prominent structures that dominate the main part of the Picher Field.

Ore deposits in the Picher Field occur mainly in the upper half of the Boone Formation, a fossiliferous limestone with thick beds of nodular chert. Mining is commonly referred to as random room-and-pillar mining where rooms were excavated and pillars were left to support the mine roof. Initial extraction ratios were about 85%. As mines became depleted of ore, a second stage of mining was performed by the mining companies



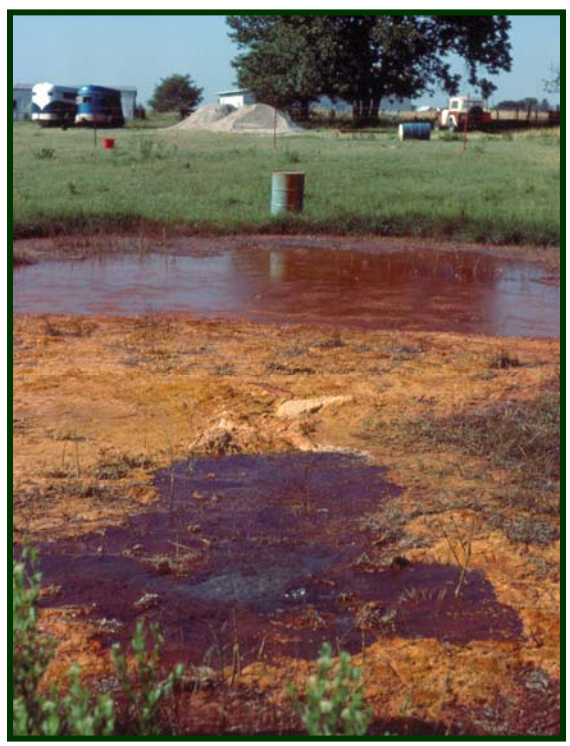
Chat Pile in Picher

which included pillar shaving (trimming) and/or complete removal of pillars left during primary mining. After the mining companies were finished removing the higher-grade ore, the mine workings were often subleased to independent miners who removed the last remnant of ore from the roof, walls, pillars, and floors. The depth of the mine workings varied from 100 ft. (east) to 400 ft. (west). Stope heights varied from 10-20 ft. to over 100 ft. The main ore minerals were sphalerite and galena; the zinc to lead ratio for the ore, based on total production from the field, was about 4:1.

The mining era left a legacy of open mine shafts, shaft-related and non-shaft-related collapse features, more than 40,000 exploratory drill holes, hundreds of abandoned deep-water wells drilled into the Roubidox Aquifer, large areas prone to subsidence, acid-mine water discharges, poor watershed drainage, and millions of tons of mill tailings containing lead, zinc, and cadmium spread over 5,000 acres. The U.S. Environmental Protection Agency (EPA) added the site to the Superfund National Priorities List (NPL) on September 8, 1983. The Oklahoma portion of the Picher Field became known as the Tar Creek Superfund Site.

The EPA issued its first Record of Decision (ROD) for the Site on June 6, 1984. The ROD addressed two concerns: 1) the surface water degradation of Tar Creek by discharge of acid mine water; and 2) the threat of contamination of the Roubidoux aquifer, the regional water supply, by downward migration of acid mine water from the overlying Boone aquifer through abandoned wells connecting the two. The dike and diversion structures around major in-flow points and plugging of 83 Roubidoux wells were completed on December 22, 1986. In 1996, EPA began a program to remove contaminated soil and chat (mill tailings) from residential yards in response to elevated blood-lead levels in children. The EPA yard remediation project was ongoing in June, 2006. Over 2,500 residential/ school yards were remediated at a cost of more than $150 million. In 2004, the state authorized the Lead Impacted Communities Relocation Trust Authority to move children 6 years old and younger and their families from the Picher-Cardin area.

On January 31, 2006, the U.S. Army Corps of Engineers released the results of their subsidence evaluation of residential areas and major transportation corridors in the Tar Creek Superfund Site. Federal and state officials announced on May 4, 2006, a voluntary buyout plan for all families and businesses that live in areas the report identified as having a potential for subsidence. ■



Acid Mine Water discharging from a Drill Hole in Commerce, OK, 1980.

Gerilyn Soreghan, Associate Professor
Dupont Young Professor and Presidential Professor

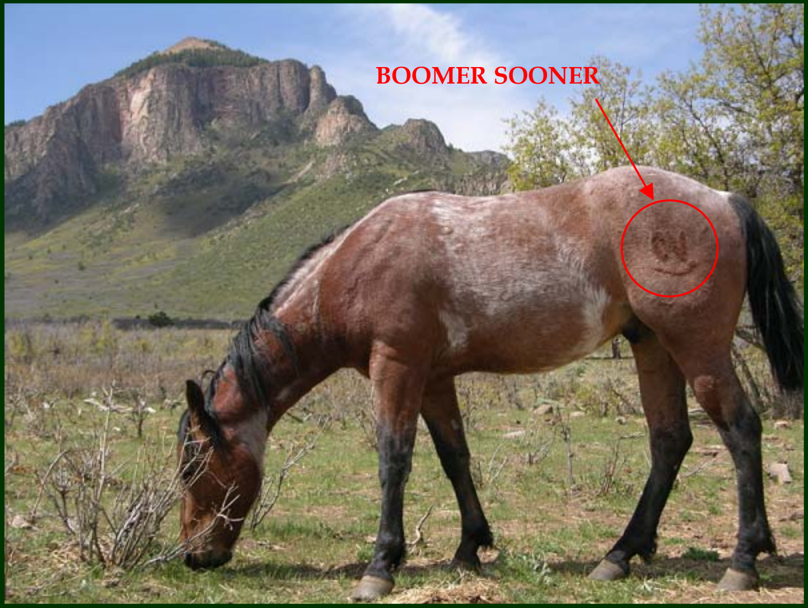
"Uncovering a Complex Landscape in Western Colorado"

UNAWEEP CANYON – "An Ancient Landscape?"

Unaweep Canyon of western Colorado is enigmatic. It is too large for the creeks that currently drain it, which oddly emanate from a divide in the midst of the canyon. Since the 1800s, several hypotheses have been proposed for the origin of the canyon, but none have adequately explained it. Lynn and Mike Soreghan, together with several colleagues and students at OU and beyond, are testing a new, radical hypothesis: That Unaweep Canyon is an ancient landscape that dates from 300 million years ago and has only recently been exhumed. The photo journal here shows various views of our efforts, including drilling, geophysical work (seismic and gravity, supervised by Dr. Roger Young), and ongoing outcrop studies, to reveal the real origin of this perplexing canyon.

Drilling (and continuously coring!) a 320m well in the middle of the canyon.

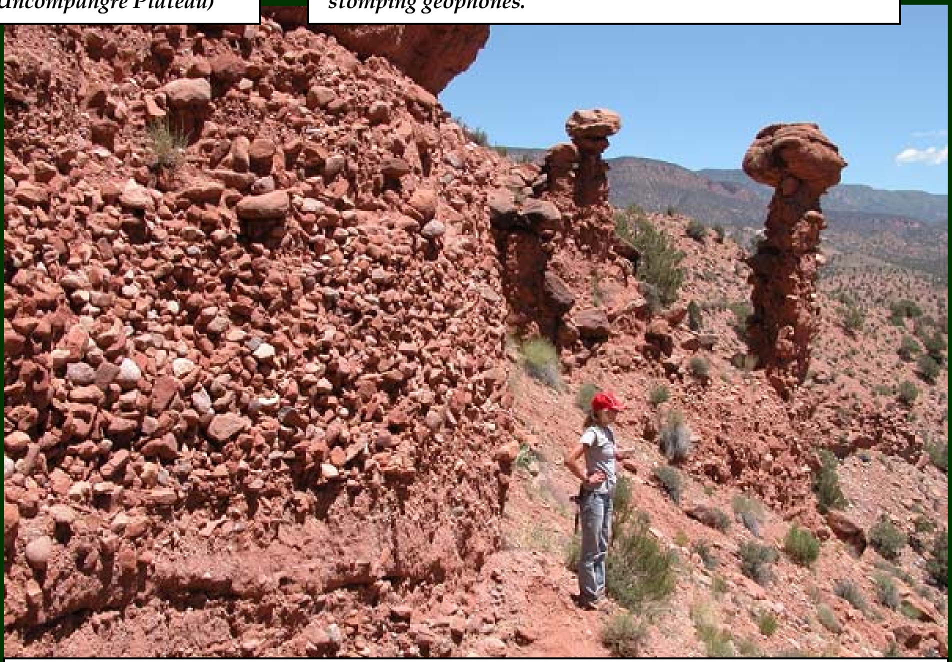
Student Yoscel Suarez surveys the gravity/seismic line.



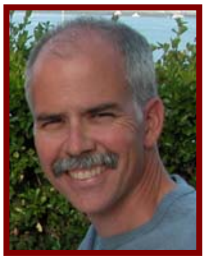
Spot the fault? Students Kristen Marra, Dustin Sweet, and Kate Moore are gazing at it. (Granite Creek, Uncompahgre Plateau)

Student Kristen Marra and Dr. Roy Johnson (Univ of AZ) stomping geophones.

Above: *Student Dustin Sweet firing the Betsy Gun during seismic data acquisition across the canyon.*



Student Sara Kaplan ponders the origin of recent gravel deposits at Unaweep's western mouth.



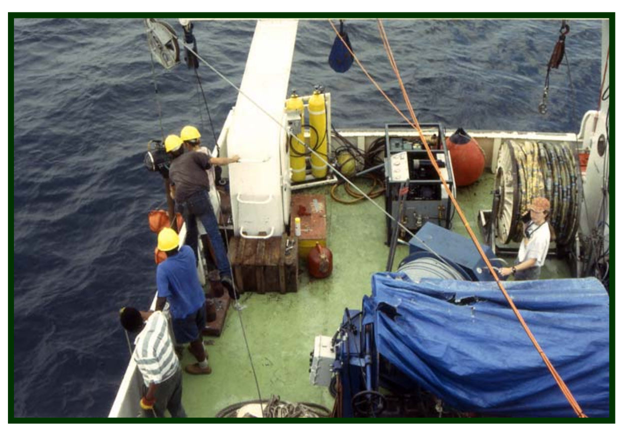
Michael Soreghan, Research Associate/Adjunct Associate Professor
Sedimentology

"Paleoclimate Study of Lake Tanganyika, Africa"

Lake Tanganyika, located within the East African rift forms an important natural laboratory for understanding a spectrum of geologic, ecologic and environmental processes. Lake Tanganyika is stunning in its enormity and in its beauty; it is over 700 kilometers long and 1470 m deep and is bordered by mountains that rise more than 2 kilometers above the lakeshore. Geologically, the lake forms a modern analogue for many petroliferous buried rift basins offshore of Brazil, West Africa, and China. In addition, over 5 kilometers of sediment underlie the lake, forming a high-resolution proxy record of regional climate change. The rich endemic biota of Lake Tanganyika makes the lake a spectacular laboratory for studying speciation and rates of evolution. Finally, Lake Tanganyika forms a critical natural resource for the 4 riparian countries of Burundi, Democratic Republic of the Congo, Tanzania, and Zambia. The growing population has led to severe deforestation in the watersheds adjacent to the lake and several research groups are documenting these effects. There is also serious concern regarding the impact of anthropogenic global warming on the lake ecosystem.

Northern Tanzania coast (east side of Lake Tanganyika). The heavily deforested slopes (right side of photo) stand in stark contrast to the adjacent slopes within the Gombe National Park (left side of photo), made famous by Jane Goodall and the chimpanzees she studied.

Michael Soreghan has been studying a core collected from Lake Tanganyika in order to unravel a detailed record of tropical climate change over the last 80,000 years. He along with co-authors Chris Scholz, Syracuse University, and Andrew Cohen, University of Arizona, presented a paper at the recent American Geophysical Union meeting in San Francisco. The study focused on wind-blow sediment within the lake as a proxy for changes in aridity at the tropics.



Coring operations from deck of R/V Tanganyika Explorer. Coring was accomplished with an oceanic vibrocoring system.

The flux and grain size of wind-blown sediment to Lake Tanganyika allows reconstruction of wind regimes over continental East Africa, which is important, for example, in understanding temporal changes of the Asian Monsoon. During a scientific cruise aboard the R/V Explorer, a 6.3 m core was collected from a submerged ridge that presently lies approximately 10 km offshore and in 393 m of water. Geomorphic and seismic evidence suggests that clastic sedimentation to this site is primarily suspension derived; further, because of the isolated nature of the ridge, riverine or gravity-induced sediment is unlikely. Therefore, the sediment consists primarily of authochtonous calcite, organic matter (algae and diatoms) and wind-blown clastic sediment. A previously published sedimentation model based on 11 calibrated C-14 AMS dates of bulk sediment suggests a slow, linear sedimentation rate. Samples collected on 4-cm spacing were subjected to a series of chemical treatment to remove all calcite, organic matter, and autochthonous oxide phases. On a weight fraction basis, the remaining clastic material, ranged between 5 and 74 % and mean grain size of this fraction ranged between 5.9 and 101 μm. The temporal trends show significant variation: low clastic fraction and finer grain sizes occur during the Holocene (to ~9 kyrs BP), abruptly changing downward in the core to very high clastic fraction and maximal grain size at ~11 kyrs BP. This interval of high clastic fraction corresponds to the Younger Dryas (YD) period, which is receiving a lot of scientific attention given interest in periods of abrupt climate change. Immediately preceding the YD, clastic fraction was low and mean grain size were finer, but during the Last Glacial Maximum (LGM) both variables were much higher than Holocene values. Prior to ~20 kyrs BP, the clastic fraction was generally lower, although broad peaks of higher clastic fraction occur at roughly 29, 34, 40, 46 and 53 kyrs BP. The mean grain size data prior to ~20 kyrs BP does not necessarily track the clastic fraction, and exhibits more abrupt peaks, particularly prior to ~42 kyrs BP. The dataset as a whole correlate well with previous data from the Indian Ocean that suggests enhanced monsoonal circulation during the Late Glacial Maximum and correspondingly enhanced dust loads. Further work on bulk chemistry of the core and comparisons to other datasets, particularly those from higher latitudes, continue in order to relate these trends to regional and global patterns of atmospheric circulation.

Dr. Soreghan is returning to Lake Tanganyika this summer as an instructor for the Nyanza Project, which is an NSF-funded research experience for undergraduates. **Katie Gunderson**, an OU geology undergraduate, is one of 15 undergraduates chosen to participate in this project and will spend six weeks at the Tanzania Fisheries Research Institute in Kigoma, Tanzania, learning biologic, limnologic, geologic and paleoclimatic concepts and research techniques related to tropical lakes. After intensive short-course type instruction, the students then match with a faculty mentor and conduct a research project in which the student is responsible for all aspects of research, from project design to data collection and analysis to writing an extended abstract. Dr. Soreghan will be the paleoclimate mentor and looks forward to continuing his work on the lake. In the next issue of the Earth Scientist we will report on this extremely unique and exciting opportunity! ■

Shoreline along Lake Tanganyika illustrating the asymmetric morphology. In the foreground is a small fishing village along the shoreline of a low-gradient platform that slopes toward the rugged border-fault mountains in the background.

Lake Tanganyika shoreline. Typical scene in which the boys are playing in the foreground, whereas the girls in the background are working along with their mother. The young boys are often eager to pose for the camera.

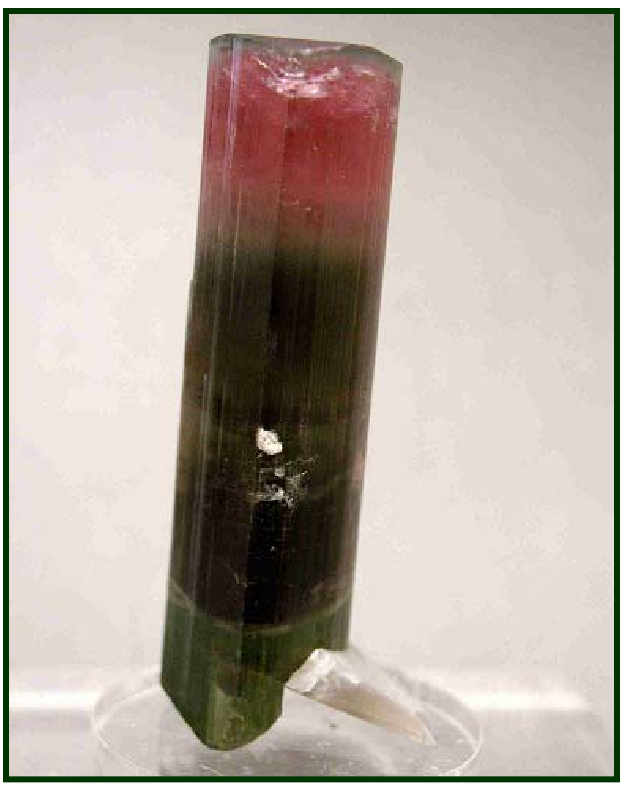
David London, Professor
Economic Mineralogy, Experimental Geochemistry, Igneous & Metamorphic Petrology

"Origins of Gem Minerals in Pegmatites"

(Modified abstract from keynote lecture to be presented at the GIA Gemological Research Conference, San Diego, California, August 26, 2006)

Gem-quality minerals are rare for three reasons: (1) the minerals themselves are uncommon, (2) the potential gem crystals are too small to be usable in jewelry applications, or (3) the crystals lack the necessary clarity regardless of size. One environment in which a variety of minerals achieve large, clear crystal perfection is found in normally clay-filled cavities within granitic pegmatites. These cavities, termed miaroles (from *miglio*, Ital., millet grain), represent the last portions of granitic pegmatites to solidify. Pegmatitic gems include colored varieties of beryl, tourmaline, spodumene, topaz, spessartine, and a few others. In addition to the common constituents of Si, Al, and O, each of these minerals contains an essential structural component (ESC) that is comparatively rare: Li in spodumene, Be in beryl, B in tourmaline, F in topaz, and Mn in spessartine. The formation of these potential gem minerals, therefore, is controlled by the geologic abundance of the rare ESC that each contains.

Two important observations emerge from the data of **Table 1.** First, the formation of minerals with rare ESCs requires an extraordinary degree of chemical refinement via crystal fractionation. In general, these rare minerals become saturated in pegmatite melts only after > 95% of the original granitic melt has solidified. Though this evolutionary relationship from granite to pegmatite has long been assumed, it has not previously been demonstrated, and contradictory models have persisted in the scientific arena. Secondly, the pegmatites do not always appear to contain sufficient ESCs to form these gem minerals at magmatic temperatures. There are several possible explanations for this conundrum, including the likely case that the ESCs of some



Polychrome elbaite (tourmaline group), Himalaya Mine, Mesa Grande, California. This doubly terminated crystal is 10 cm in length, with a smoky quartz crystal projecting from the base. (David London specimen and photo)

Aquamarine (variety of beryl), Gilgit, Pakistan. This doubly terminated 12-cm crystal contains crossing planes of fluid inclusions that give the crystal a layered, "parfait" appearance. (David London specimen and photo)

Table 1. Elemental abundance in ppm

	Li	Be	B	F	Mn
crust[1]	20	3	20	625	950
obsidian[2]	57	4	30	900	700
saturation[3]	7000	150	6000	30000	10000
pegmatite[4]	3000	550	1900	6400	1200

[1] from Mason (1982)

[2] from MacDonald et al. (1991)

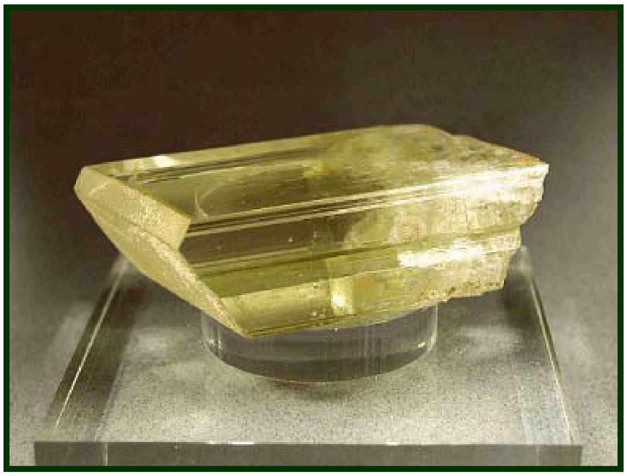
[3] Li from Stewart (1978), Be from Evensen et al. (1999); B from Wolf and London (1997); F from London et al. (2001a); Mn from London et al. (2001b)

[4] Li from Stewart (1978), Be from London and Evensen (2002); B from London et al. (1996); F and Mn from Černý (2005)

gem minerals only become sufficient to produce gem minerals after extended fractional crystallization of the pegmatite magmas themselves. In addition, though, lower concentrations of rare ESCs are needed to crystallize the gem-forming minerals as temperature falls. Recent modeling suggests that pegmatite dikes – miarolitic gem pegmatites in particular – solidify ~ 200°C below the temperatures expected of granitic magmas. At these lower temperatures, near ~ 400°-450°C, the "saturation" and "pegmatite" concentrations of the ESCs converge to similar values.

Microcline (feldspar group), Aracuai district, Minas Gerais, Brazil. The large crystal is 20 cm tall, and some portions of the crystal are blue (amazonite) in color. (David London specimen and photo)

For spodumene, beryl, tourmaline, topaz, and spessartine, **Table 1** lists the average abundance of Li, Be, B, F, and Mn in the earth's crust and in rhyolite obsidians that represent the unfractionated igneous precursors of granitic pegmatites. In **Table 1**, the line of "saturation" denotes the approximate concentration of each element needed to precipitate its characteristic mineral in granitic melts at pressures of ~ 100-300 MPa and at magmatic temperatures of ~ 600°-650°C, if these are relevant to the consolidation of granitic pegmatites. "Pegmatite" cites a representative concentration of each ESC in pegmatites that notably contain spodumene, beryl, tourmaline, topaz, or spessartine.



Triphane (yellow variety of spodumene), Langman, Afghanistan. Except at the base, this 8-cm crystal is internally flawless. (David London specimen and photo)

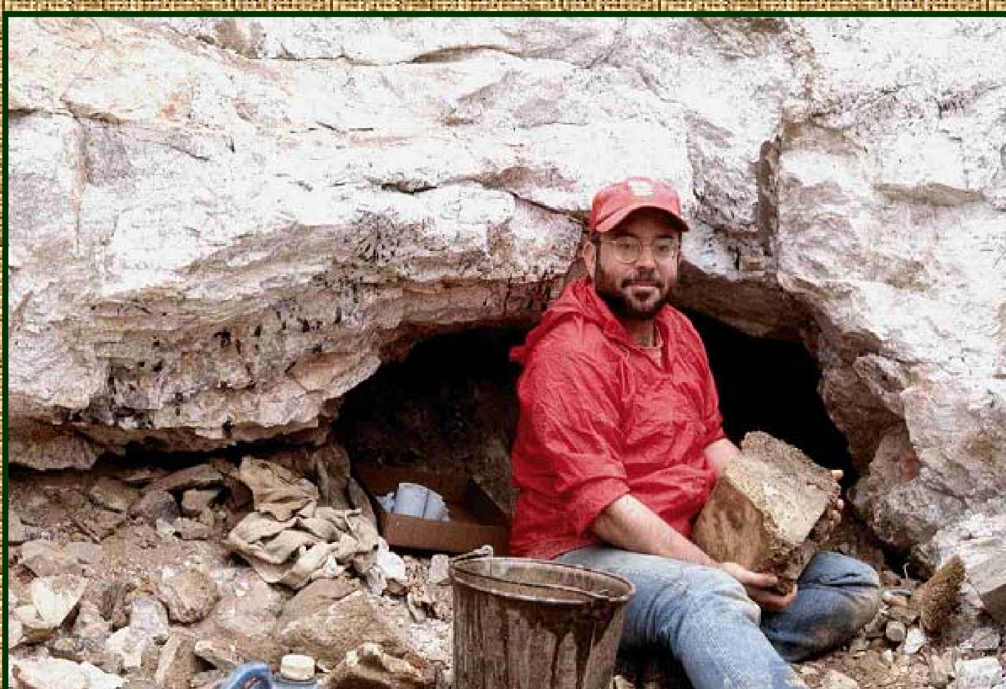
The granitic melts from which gem-bearing pegmatites evolve originate by partial melting of sedimentary and igneous rocks in mountain belts at the margins of continents, and beneath rift zones within the continental interiors. The common rock-forming minerals that participate in melting reactions include quartz, the feldspars, micas, amphiboles, clinopyroxene, cordierite, garnet, spinel, and perhaps olivine. If a rare ESC is compatible in one of these minerals (e.g., as is Be in cordierite), then that host mineral may sequester the ESC if the mineral does not participate in the melting reaction, or else it may be a source of the rare ESC if that host mineral is a major contributor to the formation of the granitic melt. For the rare elements Li, Be, F, and Mn, the micas – biotite and muscovite – are the most important minerals in determining the rare-element enrichment in the granitic melt at source. Micas and tourmaline also contribute most of the B.

Topaz, Little Three pegmatite, Ramona, California. This naturally blue topaz (7 cm) came from the 1976 New Spaulding pocket. (David London specimen and photo)

Almost any transparent mineral may be useable as a gem if it meets the latter two conditions above, but the rarity of large, clear crystals indicates that these environments do not usually occur in nature. Industrial mineralogists have learned to create large, clear single crystals of normally insoluble oxides and silicates by growth in high-temperature fluxed melts. The fluxes that

A cache of crystals from the opening of the 1991 London pocket at the Little Three pegmatite. This pocket, which was named for its discoverer, David London, measured 4m x 3m x 1m and contained hundreds of perfect crystals of smoky quartz, feldspars, mostly green elbaite (also raspberry and yellow), blue topaz, and lavender lepidolite (Li-mica) clusters. The large topaz crystal near the camera lens was reattached to its natural base and is now in the collection of the L.A. County Natural History Museum. (David London photo) are used, which include H_2O, excess alkali, boron (B), phosphorus (P), or sometimes fluorine (F), promote the growth of large, clear crystals in two ways: (1) the fluxes decrease the viscosities of melts and, as a result, enhance mass transport via diffusion of nutrients from the melt to the growing crystal surface, but more importantly, (2) the fluxes interfere with the normal nucleation of crystals from melt, such that when relatively few crystals nucleate, they grow to large size. When a flux-rich melt is in contact with silicate crystals, it can dissolve other silicate solids or liquids along the crystal surface, leaving the crystal inclusion-free, and hence clear.

Nature uses precisely the same process, to the same end, in the creation of gem crystals in miarolitic pegmatites. The pegmatite-forming process creates the necessary fluxes by concentrating alkalis, H_2O, B, P, and F in the melt along the boundary surfaces of growing crystals. As long as the crystal growth rate remains high, these fluxed boundary layers of melt can concentrate rare elements and dissolve solid phases in their path. The transition from rather ordinary pegmatite mineralogy to that enriched in rare elements and gem-quality crystals denotes a change in the medium of crystallization, from bulk pegmatite melt (which contains some flux but is typical of granitic compositions) that dissolves *through* the fluxed boundary medium, to the crystallization of the fluxed boundary liquid itself. The fluxed medium may exist to low temperatures, and once the fluxes are removed by crystallization or loss to surrounding rocks, then the remainder of the silicate material solidifies to fine-grained aluminosilicates. Together with the flux-rich crystalline gem mineral phases like tourmaline (B), topaz (F), montebrasite (P) and other rare minerals, the primary pocket clays probably constitute the last remains of the original gel-like fluxed boundary medium. The excess, soluble components of the fluxes are lost to the surrounding host rocks, where localized reactions between the pocket fluids and the hosts may be useful for indirect discovery of gem cavities within.



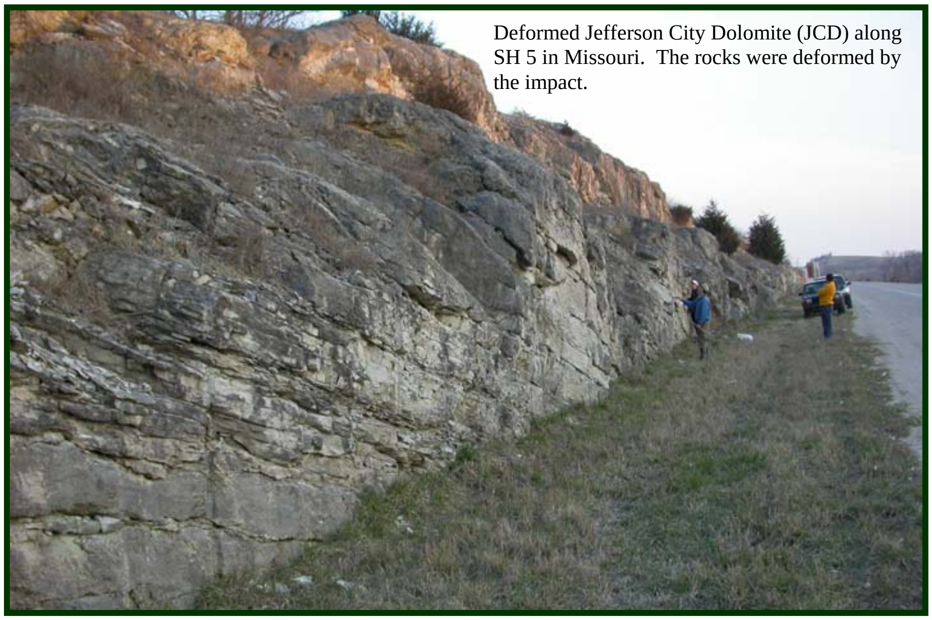
David London holding a 35-kg microcline crystal coated with albite, lepidolite, and topaz from the initial opening of the 1991 London pocket, Little Three pegmatite. (David London specimen and photo)


Shannon A. Myers and R. Douglas Elmore
University of Oklahoma, School of Geology and Geophysics

"Paleomagnetic Constraints on the Age of the Decaturville Impact Structure, SW Missouri"

INTRODUCTION

The Decaturville impact structure is a circular area 5.5km across and located ~15 miles south of Camdenton, Missouri. The presence of shock features delineates the structure as an impact. The date of the impact has been suggested as Pennsylvanian to Cretaceous [1]. There are two types of breccias associated with the impact within the Ordovician Jefferson City Dolomite (JCD) : a mixed breccia that is composed of clasts of different units and a monolithologic breccia that is intraformational. Paleomagnetic tests, such as a modified conglomerate test, can be performed on these breccias by sampling different clasts within the breccia and then comparing the magnetic directions of each clast. If the clasts hold different magnetizations, then the breccia was magnetized pre-depositionally—before (or during) impact. If the clasts have the same magnetization direction, they were remagnetized post-depositionally. If the remagnetization was caused by heat or impact-related fluids, then the age of the impact may be determined.



Deformed Jefferson City Dolomite (JCD) along SH 5 in Missouri. The rocks were deformed by the impact.

METHODS

Samples of the breccias and the JCD were collected along State Highway 5, in the southeastern quadrant of the impact. Cores were collected in clasts of different lithologies and matrix within the mixed breccia, clasts of the monolithologic breccia, and the host JCD. Samples were also collected from the JCD outside of the impact structure along Interstate 44, north of Springfield. All samples were subjected to stepwise thermal demagnetization and rock magnetic studies to determine magnetic direction and magnetic carriers, respectively.

RESULTS

At low demagnetization temperatures (<250°C) the mixed breccia clasts and matrix contain a modern viscous magnetization. At higher temperatures (250-500°C) all samples contain a characteristic remanent magnetization (ChRM) with southeasterly declinations (D = 155.6°) and shallow inclinations (I = -9.2°). The ChRM is well grouped (k = 42.9 and $\alpha95$ = 2.4°; n = 16 sites). The host JCD and clasts within the monolithologic breccia did not contain a stable magnetization. The ChRM corresponds to a pole position of 50°E, 127°N, which plots on the mid-Permian portion of the apparent polar wander path (APWP). Since all the magnetization directions within the clasts and matrix are the same, the rocks were magnetized post-impact. Therefore the Decaturville impact can be no older than the mid-Permian.

The JCD outside of the impact contains a ChRM (D=151.7°, I=3.1°, k=1237, $\alpha95$= 1.2°, n = 12 specimens). The preliminary pole lies close to the Pennsylvanian portion of the APWP, at 42.5°N

127.4°E, and is distinct from the mixed breccia pole. This suggests a different ChRM is present in the dolomite outside the impact. More sampling is planned to test this result.

Rock Magnetics. The demagnetization characteristics suggest that the dominant magnetic carrier within the breccias is a low-coercivity phase, probably magnetite. The rock magnetic results are consistent with this interpretation. Petrographic analysis with the scanning electron microscope is planned to further identify the magnetic mineralogies that are present.

Geochemistry. Strontium isotopic analysis was also performed on representative samples. The $^{87}Sr/^{86}Sr$ values were compared to the coeval seawater values for the early Ordovician [2]. Most of the samples have coeval to depleted $^{87}Sr/^{86}Sr$ values, ruling out externally-derived radiogenic fluids as an alteration source.

CONCLUSIONS

The ChRM directions within the mixed breccia clasts and matrix are the same, indicating a post-depositional magnetization. The ChRM is mid-Permian which places a limit on the age of the impact. The impact can be no younger than the mid-Permian, regardless of the origin of the magnetization. The paleomagnetic and stratigraphic constraints, therefore, indicate that the impact occurred during the Pennsylvanian through the mid Permian which is much less than the Pennsylvanian-Cretaceous estimate by Offield and Pohn. The origin of the remagnetization mechanism is currently under investigation with two likely possibilities: heat remagnetization related to the impact or chemical remagnetization due to fluid flow, driven by the impact or a later event. If impact heat or impact related hydrothermal fluids caused remagnetization, the mid-Permian pole dates the impact. The lack of elevated strontium values rules out radiogenic fluids as an agent for the remagnetization. Conodont alteration analysis is underway to test if the breccia was hot at deposition, and if heat can explain the remagnetization. ■

Shannon Dulin drilling and Vanessa O'Brien pumping water.

References: *[1] Offield T.W. and Pohn H.A. (1979) USGS Professional Paper 1042. [2] Gao G. and Land S.D. (1991) "Geochemica et Cosmochimica Acta", 55, pp. 2921-2920.*

SAMPLING STRATEGY

With paleomagnetic drill holes

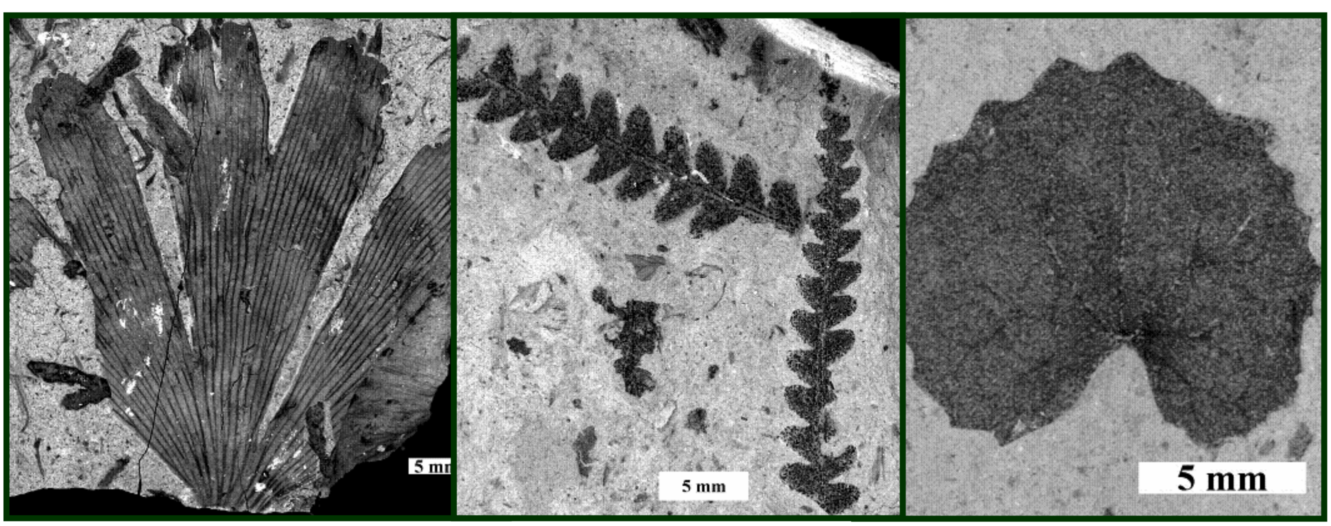
Different clasts within the impact breccias

Brooke Wilborn, PhD in Paleontology
School of Geology and Geophysics, The University of Oklahoma

"Macrofloral Assemblages of the Cloverly Formation, Bighorn Basin, Wyoming"

Macrofloral assemblages recovered near the boundary between the Morrison Formation and the overlying Cloverly Formation are scarce in Wyoming and Montana. However, identifying such floras is critical to accurate determination of the age of the deposits, and might prove helpful for determining the stratigraphic placement of the boundary between them. In addition, documentation of plant paleoecology of this region during the Late Jurassic and Early Cretaceous provides a baseline against which to evaluate changes in terrestrial floras in response to the radiation of flowering plants (angiosperms) at this paleolatitude.

During recent fieldwork I located and collected three macrofloral deposits from the Cloverly Formation in the northern Bighorn Basin, Wyoming. I placed these deposits into the existing stratigraphic frameworks for the formation in this area (Ostrom, 1970; Kvale, 1986). The lowest deposit is in a grey mudstone and siltstone. This deposit has the lowest diversity of plants, with only four species recovered so far. The middle macrofloral deposit is in a clay and siltstone channel-levee system within the next highest unit in the Cloverly Fm. The deposit has a high abundance of plant specimens, with a much larger diversity of plant groups then the underlying deposit. Dominated by taxodiaceous conifers, multiple specimens of Gingko also have been recovered, but no angiosperms have been found to date. The highest deposit is in a large sand channel complex near the top of the Cloverly Fm. The plant fossils are found in a grey claystone adjacent to and surrounded by the sandstone. This deposit contains the highest diversity of plants, with abundant angiosperms as well as ferns. ■






George Morgan, Staff and **David London,** Professor
Kerry Paul, MS Student and **Katie Gunderson,** BS Student
School of Geology and Geophysics, The University of Oklahoma

"The Elusive (□P)(M$^+$Si)$_{-1}$ Substitution in Potassic Alkali Feldspar"

Although it is well known that feldspars comprise more than 50 volume percent of most granitic rocks, it is less well known that feldspars may represent the dominant mineralogical host for phosphorus in the rocks. This is especially true in highly-fractionated, Ca-poor, S-type granites, for which P is usually accommodated in feldspar via the (AlP)Si$_{-2}$ (berlinite) substitution that becomes more effective as magmas become richer in aluminum. Morgan and London (2005) observed that synthetic potassic alkali feldspars (Kfs), produced in strongly undercooled **(Figure 1)** metaluminous granitic liquids, may contain significant amounts of P accommodated by a (□P)(M$^+$Si)$_{-1}$ substitution (□ indicates a vacancy in the alkali cite) **(Figure 2)**. The latter substitution was not previously identified in natural feldspars, and was intuited to result in the experiments from the presence of alkaline, P-enriched boundary layers that formed adjacent to crystals by very rapid feldspar growth **(Figure 3).** This suggests that the (□P)(M$^+$Si)$_{-1}$ substitution is likely to occur only in small, P-enriched granitic bodies that undergo significant liquidus undercooling. If this observation were to be corroborated in nature, the percentage of phosphorus accommodated by (□P)(M$^+$Si)$_{-1}$ might represent a monitor of the degree of undercooling under which feldspars crystallize.

On the basis of the preceding observations, Morgan and London (2005) re-evaluated previous data from feldspars in peraluminous granites and rhyolites (from London, 1992) and identified two occurrences in which P appeared to be accommodated in Kfs by the (□P)(M$^+$Si)$_{-1}$ substitution: the marginal BPF3 facies of the Beauvior granite, Massif Central, France, and pegmatites marginal to Li-mica granites of the Cornwall district, England. Partly as a research project for their course in electron microbeam methods, co-authors Kerry Paul and Katie Gunderson re-investigated those feldspar compositions by electron microprobe. Their microprobe methods, including the minor/trace components Rb and Cs, were more complete and represented a larger statistical sample than the

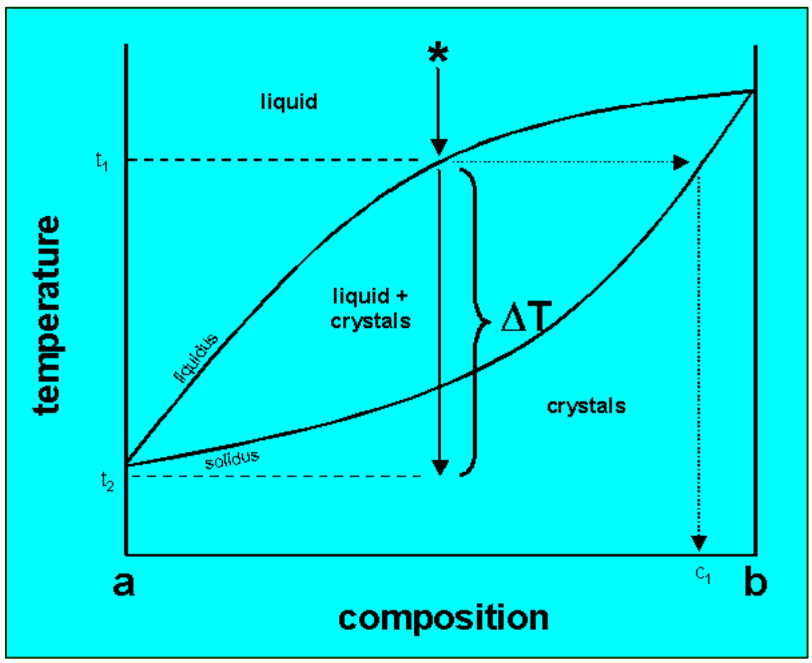


Figure 1: *Undercooling, as seen from schematic phase relations for alkali feldspars (albite = a, orthoclase = b). Begin with starting liquid composition and temperature indicated by the asterisk. As temperature falls under equilibrium conditions of slow cooling, crystals (of composition c_1) will begin to form at the liquidus temperature t_1. In cases where heat loss occurs more rapidly than crystals can form, such as in shallow crustal environments, liquids may cool to well below liquidus or even solidus temperatures, such as at t_2, before crystals begin to form. The temperature difference between where crystals would form under equilibrium conditions and where they actually being to grow, t_1 - t_2, is called the undercooling (ΔT).*

Figure 2a.

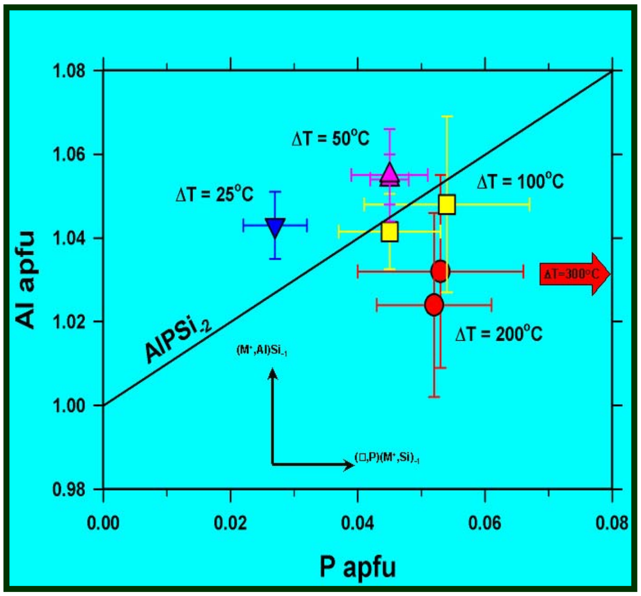


Figure 2b.

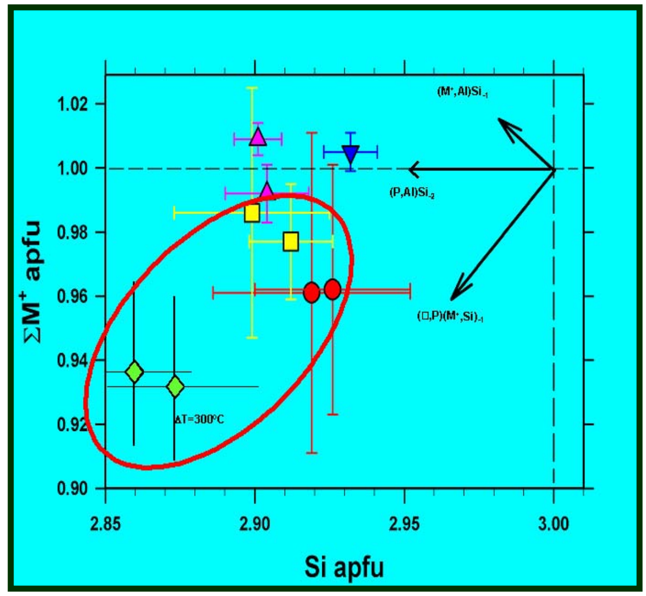


Figure 2: *Cation contents (atoms per formula unit: apfu) of feldspars synthesized by Morgan and London (2005).* ***a.*** *Al versus P. Feldspars in which P is incorporated by the berlinite substitution would fall along the line $AlPSi_{-2}$. Feldspars above this line, formed at low undercooling, have excess Al due to $(M^+Al)Si_{-1}$ substitution (M^+ = Na, K, H_3O). Feldspars below the line, formed at undercooling $\geq 100^oC$, have insufficient Al contents to account for P incorporation by the berlinite substitution.* ***b.*** *Sum of cations in the alkali cite (ΣM^+) versus Si (symbols are the same as in a). Feldspars formed at large undercooling (red circle) have deficiencies in both alkalis and Si, indicating P incorporation by $(\square P)(M^+Si)_{-1}$.*

Figure 3a.

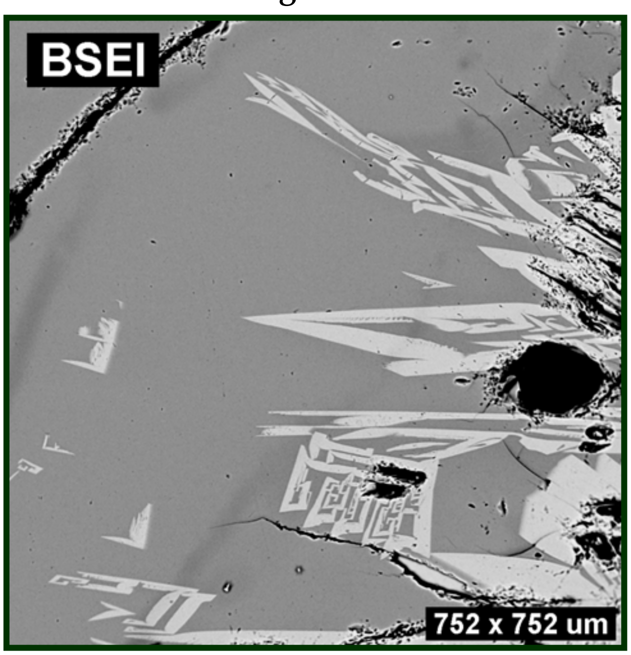


Figure 3b.

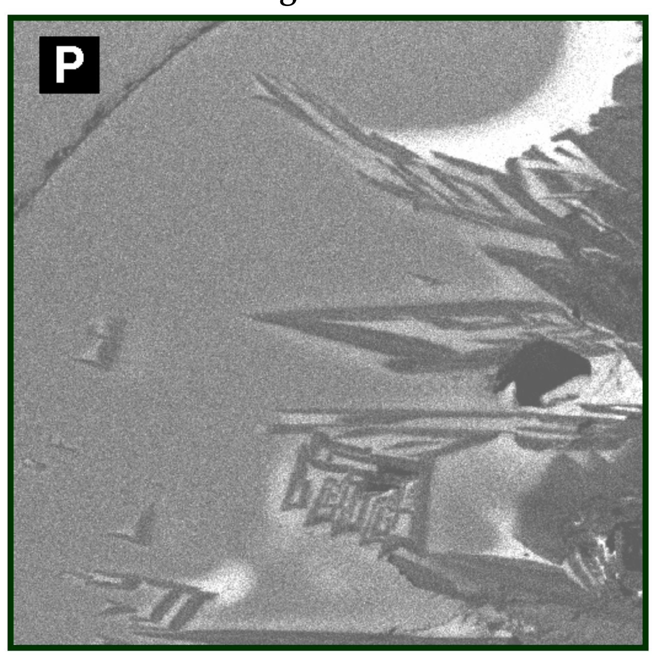
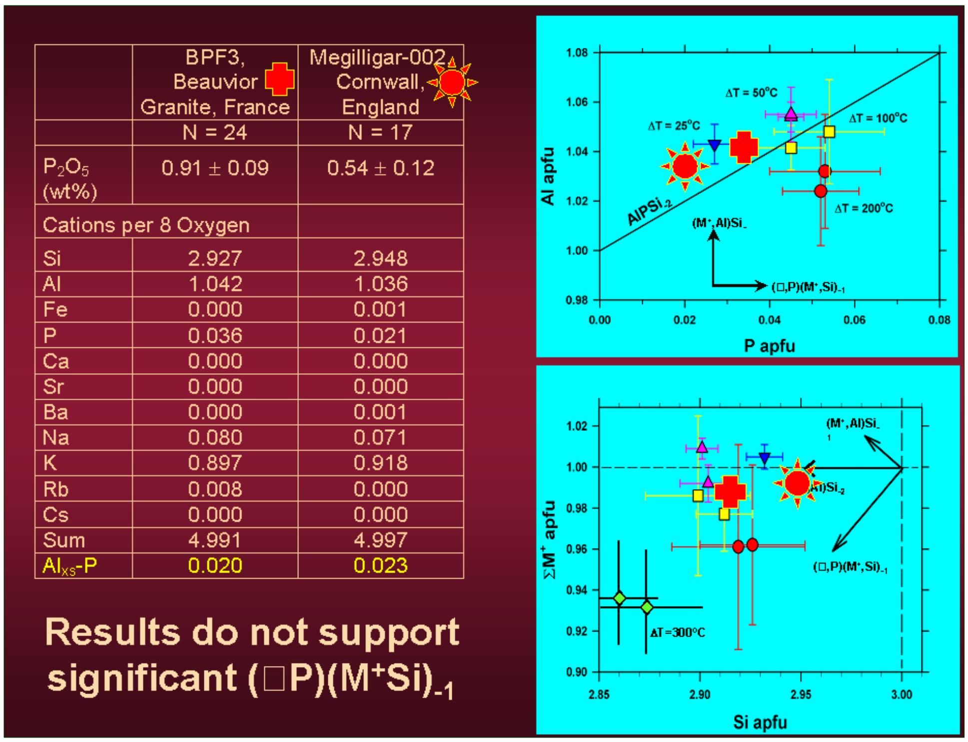


Figure 3: *Feldspar growth at ΔT = 100^oC, from Morgan and London (2005).* ***a.*** *Backscattered electron image showing skeletal habit of feldspar (light gray) produced by rapid crystal growth in liquid (quenched to glass: darker gray).* ***b.*** *Phosphorus $K\alpha$ x-ray intensity map from same region; greater concentration is shown by brighter shades of gray to white. Note the presence of P-rich (up to 11 wt% P_2O_5), alkaline boundary layers in glass adjacent to feldspar crystals.*

previous analyses in which emphasis was placed more on P content than its substitution mechanism. Although the P_2O_5 concentrations obtained for these crystals were in agreement, the new results **(Figure 4)** contradict the previous data in showing that all of the P in these feldspars can be explained by the berlinite substitution. Hence, documentation of $(\square P)(M^+Si)_{-1}$ in natural feldspars remains elusive.

In both the French and English deposits hosting the analyzed feldspars, crystals should have grown at considerable liquidus undercoolings. Apparent absence of the $(\square P)(M^+Si)_{-1}$ substitution in these feldspars could stem from the very (per-) aluminous compositions of the magmas, in which the berlinite substitution is known to be effective. This may suggest that the $(\square P)(M^+Si)_{-1}$ substitution is dominant only in metaluminous to alkaline magmas. Conversely, however, we note that the experimental feldspars of Morgan and London (2005) contain significant structural non-idealities due to both the $(\square P)(M^+Si)_{-1}$ and $(M^+Al)Si_{-1}$ substitutions. These non-idealities are likely to make the feldspars energetically prone to recrystallization as the solidified bodies cool well below their solidi. Such recrystallization may involve little or no change in feldspar morphology, but will cause minor changes in composition that wipe out evidence of the $(\square P)(M^+Si)$-1 substitution.



	BPF3, Beauvior Granite, France	Megilligar-002, Cornwall, England
	N = 24	N = 17
P_2O_5 (wt%)	0.91 ± 0.09	0.54 ± 0.12
Cations per 8 Oxygen		
Si	2.927	2.948
Al	1.042	1.036
Fe	0.000	0.001
P	0.036	0.021
Ca	0.000	0.000
Sr	0.000	0.000
Ba	0.000	0.001
Na	0.080	0.071
K	0.897	0.918
Rb	0.008	0.000
Cs	0.000	0.000
Sum	4.991	4.997
Al_{xs}-P	0.020	0.023

Figure 4: *Analytical results (cations per formula unit) for French and English feldspar samples, and comparison to feldspars synthesized by Morgan and London (2005).*

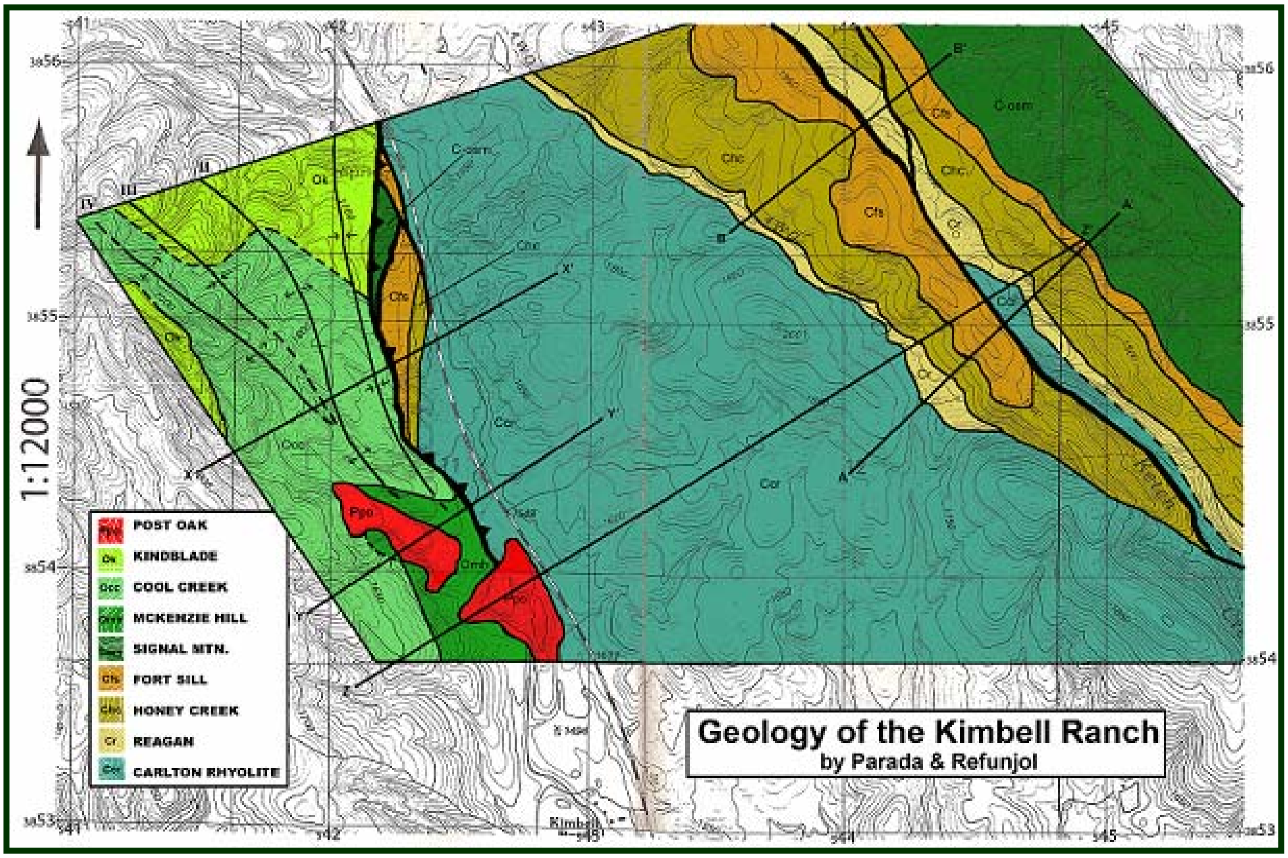
References

London, D (1992) Phosphorus in S-type magmas: The P_2O_5 contents of feldspars from peraluminous granites, pegmatites and rhyolites. American Mineralogist, **77**, 126-145.

Morgan, GB VI and London, D (2005) Phosphorus distribution between potassic alkali feldspar and metaluminous haplogranite liquid at 200 MPa: the effect of undercooling on crystal-liquid systematics. Contributions to Mineralogy and Petrology, **150**, 456-471.


XAVIER REFUNJOL, BS in Geophysics
DIANA PARADA, BS in Geology
School of Geology and Geophysics, The University of Oklahoma

"Kimbell Ranch Report Abstract"



This report describes the geology and the geological history of the Kimbell Ranch, and includes a geologic map of the area, with detailed descriptions of the geologic formations and their stratigraphy. The Kimbell Ranch is a small part of the Slick Hills in the southwestern section of Oklahoma. The area of study lies just north of the Wichita Mountain Uplift and covers roughly six square kilometers east and west of highway 58. The mapping process was divided into two sections, the mapping of the east side and the mapping of the west side. Each area exhibits different geologic characteristics.

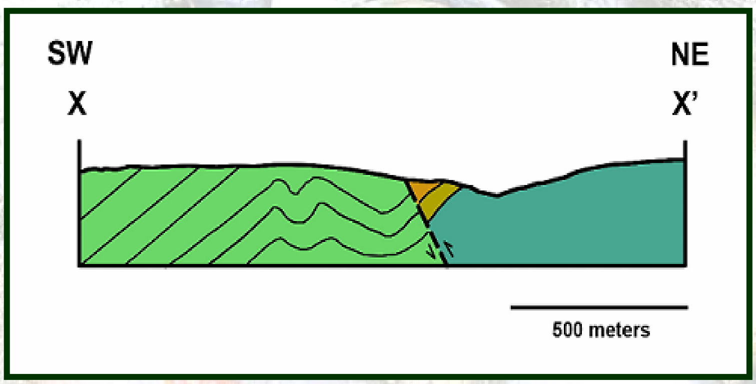
The oldest unit found in the area is the Carlton Rhyolite, which presents a laterally continuous nonconformity contact with the Reagan Sandstone Formation. The overlying Reagan Sandstone has high quartz content. The composition of the 36-meter-thick sandstone suggests the presence of a shallow marine environment. The contact of the sandstone with the overlying formation, the 44-meter-thick Honey Creek Formation, marks the first appearance of calcite. This presence of calcite hints of a possible transgression in the area. Following the Honey Creek Formation is the 68-meter-thick Fort Sill Formation, which presents the first appearance of limestone. The formation's composition shows the continuous change from a shallow environment toward a deeper environment. In fact, as we travel through the formations the grain size decreases and sand grains disappear toward the younger ones. The oldest formation found on the east side of the Kimbell Ranch is the Signal Mountain Formation. This can be observed in the Geologic Map of the Kimbell Ranch.

The west side is similar to the sedimentary formations found on the east side in a small area bounded by faults. In contrast to the east side, the west side of the Kimbell Ranch has large exposures of the older formations, which are composed primarily of limestone. These formations are the McKenzie Hill Formation the Cool Creek Formation, and the Kindblade Formation. Characterized by its compressional deformation, this area portrays a series of synforms and antiforms with a northwest – southeast orientation. **Cross section X** shows the bifurcation of a syncline in the Cool Creek formation into two other synclines separated by an anticline.

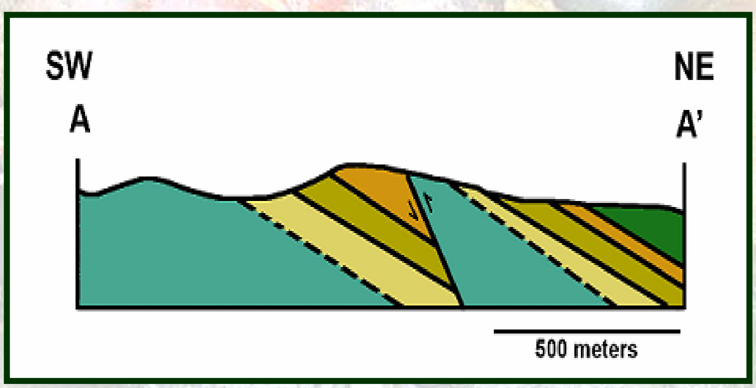
It can be inferred that the compressional forces that acted upon the area caused a reverse fault system characterized by two major faults, the Blue Creek Canyon Fault on the west side and Ketch Creek Fault on the east side. The faults in the area present older formations on their east side and younger formations on their west side. This can be observed in a larger scale as the east side of the Slick Hills is composed mostly of older shallow marine deposits and the west side is composed of younger deeper marine deposits. **Cross sections A and X** show the Ketch Creek Fault and the Blue Canyon Fault, correspondingly. The trend of the faults, along with the orientation of the synforms and antiforms, suggest that the compressional forces that acted on the area had a northeast – southwest orientation.

In a larger scope, the sequence of geologic events could have occurred due to the presence of a large mass of rhyolite that had a hill shape. After the first transgression, sediments started to accumulate on both sides of the rhyolite, but the processes of sedimentation were affected by the currents that came from one side only. The current would have been moving from the northeast to the southwest. This explains the lack of the Reagan Sandston Formation on the west side, because the heavier particles would not have been able to pass the rhyolite barrier. A later tectonic event uplifted, tilted, fractured and folded the entire sequence.

CROSS SECTION X



CROSS SECTION A



Jennifer D. Eoff, PhD in Invertebrate Paleontology
School of Geology and Geophysics, The University of Oklahoma

"New Insights into Hummocky Cross-Stratification"

Late Cambrian (Steptoean-Sunwaptan) siliciclastic units of the Upper Mississippi Valley provide abundant lithostratigraphic and biostratigraphic data that allow examination of shallow marine depositional environments for this interval of the Sauk cratonic seaway. The Tunnel City Group (Lone Rock and Mazomanie formations), exposed in west-central Wisconsin and southeastern Minnesota, represents a storm- and wave-dominated nearshore depositional environment. Perusal of the facies anatomy indicates the presence of an upper shoreface lithofacies association, composed of trough cross-bedded and amalgamated hummocky sequences, and a lower shoreface to proximal offshore lithofacies association, composed of hummocky, micro-hummocky and thinly-bedded fossiliferous successions.

Hummocky cross-stratification (HCS) is an important stratigraphic tool, indicating deposition during the combined unidirectional and oscillatory flow of shallow water during large storm events. It can be used to understand the relative frequency, duration and magnitude of storm (or tsunami) events, which are believed to be the most geologically significant events to affect shorelines and shallow shelves. Two HCS models were proposed in the 1980s (Dott and Bourgeois, 1982, 1983; Walker et al., 1983; Figure 1), but little has been done since to test the models against outcrop data. As with other models, the HCS model is a "composite generalization" that provides guidance toward genetic interpretation for other similar units, much like the Bouma model permits conceptual understanding of turbidity deposits (Dott and Bourgeois, 1982; Walker et al., 1983). Dott and Bourgeois (1982, 1983) suggested that the high degree of variability encompassed within their HCS model is its most useful aspect, and the spectrum of HCS deposits that form possesses paleobathymetric utility (Ito et al., 2001; Figure 2). HCS occurs and is preserved best between fair weather and storm wavebases while migration of dune bedforms and/or erosion occur in shallower waters. Hemipelagic deposition near storm wavebase is punctuated intermittently by only the largest storms.

Poor preservation of HCS, due either to bioturbation and/or subsequent removal by later depositional events, has decreased the perceived significance of high-magnitude processes in the past (Dott, 1983). However, the Lone Rock Formation is an exception, recording frequent storms and indicating little about "normal," fairweather processes. Close scrutiny of previously developed HCS models with new data from the Lone Rock Formation allows for the development of a local HCS model that has significant implications for understanding flow regimes during deposition of storm beds.

In the Lone Rock Formation, high-angle, highly glauconitic laminae overlie scoured surfaces at the base of HCS units (Figures 1, 3). These bedforms have not been noted previously. They indicate that flow during storm deposition is initially a unidirectional-dominant flow. Such high concentrations of glauconite (sometimes in excess

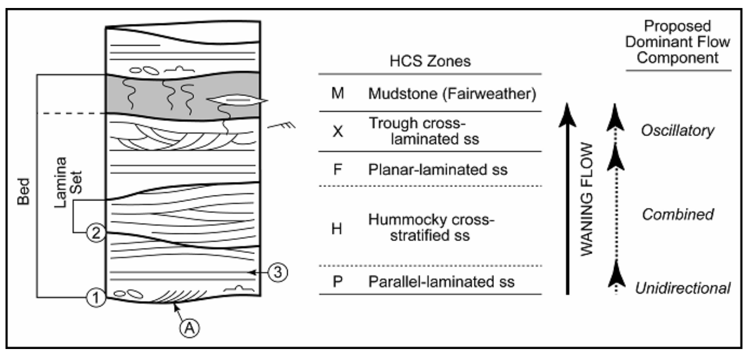


FIGURE 1: HCS model adapted from Dott and Bourgeois (1982, 1983) and Walker et al. (1983). The basic model includes five zones and three types of surfaces to explain a single depositional event: A first-order erosional surface (1), with scattered clasts and/or a fossil lag, represents initial storm scouring. This is overlain by a parallel-laminated zone (P). The hummocky interval (H) is characterized by hummocky/wavy laminae with second-order, internal truncation surfaces (2) that represent fluctuating energy during deposition. Another planar-laminated zone (F) may follow. This works upward into a trough cross-stratified interval (X) with a symmetrically rippled upper surface. Finally, a bioturbated mudstone/siltstone (M) caps the unit. Third-order surfaces (3) are individual laminae. A. An additional zone is added here to create a *local* model. Highly-glauconitic (60% +), high-angle laminae occur immediately above the first-order boundary. Examination of the spectrum of hummocky-laminated beds within the Lone Rock Formation has important implications for understanding flow regimes during deposition of HCS.

of 60%) suggest it was concentrated as a heavy mineral during early, highly energetic stages of flow, but the source remains enigmatic. Planar or wavy to hummocky laminae follow, representing deposition during fully combined flow. Arnott and Southard (1990) showed that under combined flow with large oscillatory velocities only a weak unidirectional component is necessary to produce plane beds, which are most common in amalgamated sequences from inferred shallower depths than those of well-developed HCS units. In waning storm stages, a cross-bedded zone results from reworking by oscillatory-dominant flow as the storm currents subside. The model predicts the development of fairweather deposits, but they are often absent or bioturbated thoroughly in the Lone Rock Formation.

This new model brings to light a number of questions. The first, an "age old" question to younger generations of geologists that is addressed in most stratigraphy/paleontology courses: What is the significance of episodic events in the geological record? When Dott (1983) stated "that recognition of the importance—if not predominance—of episodic sedimentation matters a great deal," he was referring to the sandstones in his backyard, those of the Upper Mississippi Valley. The only evidence for fairweather conditions within Lone Rock Formation is bioturbation and thin silty partings. Secondly, can the HCS model be applied to both cratonic settings, like that for the Tunnel City Group, and traditional shelf environments with equal merit? Does it lose any predictive ability when applied to examples from each? And lastly, recent work on HCS has focused on experimental flow-duct studies. One could not possibly model depositional events of this scale and magnitude in a laboratory. Perhaps we need to get out of the lab and back into the field to examine real stratified sequences and not limit ourselves to sequences generated by inherently confined studies.

~~ Jennifer D. Eoff

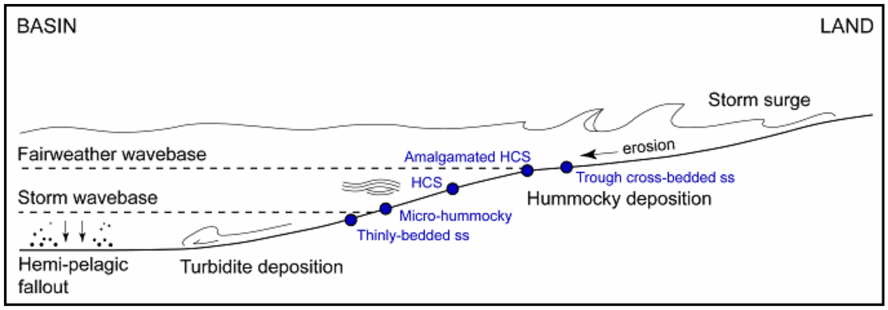


FIGURE 2: Depositional profile depicting inferred location for five facies in the Tunnel City Group. Trough cross-bedded sandstones (Mazomanie Formation) indicate deposition above fairweather wavebase. Amalgamated HCS units represent the shallowest depositional environment with preserved storm deposits; because muddy materials are scarce, deposition probably occurred near fairweather wavebase. HCS forms and is preserved best between fairweather and storm wavebases. Muddy sediments dominate micro-hummocky units, indicating deposition near storm wavebase where storms penetrate less frequently and with less intensity. Thinly-bedded sandstones indicate deposition near or below storm wavebase and may be associated with graded tempestites or "turbidite-HCS" beds (see Walker et al., 1983). Vertically exaggerated. Modified from Dott and Bourgeois (1982) and Ito et al. (2001).

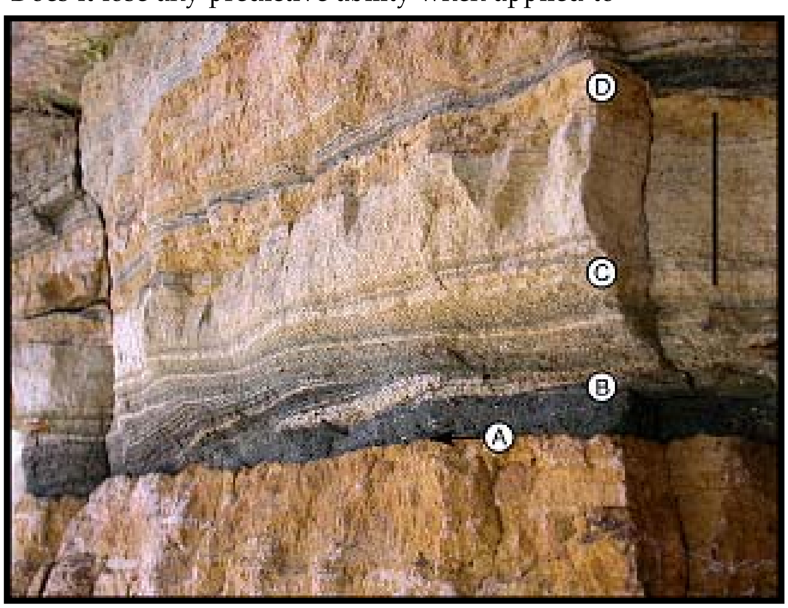


FIGURE 3: Classic, well-developed hummocky cross-stratified unit. A. Arrow points to relatively planar, first-order erosional surface (1) at base of unit. B. Extremely glauconitic, high-angle laminae indicate migration of lower flow regime bedforms during unidirectional-dominant flow. These are present consistently within the Lone Rock Formation and are added to the HCS model to produce a local model. C. Wavy to hummocky (H) laminae of combined-flow origin. D. Bioturbated upper surface that represents fairweather conditions. Scale bar is 10 cm. Tomah, WI (T16).



Vanessa O'Brien, R. Douglas Elmore, Michael Engel

"Timing and Origin of Orogenic Remagnetizations in Mississippian Carbonates, Sawtooth Range, Montana.

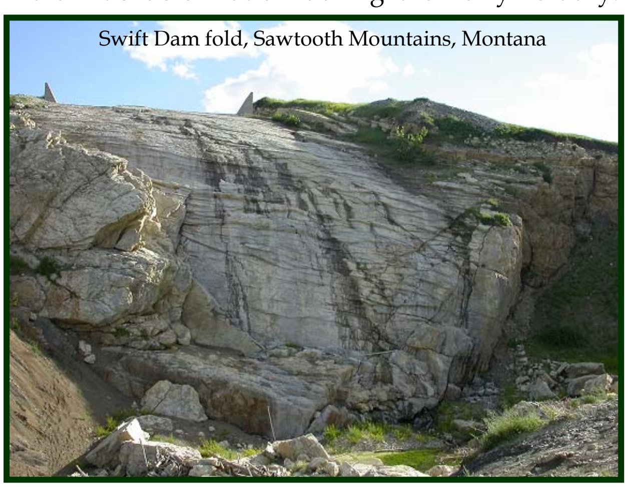
Eos Trans. AGU, 86(52), Fall Meet. Suppl., Abstract GP33A-0100.

TIMING AND ORIGIN OF CHEMICAL REMAGNETIZATION(S) IN THE MISSISSIPPIAN MADISON GROUP, SAWTOOTH RANGE, MONTANA

Paleomagnetic and geochemical results are presented from Mississippian Madison Group carbonates in the Sawtooth Range, northwestern Montana. Sites were collected from two east-west trending transects perpendicular to the thrust faults in the Sun River Canyon and in the South Fork of the Teton River and from several anticlines associated with thrust activity. Paleomagnetic and rock magnetic data indicate that the Madison Group contains a widespread characteristic remanent magnetization (ChRM) that resides in magnetite with southerly declinations and moderately steep inclinations. The ChRM cannot be explained by a thermoviscous remagnetization mechanism because burial temperatures (~150^{o}C) are too low to explain the maximum unblocking temperatures of 520^{o}C. The ChRM is interpreted as a chemical remanent magnetization (CRM). Tilt test results suggest that the CRM is syn- to pre-tilting in the thrust faults, pre-folding in the Teton Anticline, and syn-folding in a small fold to the west of the Teton anticline in the North fork of the Teton River. The tilt test results, which are similar to results reported by other workers from equivalent units in the southern Canadian Cordillera, suggest that the CRM is coeval with Laramide deformation during the Early Tertiary.

Vanessa O'Brien collecting a strike and dip at Swift Dam.

To the right: Vug with hydrocarbons from the Madison Group, Swift Dam, Sawtooth Mts. MT



Swift Dam fold, Sawtooth Mountains, Montana

To date, a remagnetization trend perpendicular to the thrust faults as reported from the southern Canadian Cordillera has not been found in the study area. Geochemical studies ($^{87}Sr/^{86}Sr$) indicate that the Mississippian carbonates that contain the CRMs were altered by radiogenic fluids, and petrographic analysis indicates that hydrocarbons migrated through the carbonates. The CRM is interpreted to be related to alteration by either or both of these fluids. Additional paleomagnetic and geochemical studies will investigate the origin of the CRM and resolve other issues such as the differences in tilt test results and the possibility of a remagnetization trend across the thrust faults. ■

Ze'ev Reches
Professor, Structural Geology, Earthquakes, Rock Mechanics

"Building an Earthquake Laboratory at Focal Depth"

INTRODUCTION

The study of faulting and earthquake processes requires direct and near-field observations at the focal depth. We think that deep mines provide an opportunity to make such observations and initiated the DAFSAM-NELSAM project that focuses on building an earthquake laboratory in deep gold mines in South Africa. The DAFSAM (Drilling Active Faults Laboratory in South African Mines) is funded by ICDP, and NELSAM (Natural Earthquake Laboratory in South African Mines) is funded by NSF. This is an international, multi-institution project with participants from the USA (University of Oklahoma, USC, Stanford, Princeton, USGS), Germany (GFZ), South Africa (UFS, ISSI, AngloGoldAshanti), and Japan (Ritsumeikan University); details in http://earthquakes.ou.edu/. The University of Oklahoma participants include faculty members Ze'ev Reches and Tom Dewers and graduate students Vincent Heesakkers, Matthew Zechmeister and Kate Moore.

The gold mines of South Africa extend to depths of a few kilometers into the massive Precambrian sequence of the Witwatersrand basin. The gold is produced by mining sub-horizontal reefs from depth of 1.5 km to 3.5 km. The closure of the space of the removed reef releases gravitational energy that induces intense seismic activity during the mine's lifetime. Mine seismicity has been investigated extensively during the last few decades, and two types of mining-induced events have been recognized: events that are related directly to mining operations and events related to movement along major faults and dykes. The earthquake laboratory focuses on the second type.

The deep gold mines offer unique conditions for earthquake investigation. First, hundreds to thousands of small to moderate events are recorded per day in a typical deep mine; the strongest may be in the m ~ 5 range. As these earthquakes are controlled by the mining activity, their location, timing and magnitude can be forecasted. Thus, the instruments can be installed at sites where earthquakes of interest are guaranteed to occur. Second, the mine infrastructure provides accessibility to the earthquake source region, it allows mapping the fault-zone in 3D, and it allows to install three-dimensional array of instruments at distances of 1-100m from anticipated hypocenters. These instruments can monitor fault activity before, during, and after an earthquake. Third, the expected earthquakes are in the moment-magnitude range of –2 to as large as 4 that bridges the scale gap between laboratory experiments and tectonic earthquakes in the crust. Fourth, the mine infrastructure provides an opportunity to investigate the subsurface microbiological communities, and particularly the potential effects of catastrophic fracturing during earthquakes on fault fluid, gas chemistry, and microbiological communities. These promising conditions have led to the launching of the building of an earthquake laboratory in TauTona gold mine in January 2005.

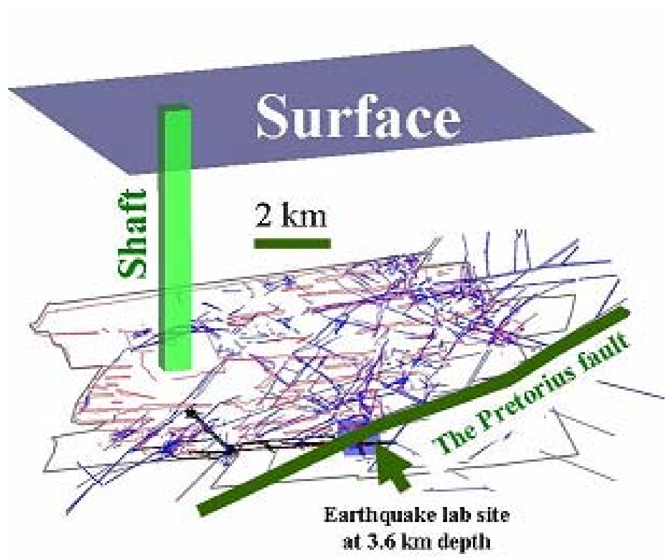


Figure 1. *A three dimensional view on the TauTona mine. The mined areas are delineated by pink lines; faults are marked by blue lines; the green line is the Pretorius fault.*

THE EARTHQUAKE LABORATORY

The laboratory site at TauTona mine

TauTona ("great lion" in Sotho) mine, the deepest mine on earth, is located about 80 km west of Johannesburg within the Western Deep Levels of the Witwatersrand basin. The gold deposit is mined here at 2-3.5 km depth from the Carbon Leader reef that dips about 21° to the south, toward the center of the basin **(Fig. 1)**. The production in TauTona mine started in 1962 and the planned expansion for the next decade requires deepening to almost 4 km, an investment that will yield more than 40 tons of gold. The deepening is facilitated by constructing two declined shafts that cut across the Pretorius fault **(Fig. 1)**. Because both sides of this fault have been (and will be) mined as part of the planned expansion **(Fig. 2)**, earthquakes of significant magnitude ($m > 2$) have already occurred in this part of the mine, and more events are likely to occur during the next few years.

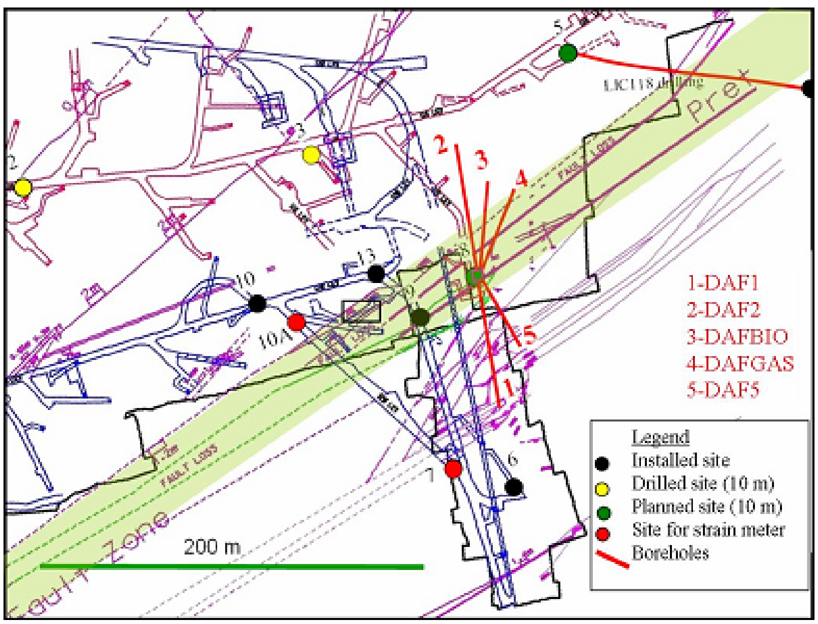


Figure 2. The earthquake laboratory at the 118-120 levels of TauTona mine. Tunnels at 118 level (depth 3.54 km) are marked by red lines; tunnels at 120 level (depth of 3.6 km) are marked by blue lines; wide zone in light green is the Pretorius fault-zone; black thick line marks the margins of the mining on both sides of the Pretorius fault. Note that while only small parts south of the fault were mined, this part will be mined in the next decade; sites marked 2-10 indicate sites of installed or planned to be installed system of two 3D accelerometers, EM sensors and thermistors; site 8 is the lab cubby with five inclined boreholes (Fig. 3).

We chose the section of the Pretorius fault that intersects the two declined shafts as the most promising site for the earthquake laboratory **(Figs. 1, 2)**. The TauTona mine collaborates, logistically and financially, in building the earthquake laboratory.

Building the laboratory

Our operations since January 2005 have focused in the laboratory site at levels 118-120 of TauTona mine **(Figs. 1, 2),** with the following key items:

<u>Drilling through the Pretorius fault-zone.</u> We established a cubby within the Pretorius fault-zone at level 118 (site 8 in Fig. 2) at depth of 3.54 km. Five boreholes were drilled from this cubby. They are inclined from 17° downward to 25° upward, and from 20 m length to 60 m length (Fig. 3). Boreholes DAF1 and DAF2 on both sides of the cubby form a collinear 95 m long borehole for the installation of a creep meter. This creep meter will be anchored across the entire fault-zone to detect its slip in a wide dynamic range. Borehole DAFBIO will be used for in-situ experimentation of the microbiological activity, and the DAFGAS will be used for continuous monitoring of fault-zone gases.

<u>Site Characterization</u>. We have characterized the earthquake laboratory site by three-dimensional structural mapping of the ancient Pretorius fault-zones as well as fault segments that were reactivated during recent earthquakes. Mechanical and chemical laboratory testing will be conducted on samples of rock, gouge and fluid from the Pretorius fault, as well as the microbial properties of the cores from the fault zones and adjacent country rock.

<u>An instrument array **(Fig. 2)**.</u> Once completed, the earthquake laboratory will include a dense array (250 m footprint) of accelerometers (3D broadband, up to 15 g), seismometers, strain-meters, temperature sensors, creep-meters, electromagnetic radiation system, and acoustic emissions. Fault-zone gas will be monitored with an on-site mass-spectrometer.

PRELIMINARY OBSERVATIONS

The Pretorius fault

The Pretorius fault is the largest fault in the Western Deep Levels area. It cuts across the slightly metamorphosed sedimentary rocks of the Witwatersrand basin, mainly quartzite, conglomerates, and mudrocks, as well as basaltic bodies. The region was tectonically inactive for the last 2.5 Ga. The Pretorius fault is at least 10 km long, ENE trending, with vertical throw of 30-60 m and estimated right-lateral displacement up to 200 m. It has a 25-30 m wide fault-zone with tens of anatomizing segments, dominantly dipping north and south **(Fig. 3).** The majority of these segments are steeply dipping (40°-90°), with some branches into bedding planes that dip 20°-22°. The segments show sub-horizontal slickensides, indicating right-lateral slip, as well as sub-vertical slickensides. Many of the individual segments of the Pretorius fault display zones of sintered gouge (cataclasites) with a thickness up to tens of centimeters **(lower left in Fig. 3)**. The cataclasite consists of a green to grey, fine grained quartzitic matrix with quartz clasts up to tens of centimeters. The cataclasite displays structural evidence for granular flow and local melting.

associated with the m = 2.2 earthquake on December 12, 2004. The event occurred before installation of the laboratory instruments, and based on eyewitness reports and the damage distribution of this event, we correlate this event to the observed rupture zone in and around the 120-17-TW tunnel, within the central part of our earthquake laboratory (small rectangle in the **center of Fig. 2)**. The rupture zone was mapped in three interconnected tunnels.

The rupture zone was traced a horizontal distance of 40 m (minimum length), and along its entire trace the rupture reactivated three segments of the ancient Pretorius fault **(Fig. 4).** These segments are quasi-planar, crosscutting segments within the fault zone that carry sintered gouge (the metamorphosed Archaean gouge). The reactivated segments

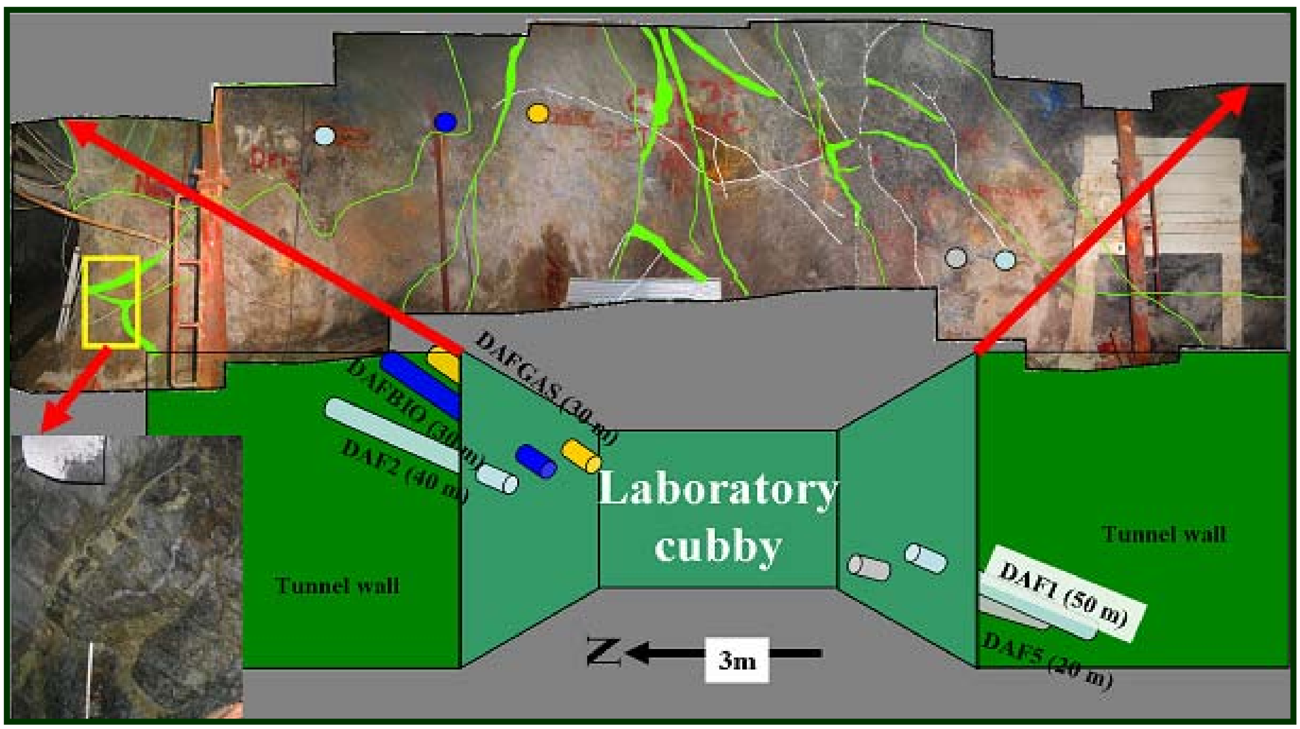


__Figure 3.__ Three-dimensional view into the laboratory cubby within the fault-zone of the Pretorius fault in 118 level (site 8, Fig. 2a). The panoramic photo (above) displays the segments of the Pretorius fault filled with sintered cataclasite (light green with detail on the lower left). The heads of the five boreholes are marked in various colors that correspond to their 3D presentation in the schematic view below.

Rupture zones of the Pretorius fault

We used the network of TauTona mine tunnels for three-dimensional mapping of the rupture zone

strike in ENE directions, yet their inclination varies from 21° (a bedding surface) to 90°. Two displaced rock-bolts **(Fig. 4c)** reveal 10 mm and 25 mm of normal-dextral slip with rake of 23° and 35°. The rupturing formed fresh fine- grained white rock powder almost exclusively along the contacts of the sintered cataclasite and the quartzitic host rock **(Fig. 4a)**. This rock powder is commonly observed in brittle failure in South African mines, and here it appears in 1-5 thin zones that are each 0.5-1.0 mm thick. Locally, the rupture zone is accompanied by a set of vertical, secondary tensile fractures (wing crack) in the hanging wall **(Fig. 4b).**

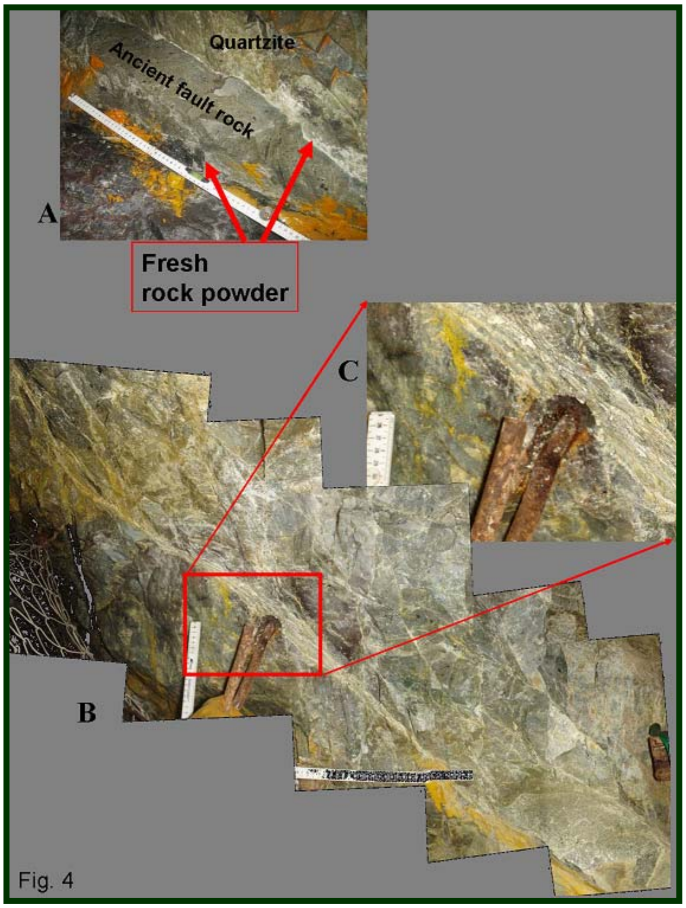


***Figure 4**. Details of the rupture zone of the m = 2.2 earthquake of December 12, 2004. The rupture zone location is marked in Fig. 2b. A. Close up view of a reactivated segment. B. A 41° segment with multiple wing-cracks, about 5 zones of fresh powder and a displaced rock bolt with close up in C.*

IN-SITU STRESS FIELD.

In-situ stresses were determined by analysis of borehole breakouts and drilling induced tensile fractures in images collected with a borehole camera. We used a slim hole, optical borehole camera to log five boreholes (three vertical holes each ~10 m deep, marked 9, 10, 13, in Fig. 2; two inclined holes (418 m long, 10°-15° inclination marked 5 in **Fig. 2,** and 37 m long, 19° inclination marked DAF1 in **Fig. 2)**. It is likely that the long hole primarily reflects the ambient, undisturbed tectonic stress, whereas the shorter holes are strongly affected by stresses induced by the mine infrastructure. The bedrock in TauTona mine is the highly competent quartzites of the Witwatersrand group (uniaxial strength exceeding 200 MPa and Young's modulus exceeding 80 GPa).

The analysis of the three holes indicates normal faulting conditions with σ_{HMAX} = 75-83 MPa and σ_{hmin} = 30-34 MPa. The axis of maximum horizontal stress, σ_{HMAX}, trends 335°, which is roughly normal to the reactivated fault segments discussed above **(Fig. 4).** The long borehole (LIC118 hole in **Fig. 2)** penetrates away from current mining activity. Breakouts were observed for almost the entire logged portion of 418 m. Its stress analysis will be completed after finishing the planned additional logging in the near future.

ANTICIPATED CONTRIBUTIONS

We believe that thanks to the proximity of our 3D dense instrument array to the hypocenters of future earthquakes, our observations will contribute key data in each of these six problem areas:

I. Nucleation processes: Determination of the scales and processes of nucleation and dynamic rupture, as well as detection of preceding signatures (geochemical or electromagnetic).

II. Rupture processes. The dynamics and energetics of the rupture process (velocity, geometry, heterogeneity; opening motion).

III. Stress/Strain/Strength. Determination of orientations, magnitude and heterogeneity of the stress/strain fields, and time variations.

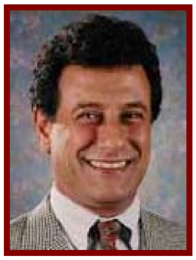
IV. Structural, mechanical, and geochemical characterization of fault-zones and rupture zones.

V. Microbial activity and the effects of faulting and earthquakes on the microbiological activity in fault-zones.

VI. Educational opportunities for U.S. and South African students.

ACKNOWLEDGEMENTS

Many thanks go to the participants of DAFSAM-NELSAM, and particularly to the people of TauTona mine for their invaluable hospitality and support. DAFSAM activities are financially and logistically supported by ICDP, Potsdam, Germany. NELSAM operations are funded by NSF (Continental Dynamics); the projects are conducted from the University of Oklahoma.



Younane Abousleiman, Professor
Director of the Rock/Poromechanics Consortium, Larry Brummet/ONEOK Chair
In collaboration with Franz-Josef Ulm, Massachusetts Institute of Technology

"The GeoGenome™ of SHALE in Nano-Technology"

ABSTRACT

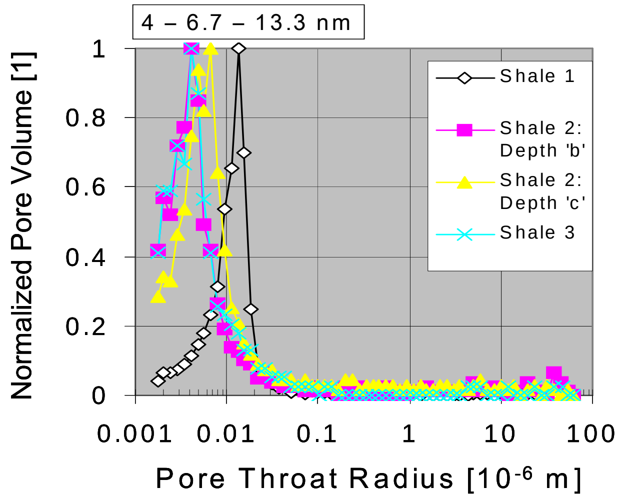
The experimental nano-poromechanics research into the invariant material properties of shale has been in place at OU/MIT for the past year. We propose a four-level microstructural think model for shale materials: the level of elementary particles (Level '0'), the one of mineral aggregates in the sub-micrometer range (Level 1), the one of flake aggregates and silt-size grain inclusions in the tens of micrometer range (Level 2), and finally the scale of deposition layers, which is the scale of e.g. oil and gas drilling applications. This four-level microstructure forms the backbone of our investigation of nano- and micro-mechanical properties using nano-indentation tests. The results reveal that the macroscopic anisotropic elasticity of shale materials is an effect of texture, which becomes apparent at a length scale of tens of microns (Level 2). Below this scale (Level 1), in the hundreds of nanometer range, the material is found to be (almost) isotropic elastic. Furthermore, we present strong evidence that the hardness distribution in shale materials is isotropic at both levels considered (Level 1 and 2). This scale transgressing isotropy can be associated with a free yielding of the cohesive-frictional material -- in the sense of yield design theory. The material appears to deform at constant volume, similar to a Cam-Clay material that reaches the critical state. At both scales considered, the hardness distribution exhibits a bi-modal structure, which suggests the existence of a low-hardness and a high-hardness phase.

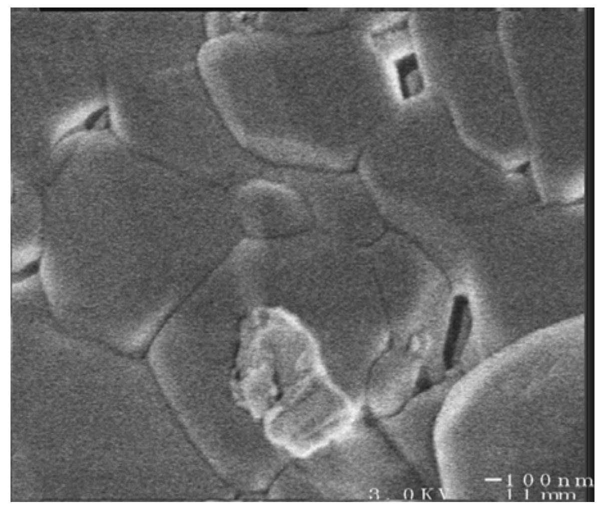
SYNOPSIS

It is well known that shale materials in oil and gas drilling applications are the major source of wellbore drilling instability due to the highly heterogeneous and anisotropic composition of shale material with possible heterogeneities that manifest themselves at multiple scales, i.e., from the scale of the platy minerals of clays in the sub-micrometer range, to the scale of silt-size (quartz) grains at 10^{-6} m, to the scale of the deposition layers of shale in the sub-mm to cm-range. The multiscale anisotropy and heterogeneity ultimately contribute to a macroscopic anisotropy and heterogeneity of the material, as it is well known today from macroscopic material testing in an attempt to measure elastic and poroelastic material properties. On the other hand, the origin of this anisotropy is still debated to date and not very well understood; that is, it is not known whether the pronounced macroscopic anisotropy of shale rock type is a consequence of the morphology of the minerals at their respective scales, or of the layered structure induced by the geological deposition, or both. This makes it difficult to go beyond empirical correlation relations between the anisotropic mechanical behavior and mineralogic composition. As a consequence, drilling through shale rock type materials still requires expensive macroscopic material sampling for macroscopic material characterization of the mechanical and poromechanical behavior for an appropriate choice of drilling fluid chemistry and density, vis-à-vis borehole stability analysis, and so on.

The objective of the research is to identify a material scale of shale materials where the mechanical properties do not change from one shale material to another. This scale is the scale where physical chemistry (mineralogy, crystallography, etc.) meets the micro-mechanical behavior. Once this scale and the properties are identified, it is possible to upscale the intrinsic material behavior from the sub-microscale to the macroscale and identify the source of the macroscopic anisotropy of shale and eventually their macro-mechanical behavior. The ultimate goal is to provide proof of concept that it is possible to determine mechanical material properties of shale from the mere knowledge of the mechanical properties of the composition (mineralogy) and the associated porosities of these materials.

It has long been hypothesized that the localized contact response measured by an instrumented indentation experiment can serve to characterize the mechanical properties of materials as quantitatively as conventional testing techniques such as uniaxial compression and tension. This experimental approach provides a continuous record of the variation of the depth of penetration, h, as a function of imposed indentation load, P, into the indented specimen surface. Advances in hardware and software control currently enable maximum penetration depths on the nanometer scale, such that nanoscale instrumented indentation provides a convenient, non-destructive means to evaluate the basic mechanical response of small material volumes of bulk, thin film, or composite materials. Commercially available indenters accommodate various indenter geometries, including sharp pyramidal, conical or spherical probes, such that elastic and plastic mechanical properties can be estimated at any scale within the limits defined by the indenter dimensions and maximum penetration depth. Thus, instrumented indentation is a versatile tool for material characterization; particularly at scales where classical mechanical tests based on volume-averaged stresses are inadequate.

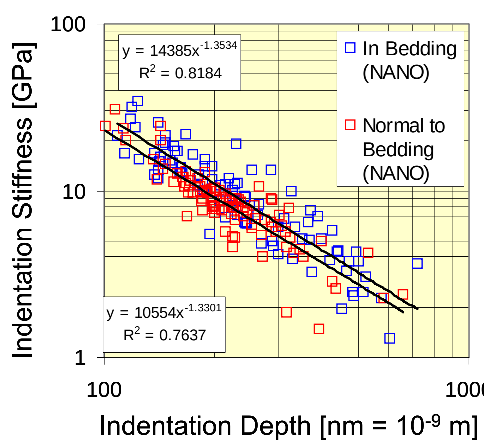


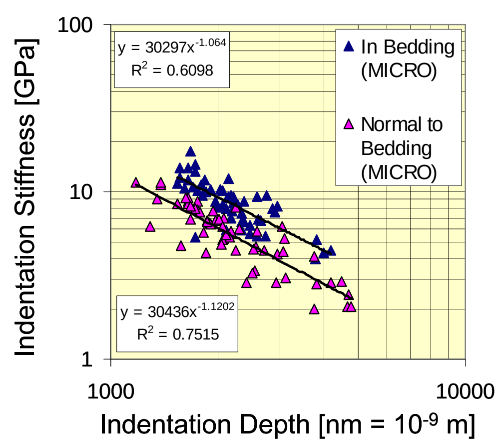


Flakes from Level 1 aggregate into layers to form a visible layered texture of the shale materials.

Nano- versus Micro-Elasticity

Indentation gives access to bulk properties of the indented material at a length scale at which the material is considered as homogeneous. Given the highly heterogeneous nature of shale materials at different scales, it is unlikely that the condition of continuum (poroelasticity) is met in each indentation test. Hence, one needs to perform a sufficiently large number of indentation tests at different scales in order to extract mean values of the material properties and distributions. It is obvious from the figures below that the shale mechanical material anisotropy is exhibited at much larger scales than the nano scale, when tested normal to geological deposition or parallel to it.





M. Reza Rezaee, Associate Professor in Petroleum Geology

[1*] *Academic Visitor at School of Geology and Geophysics, University of Oklahoma, USA.*

"Application of Intelligent Systems for Generating Wireline Logs"

Rezaee[1*], R.M., Slatt[2], R., and Kadkhodaie Ilkhchi[1], A.

1. *School of Geology, University of Tehran, Iran*
2. *School of Geology and Geophysics, University of Oklahoma, USA*

ABSTRACT

Accurate log analysis in a hydrocarbon reservoir requires a complete suite of well logs. For any number of reasons, such as incomplete logging in old wells, destruction of logs due to inappropriate data storage, and measurement errors due to logging tool problems or hole conditions, log suites are either incomplete or not reliable.

In this study, fuzzy logic and artificial neural networks were used as intelligent tools to synthesize petrophysical logs. The petrophysical data from two wells were used for constructing intelligent models. A third well from the field was used to evaluate the reliability of the models. Results show that artificial neural networks and fuzzy logic were successful for synthesizing wireline logs.

INTRODUCTION

Reservoir properties such as porosity, permeability, fluid saturation, lithology and fluid contacts are obtained from well logs. In many cases, a complete set of log data may not be available. Hole conditions, tool failure, loss of data due to inappropriate storage, and incomplete logging are some of the reasons. In recent years, intelligent systems have been used as powerful tools for modeling and prediction in the petroleum industry and also have been used to generate unconventional logs, such as NMR, from conventional logs. In this study, artificial neural networks and fuzzy logic have been chosen as mathematical tools for reconstruction of wireline logs.

Artificial neural networks (ANN)

A neural network is a mathematical algorithm that can be trained to solve a problem. Artificial neural networks are adaptive and parallel information-processing systems that have the ability to develop functional relationships between data and to provide a powerful toolbox for nonlinear, multidimensional interpolations. Artificial neural networks can recognize highly complex patterns within a data set (Mohaghegh et al., 1995). The components of an ANN are neurons (or nodes) and connections (which are weighted links between neurons). An ANN has three layers: an input layer, a hidden or inner layer and an output layer (Fig. 1a). The input layer receives the information. The hidden layer, which can consist of several layers, analyzes the information. The output layer receives the results of the analysis and provides the output (Zeidenberg, 1990). Figure 1b shows a schematic model of the processing procedure in a neuron element cell. The body of this cell consists of two parts. The first part is the "combination function" that sums up all inputs and produces a value. This figure illustrates that for a neuron *I*, all inputs I_j are weighted by a factor W_j and then summed to the final output u_i,

$$\upsilon_i = \sum_{j=1}^{i} W_j I_j$$

The second part is the "activation function" or "transfer function". When the weighted sum reaches a threshold, the transfer function is activated to produce the output. Transfer functions are of several types including sigmoid, Tansig and Logsig (Zeidenberg, 1990).

Usually in a neural network cell there is an additional "bias" input. The bias increases or decreases the weighted sum (Chen and Sidney, 1997). The bias factor acts as a compensator and helps the network to best recognize the patterns. Learning in neural network occurs by adjustment of the weights via a training rule (Zeidenberg, 1990). Training algorithms are categorized as supervised or unsupervised. An error-back propagation algorithm is a supervised training technique that sends the input values forward through the network, then computes the difference between the calculated output and the corresponding desired output from the training dataset. This error is then propagated backward through the net and the weights are adjusted during a number of iterations. The training stops when the calculated output values best approximate the desired values (Bhatt and Helle, 1999).

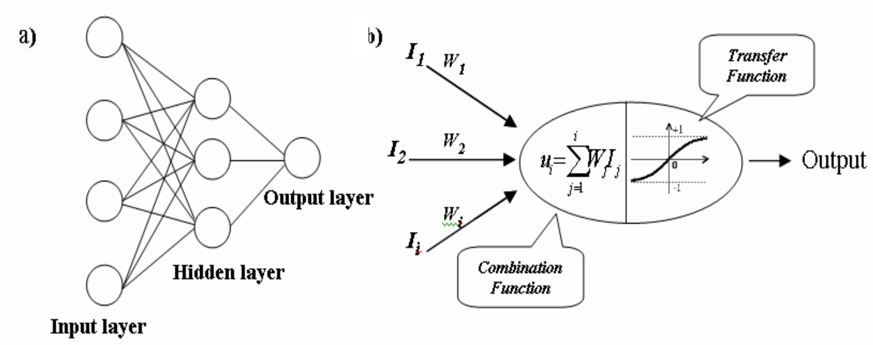


Figure 1 - *(a) Schematic diagram of an artificial neural network structure which consists of an input layer, one hidden layer and an output layer. (b) A mathematical model of an artificial neural network cell.*

Fuzzy logic

Fuzzy logic starts with the concept of fuzzy sets (Zadeh, 1965). Crisp sets only allow full-membership or non-membership, whereas fuzzy sets allow partial membership which can take values ranging from 0 to 1:

$$\mu_A(x): X \rightarrow [0,1]$$

where X refers to the universal set defined in specific problem and $\mu_A(x)$ is the grade of membership for element x in fuzzy set A (Yagar and Zadeh, 1992).

Crisp sets are special cases of fuzzy sets, where the membership function for each element has only two values, 0 or 1 (Saggaf & Nebrija, 2003). Although fuzzy logic is sometimes used as a synonym for multivalent logic, its more common use is to describe the logic of fuzzy sets (Zadeh, 1965). The most important concept in fuzzy logic is definition of membership functions for input and output data sets. For constructing a model based on fuzzy logic, it is important to select proper types and parameters for membership functions that best fit the dataset. There are several types of membership functions such as Gaussian, sigmoid, triangular, and trapezoidal functions. In recent years, fuzzy logic has been used as a tool to construct petrophysical models in hydrocarbon reservoirs.

Fuzzy inference system (FIS)

Fuzzy inference is the process of formulating from a given input to an output using fuzzy logic. There are two types of fuzzy inference systems, by Mamdani (1975) and Takagi-Sugeno (1985). Mamdani's method attempts to control a system by synthesizing a set of linguistic control rules obtained from experienced human operators. The Takagi-Sugeno method is similar to the Mamdani FIS. The main difference between them is that the output membership functions are only constant for Takagi-Sugeno FIS. Figure 2 shows a schematic structure of FIS. In the Takagi-Sugeno FIS, membership functions are defined by a clustering process. Each cluster center has a range of influence (cluster radius) for each input and output dimension.

Assuming a smaller cluster radius will usually yield many small clusters (resulting in many rules), while specifying a large cluster radius yields a few large clusters in the data resulting in a few rules (Chiu, 1994). In FIS, a set of if-then rules provides a relationship between input and output data sets. The closer a given input is to the “if” part of the rule, the more the "then" part will be influenced. Then the fuzzy system adds up all of the "then" parts and uses a defuzzification method to give the final output (Kosko, 1991).

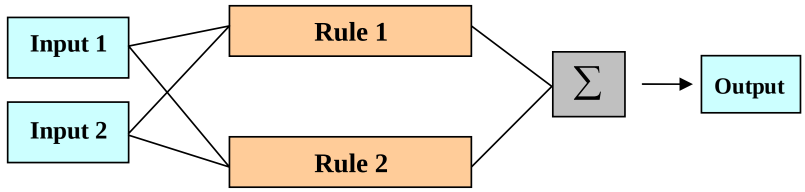


Figure 2 - *Schematic diagram of information flow in a simple fuzzy inference system.*

SYNTHESIZING PETROPHYSICAL LOGS

Artificial neural network

A three layer error-back propagation algorithm with Levenberg-Marquardet training function was used for training all the data set. Seven networks were generated for synthesizing NPHI, RHOB, DT, GR, LLD, LLS, and MSFL logs using the same inputs which were used for fuzzy models construction. For each of the networks the data set were divided into three groups including training and validation data from two wells and test data from a third well. The first layer includes 2, 2, 2, 3, 3, 3 and 3 neurons for the NPHI, RHOB, DT, GR, LLD, LLS, and MSFL networks respectively. A hidden or inner layer includes 12, 7, 5, 17, 8, 13 and 10 neurons for the NPHI, RHOB, DT, GR, LLD, LLS, and MSFL networks, respectively, and a third layer has one neuron for all networks. Logsig transfer function was considered for the networks. The selected performance function for each of the networks is the mean squared error between the network outputs and target outputs that is below a certain tolerance value. Figure 3 compares measured and synthesized neutron, sonic, density, GR, LLD and LLS logs.

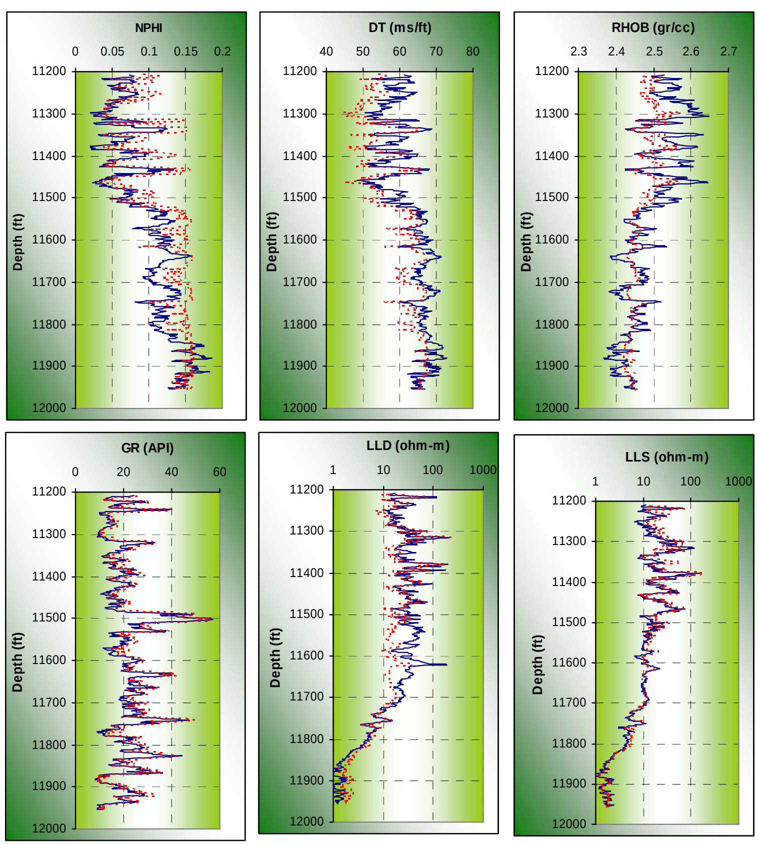


Figure 3 - *Synthesized NPHI, DT, RHOB, DT, GR, LLD and LLS logs utilizing ANN technique for the test well (dotted lines). Real logs are shown by solid lines.*

Fuzzy logic

A Takagi-Sugeno FIS was used for creating synthetic petrophysical logs. For each of the constructed models, the data set were divided into two groups including modeling data from two wells and test data from a third well. Appropriate inputs to construct intelligent models based on FL are determined from crossplot analysis of log data from two wells (known input). All input and output membership functions and their parameters were extracted by a subtractive clustering method. The following petrophysical logs were synthesized:

Neutron log: By specifying 0.25 for cluster radius, four Gaussian type membership functions were extracted for DT and RHOB inputs which were captioned by very low, low, moderate, and high. Generated if-then rules are as below:
1. *If* (DT is very low) *and* (RHOB is high) *then* (NPHI is very low)
2. *If* (DT is low) *and* (RHOB is moderate) *then* (NPHI is low)
4. *If* (DT is moderate) *and* (RHOB is low) *then* (NPHI is moderate)
3. *If* (DT is high) *and* (RHOB is very low) *then* (NPHI is high)

Density log: By specifying 0.5 for cluster radius, three Gaussian type membership functions were extracted for NPHI and DT inputs which were captioned by low, moderate, and high. Generated if-then rules are as below:
1. *If* (NPHI is low) *and* (DT is low) *then* (RHOB is high)
2. *If* (NPHI is moderate) *and* (DT is moderate) *then* (RHOB is moderate)
4. *If* (NPHI is high) *and* (DT is high) *then* (RHOB is low)

Sonic log: By specifying 0.5 for cluster radius, three Gaussian type membership functions were extracted for NPHI and RHOB inputs which were captioned by low, moderate, and high. Generated if-then rules are as below:
1. *If* (NPHI is low) *and* (RHOB is high) *then* (DT is low)
2. *If* (NPHI is moderate) *and* (RHOB is moderate) *then* (DT is moderate)
4. *If* (NPHI is high) *and* (RHOB is low) *then* (DT is high)

Gamma ray log: By specifying 0.28 for cluster radius, five Gaussian type membership functions were extracted for CGR, SGR and NPHI inputs which were captioned by very low, low, moderate, high, and very high. The generated if-then rules are as below:
1. *If* (CGR is very low) *and* (SGR is very low) *and* (NPHI is very high) *then* (GR is very low)
2. *If* (CGR is low) *and* (SGR is low) *and* (NPHI is high) *then* (GR is low)
3. *If* (CGR is moderate) *and* (SGR is moderate) *and* (NPHI is moderate) *then* (GR is moderate)
4. *If* (CGR is high) *and* (SGR is high) *and* (NPHI is low) *then* (GR is high)
5. *If* (CGR is very high) *and* (SGR is very high) *and* (NPHI is very low) *then* (GR is very high)

LLD resistivity log: By specifying 0.65 for cluster radius, three Gaussian type membership functions were extracted for LLS, MSFL and NPHI inputs which were captioned by low, moderate, and high. Generated if-then rules are as below:
1. *If* (LLS is low) *and* (MSFL is low) *and* (NPHI is high) *then* (LLD is low)
2. *If* (LLS is moderate) *and* (MSFL is moderate) *and* (NPHI is moderate) *then* (LLD is moderate)
3. *If* (LLS is high) *and* (MSFL is high) *and* (NPHI is low) *then* (LLD is high)

LLS resistivity log: By specifying 0.20 for cluster radius, five Gaussian type membership functions were extracted for LLD, MSFL and NPHI inputs which were captioned by very low, low, moderate, high, and very high. Generated if-then rules are as below:
1. *If* (LLD is very low) *and* (MSFL is very low) *and* (NPHI is very high) *then* (LLS is very low)
2. *If* (LLD is low) *and* (MSFL is low) *and* (NPHI is high) *then* (LLS is low)
3. *If* (LLD is moderate) *and* (MSFL is moderate) *and* (NPHI is moderate) *then* (LLS is moderate)
4. *If* (LLD is high) *and* (MSFL is high) *and* (NPHI is low) *then* (LLS is high)
5. *If* (LLD is very high) *and* (MSFL is very high) *and* (NPHI is very low) *then* (LLS is very high)

MSFL resistivity log: By specifying 0.40 for cluster radius, three Gaussian type membership functions were extracted for LLD, LLS and NPHI inputs which were captioned by low, moderate, and high. Generated if-then rules are as below:
1. *If* (LLD is low) *and* (LLS is low) *and* (NPHI is high) *then* (MSFL is low)
2. *If* (LLD is moderate) *and* (LLS is moderate) *and* (NPHI is moderate) *then* (MSFL is moderate)
3. *If* (LLD is high) *and* (LLS is high) *and* (NPHI is low) *then* (MSFL is high)

When fuzzy membership functions and fuzzy if-then rules were generated, the following steps were carried out by using Takagi-Sugeno FIS for prediction of log values in the third well of the field (the test well):

Step 1. Fuzzify inputs: The FIS takes the inputs and determines the degree to which the inputs belong to each membership function.

Step 2. Apply fuzzy operator and truncation methods: For the case that the antecedent of a given rule has more than one part, the fuzzy operator is applied to obtain one rule that represents the result of the antecedent for that rule. The most common operators are shown below:

"and"= use the minimum of the options.

"or" = use the maximum of the options.

"not" = use 1- option

Applying the fuzzy operators gives a value to the antecedent of each rule, and then the output membership function is truncated by this value. In this study *"and"* has been used.

Step 3. Apply aggregation method: In this step, outputs of each rule that fit into a fuzzy set are combined into a single fuzzy set.

Step 4. Defuzzify: The input for defuzzification process are the results of the aggregation method. Then FIS uses a defuzzification method (in this study, a weighted average) for the resulting output which is a crisp numerical value. Figure 4 shows an example of processing steps to use Takagi-Sugeno FIS for creation of a sonic log from neutron and density log inputs. Figure 5 compares real data and the FL predicted results for neutron, sonic, density, gamma ray, LLD and MSFL logs in the test well.

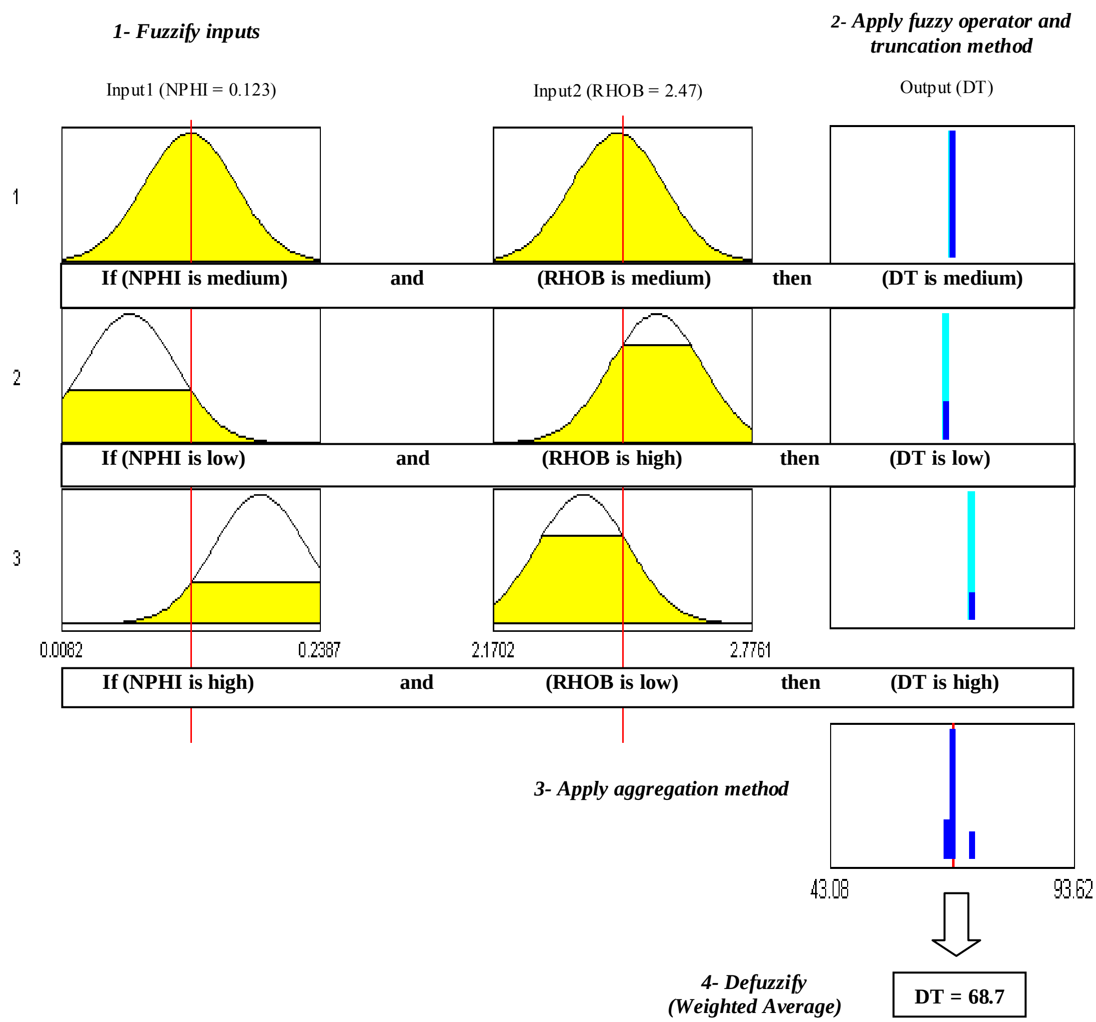


Figure 4 - *Processing steps to use Takagi-Sugeno FIS for creation of a sonic log from neutron and density log inputs. This FIS consists of three rules with the antecedent of each rule separated by the "and" operator.*

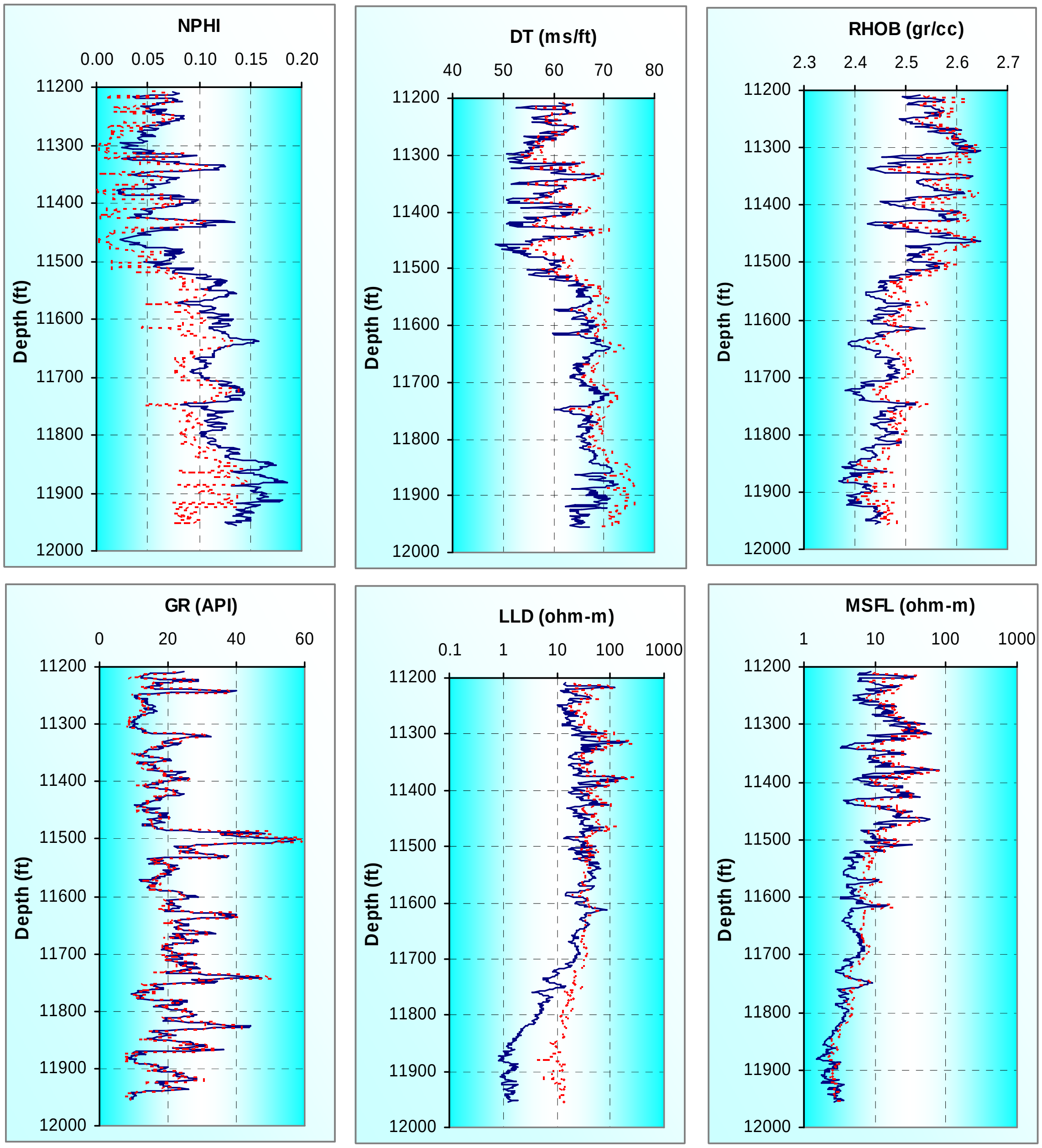


Figure 5 - *Synthesized NPHI, DT, RHOB, DT, GR, LLD and MSFL logs utilizing the FL technique for the test well (dotted lines). Real logs are shown by solid lines.*

CONCLUSIONS

This study shows that both artificial neural networks and fuzzy logic have been successful for synthesizing petrophysical logs. They are robust, fast, and precise tools for reservoir characterization and solving reservoir problems. In specific cases, one of these techniques may give better results than the other. For cases with limited data, fuzzy logic gives better results in comparison to ANN. For example, the fuzzy logic technique can make three clusters from only three data points. On the other hand, an ANN requires more data points for training and constructing of an intelligent model.

REFERENCES

Bhatt, A., Helle. H. B., 1999. Porosity, permeability and TOC prediction from well logs using a neural network approach. 61 ST EAGE, Conf. Helsinki, Finland, pp. 1-4.

Chen, Q., Sidney. S., 1997. Seismic attribute technology for reservoir forecasting and monitoring: The leading Edge., 16: 445-456.

Chiu, S., 1994. Fuzzy model identification based on cluster estimation. Journal of Intelligent & Fuzzy systems., 2: 267-278.

Kosko, B., 1991. Fuzzy Thinking. Hyperion, New York.

Mamdani, E. H., Assilian. S, 1975. An experimental in linguistic synthesis with a fuzzy logic control: International journal of Man-Machine studies., 7: 1-13.

Mohaghegh, S., Balan, B., Ameri, S., 1995, State-of-the-art in permeability determination from well log data: part 2- verifiable, accurate permeability predictions, the touch-stone of all models, *SPE 30979*.

Saggaf, M. M., Nebrija. Ed. L., 2003. A fuzzy approach for the estimation of facies from wireline logs. AAPG Bulletin., 87: 1233-1240.

Sugeno, M., 1985. Industrial applications of fuzzy control. Elsevier, Amsterdam.

Takagi, T., Sugeno. M., 1985. Identification of Systems and its Application to modeling and Control. Institute of electrical and electronics engineers transactions on systems, Man and Cybemetics., 15: 116-132.

Yagar, R. R., Zadeh. L. A., 1992. An introduction to fuzzy logic applications in intelligent systems. Kluwer Academic Publishers., 165: 69-70.

Zadeh, L. A., 1965. Fuzzy Sets. Information and Control., 8: 338-353.

Zeidenberg, M., 1990. Neural Network in Artificial Intelligence. Ellis Horwood Limited, NewYork. ■

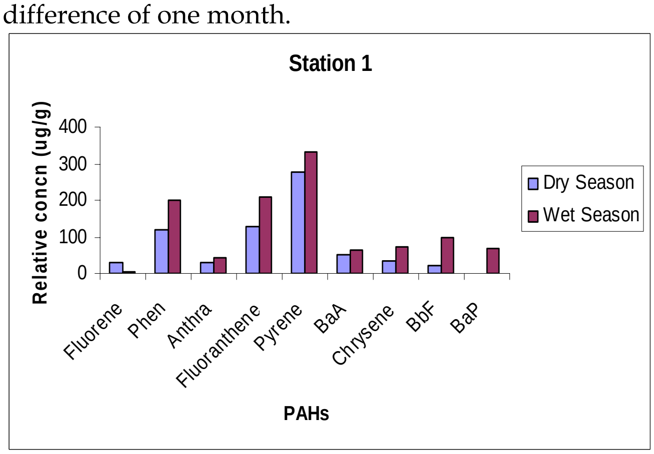

Pamela Gerrez V. Taneza
M.S. Student in Geology, Research Assistant

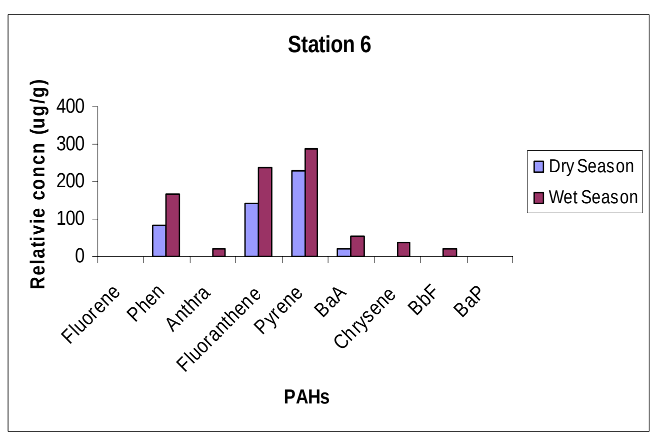
R. Paul Philp,
Joe & Robert Klabzuba Professor, George Lynn Cross Research Professor
Petroleum and Environmental Geochemistry

"Occurrence of Polycylic Aromatic Hydrocarbons (PAHs) in Iloilo River, Philippines"

Polycylic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that have received special attention due to their highly mutagenic and carcinogenic properties. The objective of this presentation is to investigate the occurrence, distribution, concentration and potential sources of PAHs in Iloilo River, Philippines using geochemical techniques. Biomarkers, which include steranes and hopanes were also analyzed in order to determine the influence of petroleum. Studies on the persistent organic pollutants are very limited in the tropical /subtropical countries in Asia. These pollutants can be quickly dispersed into the atmosphere and into aquatic systems from point sources due to mild-to-high tropical temperatures and heavy rainfall in the region. **Six sampling stations** were established along the 10-km long Iloilo River in the Philippines. In order to assess the influence of precipitation on the concentration of organic compounds in the river, sediment and water samples were collected during the wet and dry season, with a time difference of one month.

Concentration of PAHs was especially high when the samples were taken during the dry season (1105.5 – 3134.3 μg/g) in comparison to the wet season (518.6 – 1304.8 μg/g). PAH concentration peaked at the middle reach of the river (Station 5) in both wet and dry seasons since the area is the confluence of Iloilo River and Dungon Creek thus receiving more organic material. Parameters including isomer ratios, the dominance of 4- to 6-ring parent PAH compounds particularly pyrene, and high parent/alkylated PAH ratios indicated a pyrogenic (combustion) source for the sediments in Iloilo River. Motor vehicles from heavy duty diesel engines were a significant source of PAH emissions. A relatively smaller contribution from pyrogenic (petroleum – derived; most from the Middle East oil) was also evident, based on hopane and sterane biomarkers. Perylene, a high molecular weight PAH of biogenic/diagenetic origin, often associated with an anoxic marine environment, was also abundant except in the upstream portion of the river.





PAH concentrations are higher during the wet period than the dry period due to wet scavenging from the atmosphere and increased urban runoff.

Jennifer D. Eoff, PhD in Invertebrate Paleontology

"Impact and High-Magnitude Sedimentology: Nevada/Arizona"

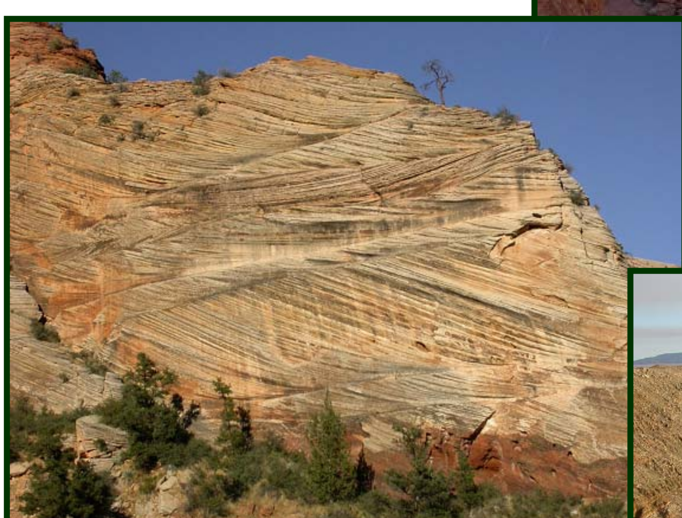
Class taught by Dr. R. Douglas Elmore

The Alamo Breccia is a carbonate megabreccia exposed in southern Nevada. It likely represents the detachment and resedimentation of 250+ km^3 of carbonate rock following a moderate-sized bolide impact in the Late Devonian (Warme and Sandberg, 1996). The breccia contains chaotic debrites with stromotoporoid clasts, an upper graded zone and carbonate lapilli. Paleomagnetic samples collected by students on the trip will be used to test the origin of the breccia (hot or cold) and will also provide information on hydrothermal alteration. The fieldtrip also included a rim tour of the 550'-deep Meteor Crater, a recent (49 Kya) impact crater near Flagstaff, Arizona. Students examined non-impact, episodic sedimentation deposits as well, including debris flows, flood deposits and terrace sequences of the Colorado River at Lee's Ferry and the Grand Canyon. The class also examined Mesozoic eolian deposits at Zion National Park.

But the biggest lesson learned on the trip: a cheap motel in Vegas is not worth the money saved. Thanks for the scary stay at the GS, Dr. Elmore!

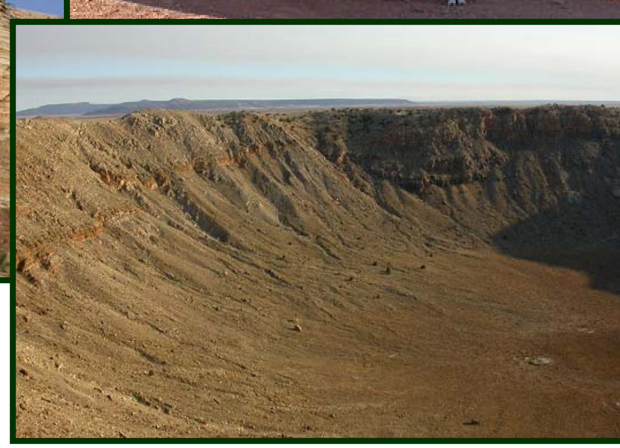
Seated from left: *Vanessa O'Brien, Shannon Dulin, John Warme (Colorado School of Mines).* ***Standing from left:*** *Devin Dennie, Alicia Branch, Louise Totten, Michelle McCarthy, Jennifer Eoff.*

To the Right: *Balanced Rock, a "hoodoo" formed by differential erosion of softer material under boulders, near Lee's Ferry, Arizona*



Above: *Cross-bedded Navajo Sandstone, Zion National Park, Utah*

To the Right: *Well-preserved impact structure, Meteor Crater, Arizona*



William Duran, MS Student in Petroleum Geology
School of Geology and Geophysics, The University of Oklahoma

"Use of Neutron-Density Logs to Detect Gas in Mature Reservoirs, Route 66, Oklahoma, USA"

ACKNOWLEDGMENTS: Thanks to Randy Pruitt & Gabe Terry at Hulen Operating Company for permission to publish these results and to Dr. James Forgotson for critically reviewing this paper.

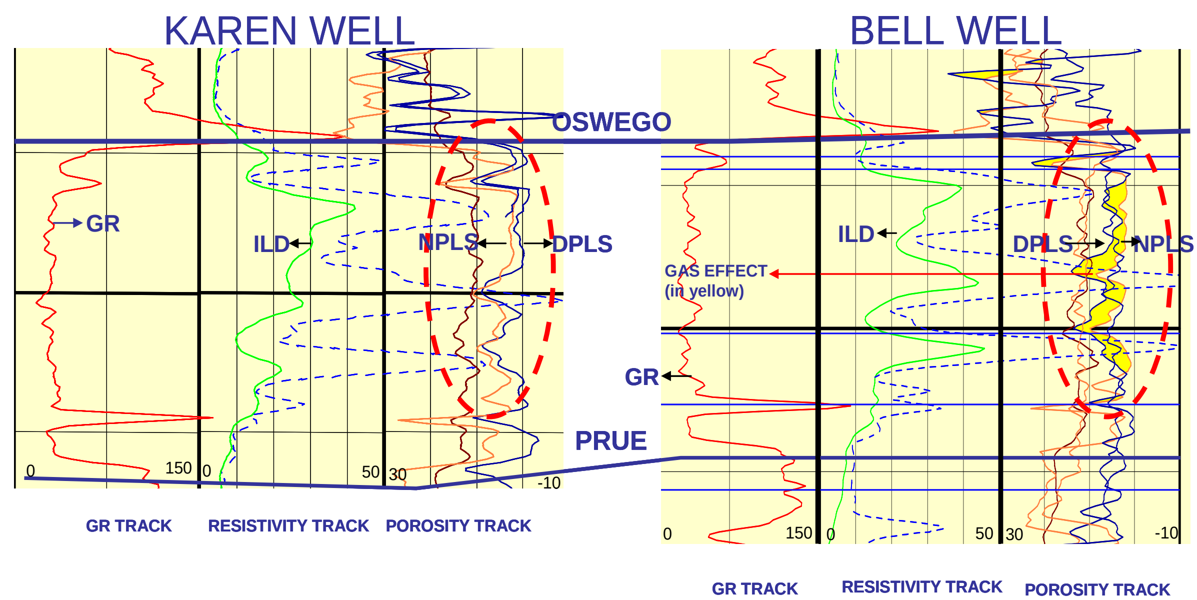


Figure 1: *The Bell well log shows the gas effect – the NPLS reading decreases and the DPLS reading increases (area filled in yellow). In addition, the resistivity reading (ILD) in the Bell well is greater than the Karen well.*

Growing demand for oil and gas has caused prices to increase. New opportunities for development in mature oil and gas areas have surfaced; however, due to the high complexity of stratigraphy and facies pattern, it is necessary to have an accurate geological model in order to understand how the potential reservoir rocks and fluids are distributed within the area of interest.

Along Route 66 in Oklahoma and Lincoln Counties, Oklahoma, several reservoir formations have been identified in the past. Formations such as Cleveland, Skinner, Oswego, Hunton, and Viola are known gas and oil producers in the area. The first two are composed of siliciclastic sediments, and they have been called "tight gas sands" because of their low porosity (< 6 %) and permeability. The last three formations are composed of carbonate sediments.

This study was focused on the Mississippian Age Oswego Formation. The objective was to integrate the data from well logs, mud logs and production information to identify the best areas to drill for oil and gas. A few years ago, Hulen Operating Company started an aggressive drilling and workover project. The application of detailed well log analysis was used to reduce the risk of drilling in areas that were overlooked in the past due to economic reasons or poor data quality.

Neutron- Density logs have been widely used in the world to detect gas bearing rocks. Neutron logs measure concentrations of hydrogen. Since hydrogen is found mainly in the pore fluids, the neutron porosity log responds principally to porosity. The neutron porosity log is strongly affected by clay and gas. Gas has a low hydrogen density so that gas zones have a very low apparent porosity. A density log records the bulk density of rocks adjacent to a drill hole by measuring the induced gamma rays emitted by the rocks after bombardment by a high gamma ray energy source encased in a probe and lowered into the drill hole. The denser the adjacent rocks, the more gamma rays are absorbed and not returned to a detector in the probe where they are measured in grams/cm^3. Since gas is lighter than oil or water, the density log records an anomalously high porosity because it is calibrated assuming water filled pore space.

Figure 1 (*above*) shows the Bell and Karen well logs. The crossover zones (filled in yellow) occur where the neutron log curve (NPLS) has a lower porosity reading than the density log curve (DPLS). The gas effect starts to appear in the Elizabeth well (-3620 ft) **(Figures 2, 3)**. The regional nature of this is indicated by the strong gas effect in the Bell well which is 150 ft structurally higher than the Karen well; in addition, the mud logging report indicates a gas show in the Oswego Formation.

To summarize, the integration of the geological model, neutron logs, density logs and mud logging information showed the distribution of fluids within the Oswego Formation and indicated the presence of gas towards the northeast. Based on that data, it is proposed that new wells be drilled in the northeastern part of the Route 66 area. ■

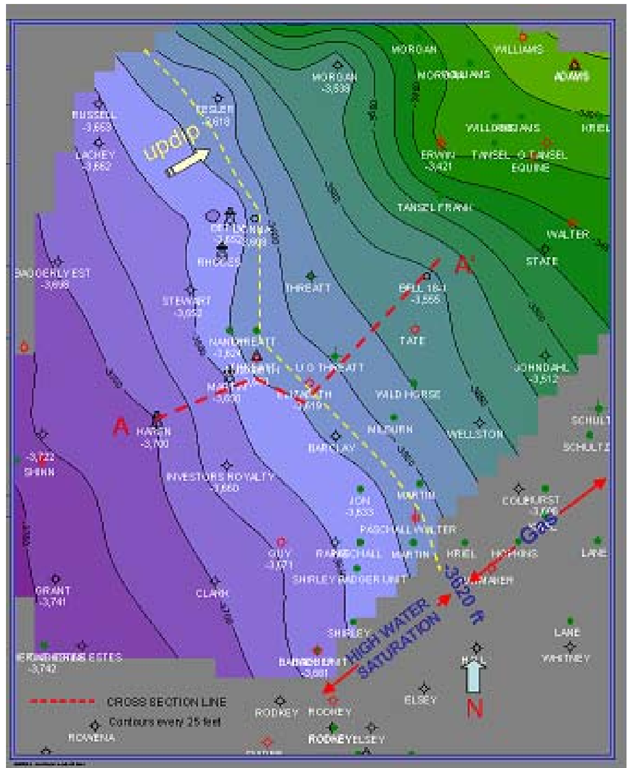


Figure 2: *Oswego Formation top structural map. Gas effect starts to appear at -3620 ft.*

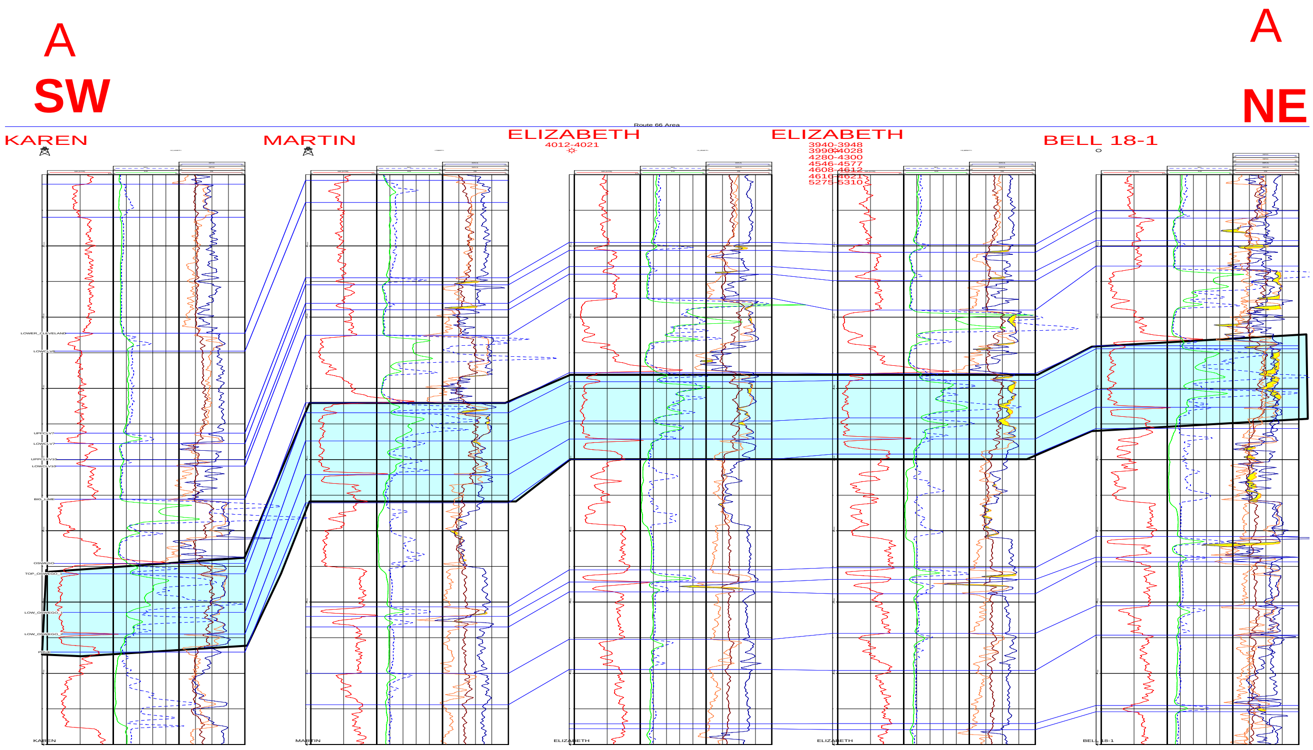


Figure 3: *Structural cross section – The Bell well is located 150 ft. updip than the Karen well. Oswego Formation in light blue.*

Roderick Perez, BS in Geophysics, Exchange Student
School of Geology and Geophysics, The University of Oklahoma

"Southern Florida Carbonate Field Trip 2005 Highlights"

Back Row from Left: Omer Aksu, Roderick Perez, Belinda Ferrero, Christian Marine; **Middle Row from Left:** Mrs. Aksu, Louise Totten, Dr. Pigott, Sebastian Bayer, Sohini Sur; **Bottom Row from Left:** Tatiya Uttarathiyang, Carisa Bomberger, Veronica Caro, Ngoc Hoang (standing)

Days before Hurricane Wilma struck Florida in October of 2005, the intrepid University of Oklahoma crew of thirteen students, and two wives for moral encouragement, led by the famous Dr. Pigott journeyed to Key West and vicinity. The principal objective of this expedition was to experience Holocene and Pleistocene carbonates on a metaphysical level, i.e. becoming "one with the rocks". Areas of amphibious assault were: Shark Bay (sponge community), Big Pine Key (protodolomites), Sugar Loaff Key (Schizoporella mats), Bahia Honda (karst and near shore profiles), Little Money Key (not to make mammon but to make a spirited test of resolve to snorkel a mile across shark infested waters), Windley Key Quarry (to examine the Key Largo Limestone face to face) and last, but not least, the Bayshore Boulevard exposure of the Miami Oolite. What did we learn? We observe the vast heterogeneity of modern carbonates and living biofacies tracts that are greatly filtered once they lithify. We described many types of calcareous algae as well as invertebrates. We learn that if we were infected by Goniolithon, that fortunately Penicillus was always close by. Geologically, we now see ancient carbonates differently. We now can better visualize the importance of diagenesis upon their original fabric and how the Wilson Tract is a secret to the foundation of their subsequent reservoir characterization. We also learned the importance of an "espirit de corps", that is, of working together as a team, sharing responsibilities and in that way, obtaining much, much more than from an individual effort. ■

KEY WEST, FLORIDA

CARBONATE GEOLOGY 2006

KRISTEN MARRA and BRIAN HARMS

BS Students in Geology

"Field Camp 2005: Abbey Road"

"It was the best of times……..it was the worst of times" may be the start of another saga, but it's also a pretty accurate summation of the OU Summer Field Camp of 2005!

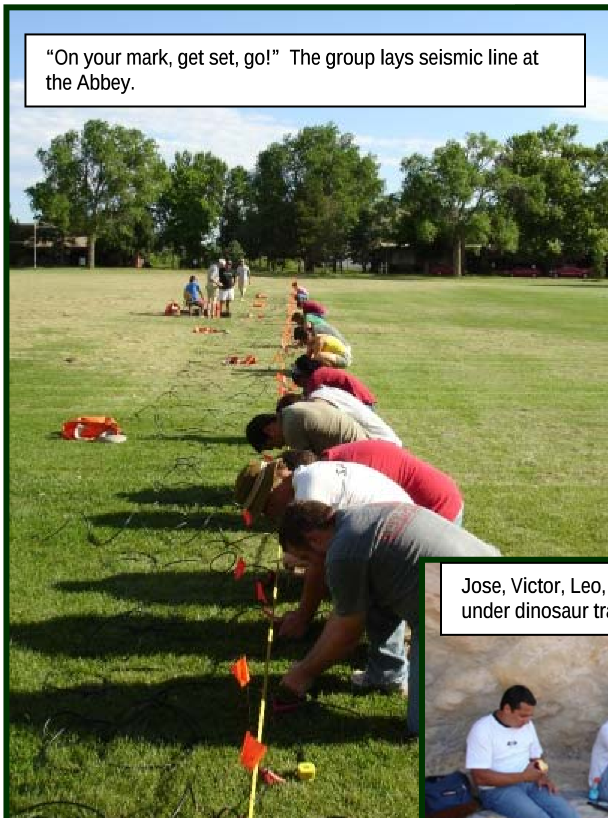
First, let's explore the "worst of times": powdered eggs, dead rodents in the freezer, veiled threats from Abbey officials, the Taco Bell that closed at 11pm, early mornings, frequent beverage droughts, and that death march to the top of the Mixing Bowl.

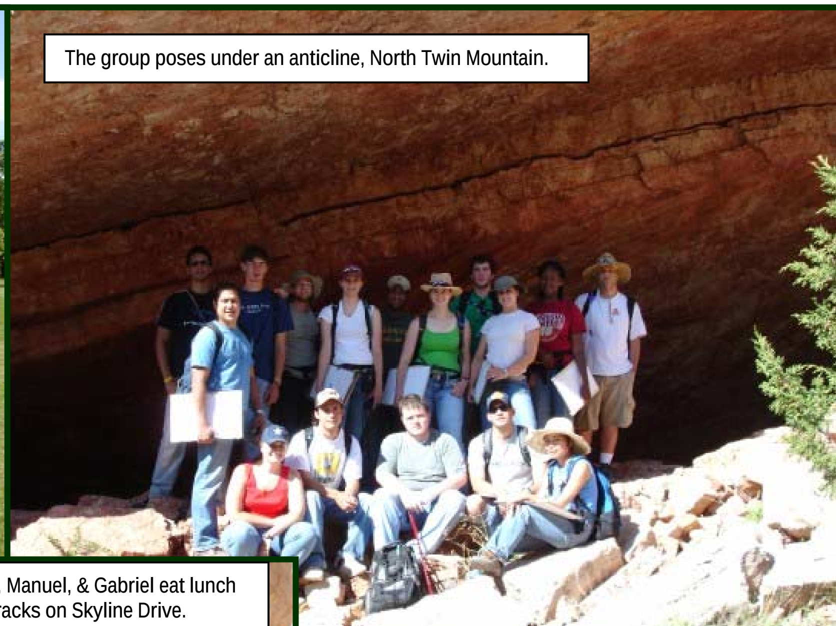
But, not to fear…….there was plenty of "good" as well: a slip-n-slide party on the Abbey lawn, wine tastings after long hot days in the field, rafting through treacherous, Class-4 rapids on the Arkansas River (our guide puked in terror!) ……..and somehow, we survived Jose's birthday in Denver. Permission slips were invented for trips like these!

But, above all, we survived six weeks of intensive field training. We mapped the Bull's Eye, the Mixing Bowl, and Blue Ridge near our home base at the Abbey in Cañon City, Colorado. We endured two weeks of indentured servitude, laying seismic lines in a rattlesnake-infested desert in Wyoming (among other places). And, as the last field class to grace the hills of Ullathorne, we made certain to leave our mark in field camp history.

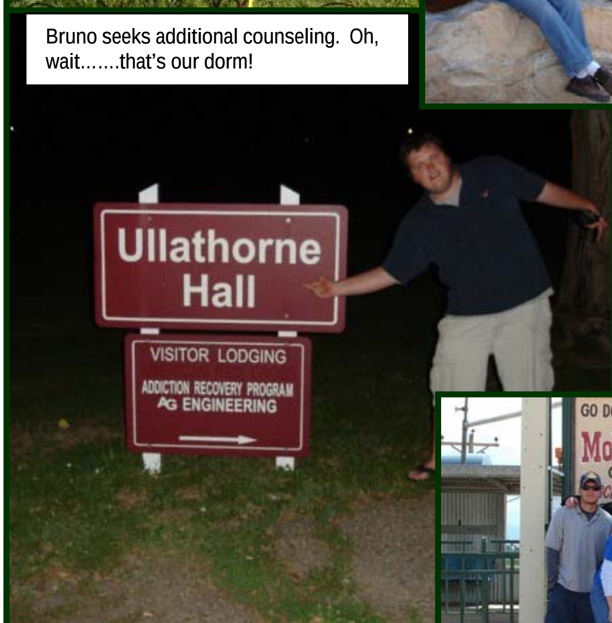
So, let's "Come Together" one more time to explore our summer through pictures………

The group (most of us) at Royal Gorge. From the left: Gabriel Borges, Chris Harms, Jose Villalobos, Bruno Harms, Paul Richardson, Leo Rojas, Kristen Marra, Kathryn Gardner, Kate Moore, Anh Pham, Colt Nickel, Victor Parro-Galvis, Brooke Anderson, Dr. Harper, Andy Hafner. (Missing: Jeff Patrick, Dara Koleowo, and Manuel Navarro.)

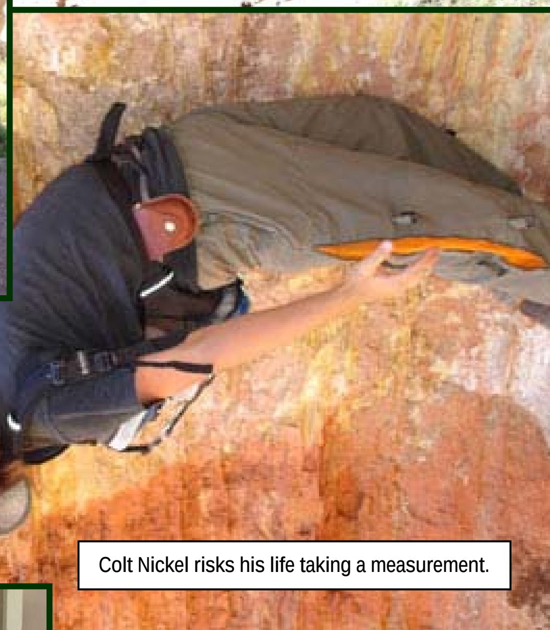

"On your mark, get set, go!" The group lays seismic line at the Abbey.


The group poses under an anticline, North Twin Mountain.


Jose, Victor, Leo, Manuel, & Gabriel eat lunch under dinosaur tracks on Skyline Drive.



Bruno seeks additional counseling. Oh, wait.......that's our dorm!


Colt Nickel risks his life taking a measurement.

Posing before our descent into a working gold mine, Cripple Creek, Colorado.


Our version of "YMCA" at Great Sand Dunes National Monument.


Snow fight on Spanish Peaks.

"2006 SGG Summer Field Camp, Cañon City, Colorado"

Neil H. Suneson
School of Geology and Geophysics and Oklahoma Geological Survey

Figure 1. Many OU alumni will recognize the field camp at Cañon City. The camp is still shown on the Florence quadrangle map as "University of Oklahoma Summer Geology Camp". Oklahoma State now owns the property, and this was the first year in over a decade that OU undergraduate students got to experience what so many alumni fondly remember. **A note to OU alums – many of your "missives" remain on the cabin walls.**

For the first time in a long time, the School's summer field camp returned to its roots along Eightmile Creek at a gap in the Dakota Sandstone hogback about 8 miles east of Cañon City, Colorado **(Figure 1)**. Having left the relative luxury of the "Abbey", OU's students got a better taste of what most undergraduate summer mappers throughout the country experience – field *camp* (with the emphasis on *camp*). Fifteen OU students (including one P.E. major), graduate teaching assistant Matthew Zechmeister, and Professors Neil Suneson and Roger Young teamed up with camp director Jim Puckette (Oklahoma State University), Aaron Johnson (University of Virginia at Wise), and 48 other geology students from as far away as Virginia Tech to take strikes and dips, shoot bearings, measure sections, and map geology.

Figure 2

Left to Right: Inyene Awakessien, Aaron Bell, Gbenga Yemidale (with Jacob's staff), Faiyaz Ali (P.E. student), Jason Moncrieff, and Amir Allam.

Generations of OU geology students will recognize some of the field projects the 2006 students completed. Field camp started with an overview of the geology of the Cañon City area, including Skyline Drive and the O.C. Marsh dinosaur quarries in the Jurassic Morrison Formation north of town. The first project was measuring a section of Precambrian through Pennsylvanian strata at Gnat Hollow **(Figure 2)**. The unconformity at the top of the Idaho Springs Group afforded most students their first, but certainly not last, religious experience at field camp – the ability to stretch their fingers across 1 billion years of missing earth history **(Figure 3)**.

The next big project was measuring the Precambrian through Cretaceous section at Grape Creek **(Figure 4)**. It was here that some students decided to form a new geological society –

"Enemies of the Morrison". For some reason the Jurassic Morrison Formation, with its complex lithologic changes and rough topography, inspired not intellectual curiosity but unrepeatable profanities. And it was here at the Grape Creek section that some students experienced their second religious experience – standing on the Dakota Sandstone/Graneros Shale contact. All (mostly) terrestrial strata below and all marine strata above – you are standing on the edge of the Late Cretaceous Western Interior Seaway. After measuring the Grape Creek section, the students mapped the area. While most admitted mapping the tilted beds was relatively easy, the faulted and thrusted and folded Precambrian – Ordovician contact was not. The temperature began to get the best of some at this point; Jim Puckette commented that in his 12 years at OSU's field camp, this year was the hottest … by 10 to 15 degrees!

Figure 3

Pondering the unconformity between the 1.4-billion-year-old Idaho Springs Group gneisses & pegmatites & the Ordovician Manitou Dolomite are (from left to right, standing) Aaron Bell (laughing hysterically), Jason Moncrieff, Gbenga Yemidale, Rob Wilson, & Ali Wushur. Sitting are Paul Bowen, Inyene Awakessien, and Amir Allam.

Figure 4

Century-old kiln at contact between the Graneros Shale and Greenhorn Limestone (Cretaceous); Paul Bowen for scale.

Field trips away from Cañon City included a trip to the Denver Museum of Nature and Science and Garden of the Gods; a trip up Shelf Road (not for the faint-hearted) to the CC and V gold mine near Cripple Creek followed by a ride down, in the dark, Phantom Canyon Road (where the SGG van acquired the nickname *"Tafone Coaster"*); a trip to near Divide to collect amazonite and smoky quartz and another to the Calumet iron mine (skarn deposit) to collect prize epidote crystals; and lastly a trip up the Arkansas River to near its headwaters to Leadville (elevation 10,350 ft) for a snowball fight.

I left camp after three weeks and Roger Young and TA Carlos Russian took over for a field geophysics (gravity and magnetics) exercise near Gem Park. He promised this would be the most beautiful of the field camp projects, with superb views of the Sangre de Cristo Mountains. Week 4 would be half field geophysics and half Mixing Bowl and week 5 would be Twin Mountain. Details of these will have to await those who survive.

As I write this (June 16) the students have one week to go. Hopefully, the students will remember the friends they've made from other schools and forget the heat. They'll remember the classic Front Range geology and forget the occasionally leaky roofs. They should remember the great food and the late, late nights completing reports and maps and the one or two late, late parties. Someday the students may even look back fondly on the flooded shower stalls and maybe, just maybe, they'll even forgive the Morrison. ■

Sooner Charles Baker at classic trace fossil locality in the Ordovician Harding Sandstone at Indian Springs Ranch a few miles west of camp. The assemblage consists mainly of tracks of merostome arthropods (horseshoe crab-like) from the Order Aglaspida and Suborders Synziphorsurina and Limulina, and the arachnid anthropod (scorpion-like) of the Order Scorpionida. In addition, this locality contains an articulated portion of a primitive fish, the ostracoderm *Astraspis* and its feeding trace *Agnathichnus*. Other OU students pictured are Josh Garrett (sunglasses, far right), Regan Drain (in sunglasses, behind and to the right of Charles), Meghan Magill (in visor) and Rob Wilson (in sunglasses talking to Meghan).

OU Summer Field Camp students at Grape Creek. *Standing from left to right*: Jake Emberson, Meghan Magill, Paul Bowen, Ali Wushur, Rob Wilson, Regan Drain, Jason Moncrieff, Charles Baker, Amir Allam, Matt Zechmeister (graduate TA), and Josh Garrett. *Sitting from left to right:* Inyene Awakessien, Aaron Bell, Eric Carter, Gbenga Yemidale, Faiyaz Ali. The infamous Twin Mountain, the students' final independent mapping project, is in the background.

NEWS FLASH!! Twelve (12) days after our students left Cañon City, a flash flood roared through camp! Four (4) women's cabins and the faculty cabin were swept away – only the foundations remain. The bridge pillar and abutment was washed out, and two other cabins were damaged. Many water and sewer lines were broken as well.

YEAR IN REVIEW

School of GEOLOGY and GEOPHYSICS

AWARDS & RECOGNITION

Above: Dr. Roger Slatt received the "Grover E. Murray Memorial Distinguished Educator Award" at this year's AAPG Convention in Houston. *To the Right:* Members of the AAPG Student Chapter in the School of Geology and Geophysics proudly pose with Dr. Slatt.

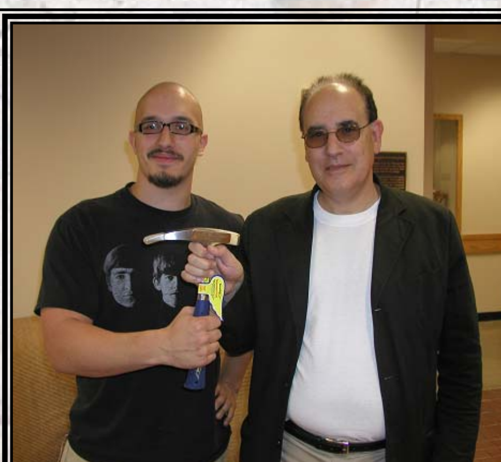
To the Left: Ellen Gilliland (center) receiving a scholarship check from Arlene Burkhalter (on the right) of the Oklahoma Mineral and Gem Society. This is an annual scholarship funded through silent auctions at their monthly meetings. Dave London (on the left) from the School of Geology and Geophysics was also present at the ceremony.

Dr. Lynn Soreghan (on the left) received the distinguished James Lee Wilson Award from SEPM (Society for Sedimentary Geology) at this year's AAPG Convention in Houston in recognition of "Excellence in Sedimentary Geology by a Young Scientist". Receipt of this award makes Lynn eligible for the Twenhofel Medal.

Kristen Marra, University of Oklahoma

Kristen's project will examine the origin, composition, and depositional history of sediment fill within Unaweep Canyon, CO in order to help constrain the canyon's unresolved genesis. The fill from the inner canyon includes a thick lacustrine section that will provide a high resolution climate record for an upland setting for the early and mid Pleistocene. Sedimentological and geochemical analyses will be conducted on core collected from the canyon's inner gorge in June, 2004. Her faculty sponsors are Dr. Michael J. Soreghan and Dr. G.S. Soreghan.

Kristen was awarded an internship (scholarship) for 2006 from DOSECC (Drilling, Observation and Sampling of the Earth's Continental Crust). Only 3 students are awarded nationally!



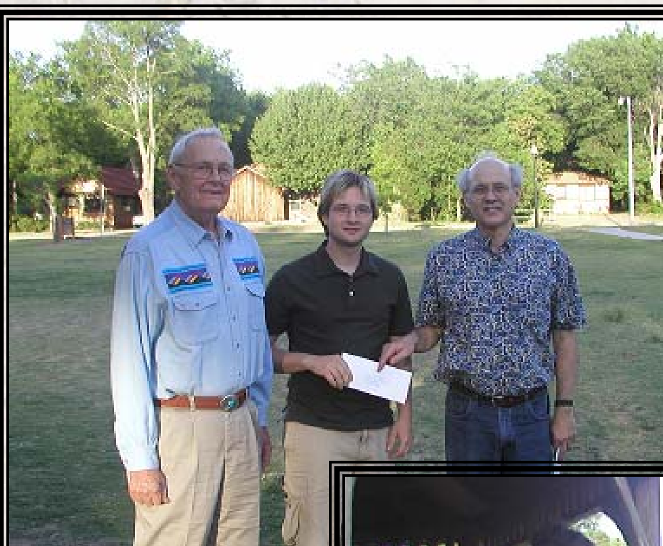
***To the Left:* Amir Allam received a geologist's pick and hammer from Dr. Mike Engel as the recipient of the "Estwing Hammer Award".**

2006 Student Award Recipients

Presented at the Spring Picnic and Awards Ceremony

Ellen Gilliland received the "Alan Witten Outstanding Senior in Geophysics Award", a new award established this year. Pictured here with Ellen is Cathy Witten.

Aaron Bell received the "Charles N. Gould Outstanding Senior Award". Presenter is Dr. Doug Elmore.



Above: **Colt Nickel** received the "David W. Stearns Outstanding Senior in Geology Award". Pictured to the left of Colt is Dr. David W. Stearns himself.

To the Right: **Dileep Tiwary** received the "Students ROCK! Award" from Nancy Leonard, SGG staffer. The "ROCK" award is bestowed by the SGG Administrative Staff to an outstanding student LEADER.

Above: **Devin Dennie** received the "Stanley Cunningham Excellence in Teaching Award", an honor bestowed on grad students. Presenter is Dr. Doug Elmore.

Picture inset: **Adam Shear** was also a recipient of the "Stanley Cunningham Excellence in Teaching Award", but was not available at the picnic for a photo.

Jason S. Moncrieff received the "Outstanding Mineralogy Student Award" from the Mineralogical Society of America (MSA). Each year Dr. David London nominates the top student in GEOL 2224 (Introduction to Mineralogy), and he selected Jason this year due to his leadership in the Fall 2005 GEOL 2224 course, his active participation in the Pick and Hammer Club, and his love for collecting and studying minerals. This award included a certificate, recognition by the MSA, his choice of one of their publications, and a one-year membership to the MSA Journal.

Dr. David London was the recipient of two honors this year: 1) The University of Oklahoma "Student Association Outstanding Faculty Award" for the 2005-2006 academic year, which was bestowed upon him by his students, and 2) the "Rocky Mountain Federation of the American Federation of Mineral Societies Honorary Award for 2006", given for distinguished achievement in the field of Earth Sciences. David was nominated by Arlene Burkhalter of the Oklahoma Mineral and Gem Society. This award provides two scholarships, awarded for two years, to geology graduate students chosen by Dr. London. Recipients for the first year will be Kerry Paul and Amie Garcia.

Annual Spring LAHC Awards Gala

(Latino Achievement & Heritage Celebration Committee)

School of Geology and Geophysics Award Recipients

4.0 GPA Award

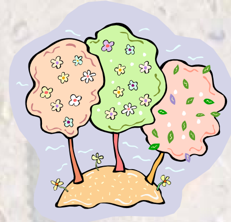
Walter Sebastian Bayer
Heidy Correa Correa
William Jose Duran
David Ramirez Mejia
Carlos F. Russian

3.5 GPA Award

Diana Carolina Parada
Ricardo Zavala Torres

David Ramirez Mejia, MS Grad in Geophysics, received an award for "Best President of the Year" for his service as president of COLSA (The Colombian Student Association).

Goodbye Claren



After 32 years of service to The University of Oklahoma, **Professor Claren Kidd** is retiring as the Geology Librarian. She received her Bachelor's and Master's degrees in Geography from OU. She received her Master's degree in Library Science from the University of Pittsburgh.

Claren began her career with University Libraries as an Interlibrary Loan Librarian in 1972. After one year, she was promoted to the branch librarian of the Geology Library. She has worked with many faculty, graduate students, undergraduate students and members of the geoscience community over the years. Her expertise in maps, geography, and the geosciences has helped many library patrons.

Claren says that her favorite part of being a librarian is that she is able to help people identify and find what they need to write papers and complete projects. She works hard to anticipate what kinds of materials are relevant to each of the areas within the geosciences.

Claren was critical to the design and building of the L.S. Youngblood Energy Library during the 1980's, working closely with Mrs. Youngblood. Claren continues to provide excellent management of the facility.

Claren has been active in the Geoscience Information Society. She has served on the Union List of Geologic Field Trip Guidebooks Committee and served and chaired the International Initiatives Committee which selects a person for the GIS fellowship annually. She has served on the University Libraries committees as well as University committees such as the Recreational Services Committee and the Speakers Bureau.

Claren is a volunteer 'tree tender' in Norman, which is a volunteer group that helps the city in deciding where to plant new trees and monitoring them after they are planted. During her retirement Claren plans to garden and travel.

We wish Claren the best of luck on her retirement. Congratulations, Claren!

Article by Debra Engel
Director of Public Services
University of Oklahoma Libraries

Oklahoma Geological Survey Director Named Regents' Professor

Charles J. Mankin, believed to be the longest-serving director of any state geological survey in the country, was named a **Regents' Professor**[1] by the University of Oklahoma Board of Regents during its March meeting.

Left to Right: Dr. Nancy Mergler, Provost; Dr. Charles Mankin; Dr. Larry Grillot, Dean of College of Earth and Energy. (Photo courtesy of Sue Crites, Oklahoma Geological Survey)

"No one is more deserving of this honor than Charles Mankin," **OU President David L. Boren** said. *"His scholarship, teaching and research have left a lasting mark on our state and its economy and energy industry."*

Mankin, director of the Oklahoma Geological Survey and professor of geology at OU, as well as former director of the Sarkeys Energy Center, is known as the **"dean of state geologists"** among his peers. He was hired in 1959 during the presidency of George Lynn Cross, OU's seventh and longest-serving president, and was asked to become the acting director of the university's School of Geology and Geophysics in 1963, while still an assistant professor. He became the school's director in 1964 and served in that capacity for 14 years. He was named director of the Oklahoma Geological Survey in 1967 and as director of the Sarkeys Energy Center in 2000. He served as executive director of the OU Energy Resources Institute from 1978 to 1987.

Mankin has served on numerous professional and scientific boards, committees and panels at state and national levels. Additionally, he is a member of numerous professional, scientific and technical organizations, including the Association of American State Geologists, the American Institute of Professional Geologists and the Geological Society of America, and has served as president of several national organizations. He is a 50-year member of the American Association of Petroleum Geologists and a life member of the Oklahoma City Geological Society, receiving honorary membership in 1994. He also serves on the National Petroleum Council, with a two-year term beginning in 2004.

In recognition of his achievements, Mankin has received the Ian Campbell Memorial Medal from the American Geological Institute; the Public Service Award from the American Association of Petroleum Geologists, serving as secretary of that organization for two years; the Martin van Couvering Memorial Award and the Ben H. Parker Memorial Medal from the American Institute of Professional Geologists; and the Conservation Service Award from the U.S. Department of the Interior, among many others.

Born in Dallas in 1932, Mankin earned his bachelor's, master's and doctoral degrees in geology from the University of Texas at Austin and was a post-doctoral fellow at the California Institute of Technology.

Aside from his posts at OU, he has taught at the University of Texas, served as a special instructor in geology for Shell Oil Co. engineers and as a geologist for the New Mexico Bureau of Mines and Mineral Resources.

~~ News Release issued by OU Public Affairs

Dr. Mankin was also honored at a reception on May 11, 2006, for his years of service as the Director of Sarkeys Energy Center. College of Earth and Energy, Dean Larry R. Grillot and staff expressed their appreciation for his dedication and years of hard work. The reception was attended by the faculty, staff of all CEE/SEC departments as well as other colleges, departments and research units in the Energy Center.

Dean Larry Grillot praising Dr. Mankin at his "Appreciation Reception" for his years of service to the Energy Center.

Dr. Evgeni Chesnokov presenting Dr. Mankin with a plate from University College London.

[1] *To qualify for a Regents' Professorship, a faculty member must have rendered outstanding service to the academic community or to an academic or professional discipline through extraordinary achievement in academic administration or professional service. Nominees for Regents' Professorships are presented to the OU Regents by the president after conferring with the chairman of the Board of Regents, the chair of the appropriate Faculty Senate, and the University Council on Faculty Awards and Honors. The term of a Regents' Professorship is continuous until retirement.*

Oklahoma Trailblazer Award Honoring The Lloyd Noble Family

Lloyd Noble, born in 1896 in Ardmore, Okla. to a pioneer merchant family, became a widely respected and successful oil driller, producer and philanthropist.

Noble worked in the family hardware business and as a church janitor before receiving his teaching certificate from Southeastern State College in 1914. After teaching for a brief time in one-room schoolhouses, he entered the University of Oklahoma as a pre-law student in 1916. A family illness and World War I interrupted his education until 1919, when he returned to OU. Shortly thereafter, oil was discovered on his mother's farm, and the oilfield proved to be an irresistible magnet.

In 1924, Noble married Vivian Bilby. They had three children, Sam, Ed and Ann, before her untimely death in 1936.

Noble became one of the largest drilling contractors in the world. Noble Corporation, the successor to Noble Drilling Corporation, continues today as one of the leading, worldwide, offshore drilling contractors. He also founded a successful exploration and production company, Samedan Oil Corporation. (named for his three children), which operates today as a subsidiary of Noble Energy, Inc.

Outside of the oil business, state and community improvement were important to Noble. As a loyal alumnus of OU, he served on the OU Board of Regents for 15 years, including two years as chairman. He also was active in politics, serving as a Republican State Representative in the 1924 to 1930 legislature.

Noble's greatest legacy lies with his establishment in September 1945 of the Samuel Roberts Noble Foundation – named to honor his father. Noble's strong interest in agriculture, land stewardship and helping his fellow man continues today through the Foundation's programs. With assets of approximately $1 billion, the Foundation has expended more than $600 million in its charitable activities, including more than $260 million in grants.

The Foundation was the primary beneficiary of Lloyd Noble's estate after he died unexpectedly in 1950. Noble's children helped shape the direction of the organization after their father's death. Today, a majority of the Foundation's governing board is composed of the Lloyd Noble family.

Noble family front row: E.E. Noble, Ann Noble Brown, Vivian Noble DuBose, Noble Energy rep, Russell Noble, Nick Noble. Back row left to right: Dr. D. Randolph Brown, Jr., James C. Day, Mike Cawley.

The Oklahoma Trailblazer Award Dinner

Honoring
The Lloyd Noble Family

With Appreciation to Sponsors

Noble Corporation

noble energy
Noble Energy, Inc.

Mewbourne School of Petroleum & Geological Engineering
The University of Oklahoma

devon
Devon Energy Corporation

Panhandle Royalty Company

Mr. Ronnie Irani ……………… *Welcome and Introductions*
CHIEF EXECUTIVE OFFICER AND PRESIDENT
RKI EXPLORATION AND PRODUCTION

Dr. Nancy L. Mergler ……………… *Remarks*
SENIOR VICE PRESIDENT AND PROVOST
THE UNIVERSITY OF OKLAHOMA

Mr. Mike Cawley ……………… *Introduction of Family*
CHIEF EXECUTIVE OFFICE AND PRESIDENT
NOBLE FOUNDATION

Mr. Ronnie Irani ……………… *Closing Remarks*

Hosted By

College of Geosciences

Mewbourne School of Petroleum & Geological Engineering
The University of Oklahoma

The University of Oklahoma
Sarkeys Energy Center

School of Geology & Geophysics
The University of Oklahoma

Energy Management Program
The University of Oklahoma

Established in 2003 at the University of Oklahoma Sarkeys Energy Center and presented annually to honor the exceptional individuals in the energy industry who blaze a trail for others to follow.

The Oklahoma Trailblazer Award recognizes those who have courageously pioneered operational or scientific practices, procedures and developments for the energy industry, thus enhancing the quality of life for the citizens of Oklahoma, the nation and the world.

Oklahoma Trailblazers have exemplified the highest standards of personal integrity, ethics and service to others. The recipient is an exceptional ambassador for the energy industry and is a role model for future generations to emulate.

AAPG Student Chapter

School of Geology and Geophysics, The University of Oklahoma

AAPG Student Chapter
By Dileep Tiwary, President

2005 – 2006 OFFICERS

Dileep Tiwary, President
Adam Shear, Vice President
Katherine Moore, Treasurer
Carla Valerio, Secretary
Dr. John D. Pigott, Faculty Advisor

The American Association of Petroleum Geologists (AAPG) Student Chapter is a registered student organization at the University of Oklahoma. It is also the largest student organization among the other registered clubs in the School of Geology and Geophysics. The Chapter has a strong pool of members who meet every month to evaluate the past performance of the Chapter and discuss future planning. Generally, the first meeting of every academic year is attended by the Chapter's faculty advisor to let students know the benefits of being an AAPG student member. The meetings are chaired by the president and supported by three other officers, the vice president, treasurer, and secretary. Presently, our Chapter is progressing to new heights under the guidance of Chapter faculty advisor, Dr. John D. Pigott.

The American Association of Petroleum Geologists strives to advance the science of geology, especially as it relates to petroleum, natural gas, and other energy mineral resources; to promote the technology of exploring for, finding, and producing these materials from the Earth; and thus to foster the spirit of scientific research throughout its membership.

A strong student program here at The University of Oklahoma, including both graduate and undergraduate members, is a vital part of the overall operation of the nationwide association. The School of Geology and Geophysics is the oldest petroleum geology school in the world, and our particular Chapter is a very important part of the history of the AAPG. According to most, we had our first meeting here before the organization was incorporated nationally in 1917.

The purpose of the AAPG Student Chapter is to keep the students posted about various events of the Association, such as educational programs, annual conventions, and regional meetings on national and international levels. The Chapter also helps the School organize various educational and social events. It shows care and concern for all elements of the School and always steps up to help the staff, faculty, and students to promote the reputation of the School. The Chapter plays an important role in advising students about career opportunities in geology and geophysics; informing students about scholarships, grants, loans and other financial aid available; and fostering a friendly environment throughout the campus.

In the beginning of the academic year 2005-06, the Chapter kicked off its first meeting by organizing a very informative talk by Dr. John D. Pigott titled *"Interviewing and How to Play the Game"*. This talk helped students immensely in their preparation for interviewing. As we all know, we had a very busy recruiting season with approximately 25 companies interviewing students for summer internships and full-time jobs. The interviewing schedule was so tight that we hardly had time to think about other activities during the semester.

Photo 1: Chapter president, Dileep Tiwary and member, Norelis Rodriguez at the Expo registration table.

We take pride in saying that the School of Geology and Geophysics has been successfully organizing AAPG/SEG Spring Student Expos for the last five years. Our Spring semester every year is largely occupied by making plans and arrangements for the Expo. It is our Chapter's responsibility to work closely with the School to execute the plans. The Expo demands huge amounts of volunteer work in all areas, like working at the registration booth **(Photo 1),** making all the information available to the recruiters from the visiting companies and the students from other universities. We try our level best to make our campus easily accessible. In many cases, we also arrange transportation for visiting students from the airport to the campus and back to their hotels at the end of the day. I highly appreciate visiting students and company representatives for their cooperation in making our Expo a very successful event.

As the Spring semester progressed, we survived the Student Expo and Mid-terms and finally made it to the long awaited event: Geology of Wine. Apart from being informative, as the name indicates, the event was packed with fun. Chapter faculty advisor, Dr. John D. Pigott, gave an excellent lecture on geology of wine explaining the finer points of wine growing and the effect of geological and geographical location on wine. He also explained how the taste changes if the grapes are grown on the edge and deep down in the basin. Four types of wine, such as Shiraz, Cabernet Sauvignon, Pinot Noir and Merlot, were brought up from four countries, viz. France, Australia, Chile and The United States. This event was open to all AAPG student chapter members, and more than 50 members attended. It was a huge success, and I think the Chapter Secretary, Katherine Moore, did a fantastic job making all the arrangements.

Effective January 1, 2006, the College of Geosciences at the University of Oklahoma was restructured. The School of Geology and Geophysics and the Mewbourne School of Petroleum and Geological Engineering became the College of Earth and Energy. We felt the need to interact with the members of other student organizations. With the help of the Dean's office, AAPG, SEG, SPE and other clubs got together and organized the 1st Energy Olympics of the new College of Earth and Energy **(Photo 2)**. We had a wonderful time talking with each other and sharing our experiences.

Photo 2: Chapter vice president, Adam Shear (on right), representing the Club at the Energy Olympic event organized by AAPG, SEG, SPE, and other student organizations.

Then, finally the time came for the annual AAPG convention in Houston. As our Chapter's members have always attended this event in large numbers, this year was no different with more than 20 members in attendance. Our school is one of the

Photo 3: Chapter members having dinner hosted by Shell Oil Co. representative during the AAPG annual convention.

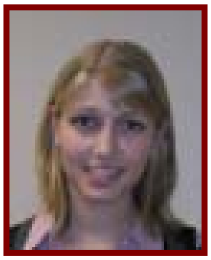
few schools that exhibited a booth to inform AAPG attendees about our research, admission process, and other pertinent information crucial for prospective students. **Shell Oil** representatives graciously hosted a dinner for all the OU students attending the convention **(Photo 3).** The student members from the School of Geology and Geophysics are proud to acknowledge our three faculty members who were honored by AAPG for their dedication and service to the geosciences throughout the world. The Grover E. Murray Memorial Distinguished Educator award was presented to Dr. Roger M. Slatt and Dr. Randy Keller, and Dr. G.S. "Lynn" Soreghan received the James Lee Wilson award for excellence in sedimentary geology by a young scientist.

I have enjoyed working with students, faculty and staff of the School of Geology and Geophysics. It has given me opportunities to work as a leader and interact with many people from academia and oil industries. I would like to take this opportunity to thank the Director of the School, Dr. R. Douglas Elmore, for his support and encouragement. My sincere thanks also go to Donna Mullins, Nancy Leonard, Niki Chapin, Therese Stone, and Lydia Jorgenson for their help, suggestions, and support in making this Chapter successful.

In addition, I would like to thank **Dr. William Clopine** and **Richard Aram** of **ConocoPhillips** and **Dr. Brent Couzens** of **Shell Oil Company** for their generous contributions to the Chapter. Dr. Clopine has been very supportive in all student activities, and I have received tremendous encouragement from him throughout the year. Without his support, it would have been very difficult for us to organize so many activities. I also appreciate the **UOSA** and **AAPG** for their financial contributions to the Chapter.

Last, but not least, my sincere thanks to other officers of the Chapter: **Adam Shear** (Vice President), **Katherine Moore** (Secretary) and **Carla Valerio** (Treasurer) for supporting me in leading this organization. My best regards goes to, none other than, Dr. John D. Pigott (Faculty Advisor) for his unwavering guidance. ■

Chapter members having fun at the SGG booth at the annual AAPG Convention. ***Back row left to right:*** Louise Totten, Roderick Perez, Xavier Refunjol, Romina Portas. ***Bottom row left to right:*** Tatiya Uttarathiyang, Prerna Singh, Diana Parada



The Pick & Hammer Club

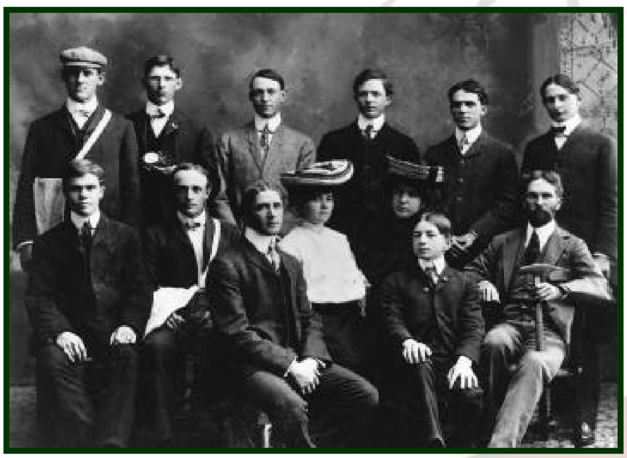
School of Geology and Geophysics, The University of Oklahoma

2005 – 2006 OFFICERS

Ellen Gilliland, President
Matt Totten, Vice President
Brooke Anderson, Treasurer
Tiffany Legg, Secretary
Dr. David London, Faculty Advisor

P&H Student Chapter
By Ellen Gilliland, President

Founded in 1903, the Pick and Hammer Club was one of the first student groups established at the University of Oklahoma. Our purpose is to encourage students to explore and expand their interest in geology and to promote interaction among members of the geosciences community at OU. Membership is free and is open to anyone with an interest in geology; you do not have to be majoring in geology to join.



Pick and Hammer Club in 1906.

The 2005-2006 academic year was an eventful one for the Pick and Hammer Club. We hosted a series of student-faculty lunches, in which students interacted with guest faculty members and learned about their research and projects. We also held a variety of social events, including a department-wide cookout and bonfire at Lake Thunderbird in the fall and a luncheon with the department staff in the spring.

Our biggest activity of the year was the gem and mineral auction the club hosted during a visit by the Alumni Advisory Council. Thanks to the generous efforts of our club liaison, Dr. David London, who purchased minerals on our behalf and also donated specimens from his own collection, as well as the efforts of a dedicated club committee, the auction was a huge success. The profits will ensure another great year for the club and help fund upcoming projects and activities that include assembling a new student lounge and planning a club field trip for the new year.

Mineral specimens that were auctioned at the Spring AAC mtg.

The club officers for the 2006-2007 year are **Matt Totten—President, Amir Allam—Vice President, Rika Hood—Treasurer, and Tiffany Legg—Secretary. The club's faculty liaison is Dr. David London**. If you have questions about the Pick and Hammer Club or would like to become a member, email oupickandhammer@gmail.com.

The group at the bonfire/cookout in Fall, 2005.

Luncheon with Dr. Lupia hosted by P&H.

Luncheon with SGG staff hosted by P&H.

Club outing to a local restaurant.

SEG Student Chapter

School of Geology and Geophysics, The University of Oklahoma

SEG Student Chapter
By Satish Sinha, President

2005 – 2006 OFFICERS

Satish Sinha, President
Ryan Miller, Vice President
Matthew Sparkman, Treasurer
Carla Valerio, Secretary
Dr. Roger Young, Faculty Advisor

Yet another great year for the Society of Exploration Geophysicists (SEG) Student Chapter at The University of Oklahoma. This year's committee consisted of Satish Sinha (President), Ryan Miller (Vice-President), Matthew Sparkman (Treasurer), and Carla Valerio (Secretary) and was assisted by Dr. Roger Young (faculty advisor). Increasing interest of students in our Society is evident as, apart from geophysics and geology students, a few petroleum engineering students as well are now members of our Society.

It was a unique year for our Chapter as the parent organization in Tulsa, Oklahoma celebrated its 75th anniversary at the Annual Meeting in Houston. As the student chapter president, I was invited at the SEG Executive Board meeting to talk about our Chapter activities and members' concerns. About 20 students from the School of Geology and Geophysics participated in the SEG International Exposition. Unlike the previous years, this year's student members were charged registration fees for the annual meeting. However, **BP** sponsored the registration fees for the Chapter members attending the meeting. The Chapter members also helped set up the School of Geology and Geophysics booth at the convention and interacted with alumni and visitors at the booth.

Photo taken at the SEG Annual Meeting in Houston, SGG booth.

We had an excellent opportunity for a seismic field trip. We went to Elk City, an area in Oklahoma where 3D seismic acquisition was being carried out by **Chesapeake Energy**. It didn't take long for us to realize that the nice sections of seismic data

Photo taken at the SEG Annual Meeting in Houston. **Left to Right:** *Carlos Cabarcas, Gloria Romero, Satish Sinha, Rodney Calvart, Marco Vignali, Dileep Tiwary, Heidy Correa, and David Ramirez.*

we displayed on our monitors actually involved lots of hard work in the field. We thank **Chesapeake** and **Dawson** crew members for organizing this event.

SEG Chapter members participated in the GSOC continuing education workshop. We are thankful to **Star Geophysics** for sponsoring our registration fees. This year has been a monetarily good year for the Chapter. Thanks to the **Shell** and **ConocoPhillips** donations, the student chapter is able to organize more activities. I hope other companies will also come forward and support our Chapter in the future. ■

Top: *Sohini Sur reading a GPS system while Jennifer Eoff observes.* **Bottom:** *Students looking at the vibroseis on a field trip.*

AAPG/SEG 2006 SPRING BREAK STUDENT EXPO

The University of Oklahoma is raising the bar! This year's Spring Break Student Expo proved to be the BEST one EVER (of course we say that after each one)! And what a labor of love it was for everyone involved. **We hosted 29 company sponsors this year, with FIVE Event Sponsors ……….record breaking numbers!** We would like to acknowledge the following companies and their recruiters with heart-felt appreciation for their dedicated and unselfish support of this vital and worthwhile event:

EVENT SPONSORS:

PLATINUM SPONSORS	GOLD SPONSORS	SILVER SPONSORS
AAPG Foundation	Crawley Petroleum	Baker Atlas
Chevron	DeGolyer & MacNaughton	David G. Campbell
Chuck Noll, Jr.	ExxonMobil Exploration	H.W. "Dub" Peace II
ConocoPhillips, Inc.	geoPLUS Corporation	Jon R. Withrow
SEG & SEG Foundation	Kerr-McGee Company	MicroSeismic, Inc.
Shell International E&P	MAP Exploration, Inc.	Oklahoma Geological Survey / Petroleum Technology Transfer Council
Total E&P USA Inc.	Mewbourne Oil	
	Minerals Mgmt. Service	
	Pason Systems USA	
	Petroleum Mud Logging	
	Schlumberger	

We also registered **146 students** from **25 different states**, representing **41 different universities**; one student came from Venezuela, South America. EVERYONE who attended got the chance to talk to the company recruiters, and some of the companies continued to interview even after the Expo was over! **SCHLUMBERGER alone interviewed 60 students……………ASTOUNDING!**

CONGRATULATIONS TO OUR POSTER CONTEST WINNERS! But, it's like Judge David G. Campbell said at the Closing Awards Ceremony……..”You're ALL winners, because all the posters were phenomenal!”

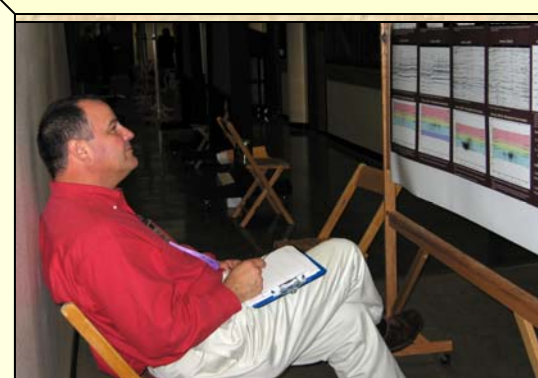
GEOLOGY WINNERS:	1st Place -	**John Ceron**, University of South Carolina
	2nd Place -	**Nathan Boersma**, University of Idaho
	3rd Place -	**Khurrum Ahmed**, University of Buffalo
GEOPHYSICS WINNERS:	1st Place -	**Ashwani Dev**, University of Texas at Dallas
	2nd Place -	**Ahmed Alahdal**, University of Oklahoma
	3rd Place -	**Heidy Correa**, University of Oklahoma

Check out the “Expo Student Abstracts” online at http://geology.ou.edu/ to review ALL the abstracts. These students are doing some fascinating research that deserves attention!

And, of course, we couldn't have a contest without judges……….so, a special THANK YOU! to the following industry friends and alumni who generously donated their time and expertise to evaluate the posters:

POSTER JUDGES

Glen Brown
David G. Campbell
Steve Carlson
Larry Lunardi
Paul McColgan
Mike Pollok
Tom Rowland
Joe T. Vaughn
Jon Withrow



Mike Pollok studying one of the posters.

In addition to the interviewing and networking opportunities, the Expo also offered FOUR educational sessions (also a record this year) taught by OU alumni and faculty. Another special THANK YOU! to these folks for sharing their most excellent knowledge:

DR. ROGER SLATT, Expo Co-Director and OU Professor, taught “Petroleum Geology of Deepwater (Turbidite) Depositional Systems”.

DR. CHARLES GILBERT, OU Professor, led the Wichita Mts. Field Trip and was assisted by GALEN MILLER of the OGS.

MIKE POLLOK, OU Alumnus and president of MAP Exploration, taught “The Potential for Big Bucks……An Independent Geologist's Perspective”.

BOB DAVIS, OU Alumnus and Scientific Advisor at Schlumberger, hosted “Schlumberger Geosciences – A Technology Overview”. Additional speakers from Schlumberger included Rick Kear, Larry Moore, Ryan Christensen, Tom Hanson, Bala Gadiyar, Thomas Hay, Tom Bratton, Ron Martin, and Ernie Gomez.

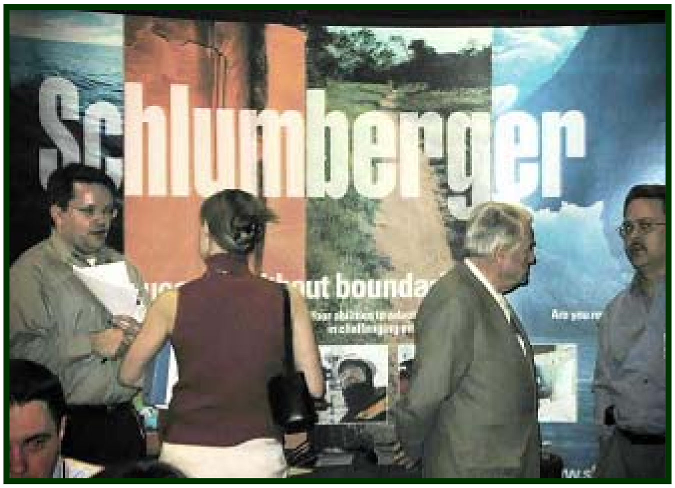
An event of this magnitude could not run smoothly without the hard work and commitment of countless volunteers from the staff and student body of the School of Geology and Geophysics. They lent their energy and enthusiasm to help make this Expo the most successful and memorable one on the books! So, I would like to mention them by name and extend a **HUGE THANK YOU!**

<u>SCHOOL OF GEOLOGY & GEOPHYSICS STAFF</u>
Dr. Roger Slatt, Expo Co-Director
Dr. Doug Elmore, School Director
Donna Mullins (who provided scheduling assistance)
Nancy Leonard
Therese Stone
Robert Turner
Lydia Jorgenson

<u>GEOSCIENCES COMPUTING NETWORK STAFF</u>
Alicia Zahrai
Taylor Brown

<u>STUDENT VOLUNTEERS</u>
Dileep Tiwary, Volunteer Organizer
Adam Shear, Team Leader
David Ramirez, Team Leader
Satish Sinha, Team Leader
Ryan Miller, Team Leader
Matt Boyce
Prerna Singh
Heidy Correa
Javier Perez
Sebastian Bayer
Veronica Caro
Jamie Rich
Aaron Rothfolk
Rika Hood
Michelle McCarthy
Kate Moore
Ramon Asuaje
Roderick Perez
Sohini Sur
Kajari Ghosh
Subho Banerjee
Sara Kaplan
Michael Hsieh
Dongwon Kim
Shamik Bose
Carlos "Tex" Bahamon
Ahmed Alahdal
Diana Parada
Romina Portas
Evan Noble
Carlos Russian
Norelis Rodriguez
Xavier Refunjol
Dara Koleowo
Angel Gonzalez Canro
Victor Parra Galvis

Recruiters Bill Williamson and Jeff Shannon with Petroleum Mud Logging



Recruiter Karyn Olschesky with Chesapeake Energy

SPECIAL ACKNOWLEDGMENT to **Jenny Cole of SEG** and **Mike Mlynek of AAPG** for all the great advertising by their organizations and for donating those **FANTASTIC** door prizes!! Also, special thanks to **Peter Pangman**, **Director of Geophysics at the SEG Foundation**, for his opening comments at the IceBreaker.

SEG Prizes

- **Introduction to Petroleum Seismology (book)**
- **Seismic Data Analysis – (2 volumes)**

AAPG Prizes

- **Oklahoma City Geological Society Publications on CD-ROM (set of 3 CD-ROMS)**
- **AAPG Memoir 77 – Color Guide to Petrography of Carbonate Rocks**
- **Treatise of Petroleum Geology, Handbook of Petroleum Geology: Exploring for Oil & Gas Traps**

Recipients of the door prizes.

And a final THANK YOU! to all the attendees who sent back the questionnaire with such good feedback and suggestions. This was my first time coordinating this event; and at first sight, the logistics seemed overwhelming! But in hindsight, I can honestly say that I've never experienced so much fun, excitement, and self-satisfaction as I did in working 14-hour days, fretting over every little detail, getting to know a lot of the attendees on a personal level, working with the awesome companies and recruiters, and as a result, knowing in the end that I played even a small part in helping so many of these young people realize their dreams. **It just doesn't get any better than that!!**

~~ ***Niki Chapin***

GEOLOGY 1ST PLACE WINNER

JOHN F. CERON, PhD Student, University of South Carolina

TECTONIC PROVINCES DERIVED FROM GRAVITY AND MAGNETICS IN THE LOWER MAGDALENA BASIN, COLOMBIA

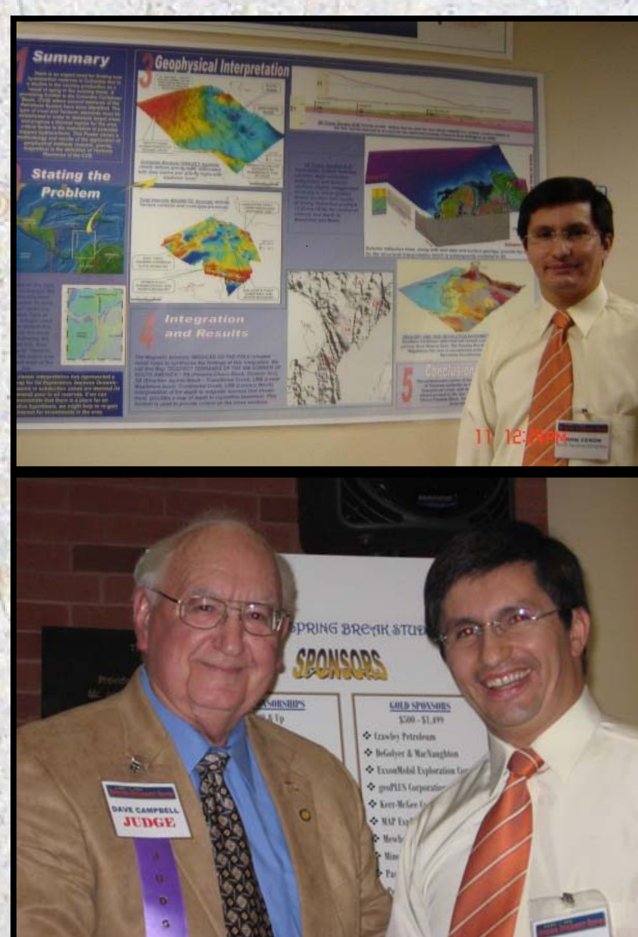
John F. Ceron and James Kellogg, University of South Carolina, Columbia, SC 29208

Tectonic provinces, recognized on the basis of their geologic boundaries and geophysical characteristics, have been mapped for the Colombia Caribbean Basin and adjacent Lower Magdalena Basin in northwestern South America. The methodology was based on regional integration of potential field data (gravity and magnetics) with available geologic and remote sensing information. Well data and outcrops provide geologic control for the interpretation of the geophysical data. The GIS - integrated approach allows weighting of the contributions of each data set towards the determination of the lithospheric structure at the convergent margin of the Caribbean and South America tectonic plates.

Gravity data was compiled for this study from land, marine, aerial and satellite based surveys. Its spatial resolution is better than 2.5 Km (wave length) onshore and about 20 Km offshore, permitting interpretation of the depth to Moho, modeling in two and three dimensions of the basin configuration, and the determination of anomalous density distribution within the lithosphere. More than 20 marine and aeromagnetic surveys were compiled into a digital data set. The magnetic anomaly field can be inverted to estimate depths to crystalline basement and compositional changes within the lithosphere above the depth of the Curie point. Surface geology and well data helped to delineate tectonic provinces.

Detailed 2D structural transect interpretations were constrained by depth converted seismic surveys. Once the cross sections are successfully modeled in terms of structural and stratigraphic control and geophysical data, we integrate them with the results from depth to basement and Moho configuration to propose a tectonic framework for the region, within constraints imposed by the regional tectonics.

While other publications have shown cross sections depicting the structure of the Sinu and San Jacinto foldbelts, and the configuration of the San Jorge basins, they deliberately ignore the relationships between the Caribbean plate subducting slab and the Cenozoic deformation in the Lower Magdalena basin. This is important because it implies differences in the thermal flow regime and sediments provenance, important factors to be considered when exploring for hydrocarbons in the region.



John receiving his award from Alumni Judge Dave Campbell.

GEOLOGY 2ND PLACE WINNER

NATHAN BOERSMA, MS of Science, University of Idaho

CHARACTERISTICS OF EXTENSIONAL FAULT-PROPAGATION FOLDS IN BASALT, SOUTHWEST ICELAND

Surface monoclines above the tips of subvertical normal faults in basalt are common on the Reykjanes Peninsula in southwest Iceland. Monocline development results from upward growth of subsurface normal faults that propagated to the surface from below, rather than from the surface downwards. As slip accrues along the underlying fault, the monocline grows in both height and width, accommodating throw at the surface purely by flexure. Bending stresses within the flexure induce tensile fracturing that breaches the upper hinge at the surface. Further movement along the underlying fault increases the dilation of this fracture resulting in a gaping chasm that may widen by collapse along the fracture walls. No throw occurs along this hinge fracture until the fault ultimately breaches the surface via the fracture. At this time, the monocline becomes a passive and detached hanging wall structure along a vertical fault scarp, thus preventing further growth of the flexure.

Detailed field and aerial photo mapping were used to interpret fracture style and surface monocline geometries, and to assess the interplay between fracturing and monocline development. To capture along-strike changes in monocline shape, elevation profiles were constructed along, and orthogonal to, fault traces using a Trimble real-time GPS data collection system. Data from the elevation profiles were then used to plot relationships such as fault and monocline displacement-length profiles, monocline width vs. height, and monocline average dip against distance along the fault trace. These graphic representations aid in the understanding of fault and monocline mechanics, recording changes in surface monocline characteristics in the along-strike dimension. The observed flexures exhibit maximum monocline-accommodated throw values towards the fault center, which is consistent with a linear elastic fracture mechanics model for fault throw. As the throw approaches zero towards the tips of the fault, there is an associated decrease in monocline-accommodated throw and monocline width until the monocline eventually disappears at the fault tips. Extensional fault-propagation forced folds provide important insights into the geometry and evolution of underlying faults, and are useful in resource and hazards analyses.

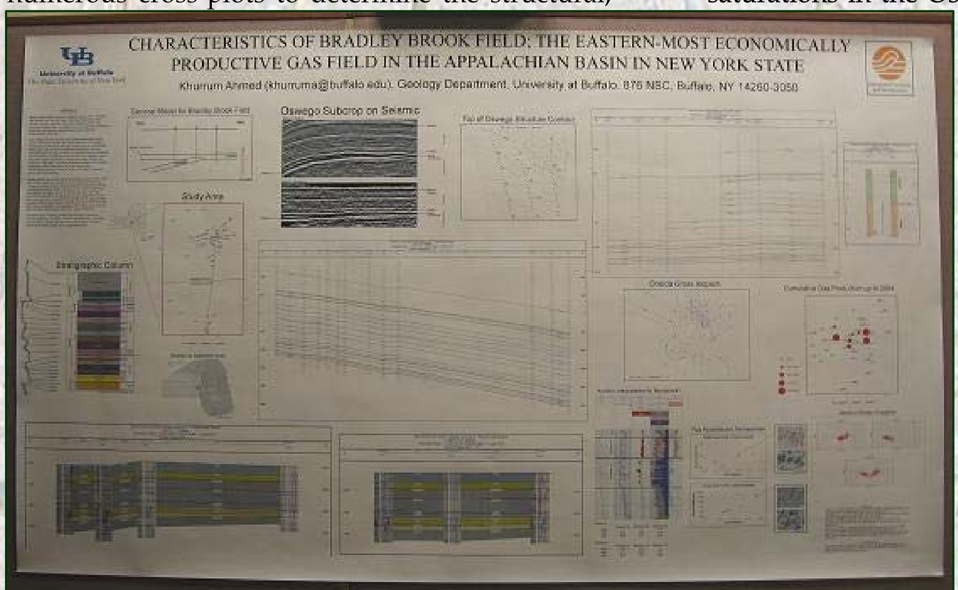
Nathan receiving his award from Alumni Judge Dave Campbell

GEOLOGY 3RD PLACE WINNER

KHURRUM AHMED, MS in Geology, University at Buffalo

CHARACTERISTICS OF THE BRADLEY BROOK FIELD; THE EASTERN-MOST ECONOMICALLY PRODUCTIVE GAS FIELD IN THE APPALACHIAN BASIN IN NEW YORK STATE

Bradley Brook Field is located in Madison County, New York, and produces gas from the Upper Ordovician Oneida and Lower Silurian Oswego sandstones. This study integrates 47 well logs, proprietary seismic data, 27 sidewall cores, and numerous cross-plots to determine the structural,



sedimentological and stratigraphic characteristics of the field.

Both seismic data and well log cross-sections demonstrate that the contact between the Oswego and Oneida sandstones is an angular unconformity; furthermore, both data sets show that the unconformity surface dips gently to the west. Individual stratigraphic units are correlated across well logs on all six cross-sections that are constructed. Oneida sandstone is isopached across the field and a structure contour map of the angular unconformity reveals that Bradley Brook Field occurs on a slight high. Anomalous thickness variations in the Silurian sedimentary section observed in well logs suggest either syndepositional faulting in Silurian times or, less likely, a repeated section from local thrusting.

Neutron-density cross-plots indicate the presence of gas in both Oneida and Oswego sandstones. Inspection of the cross-plots reveals that Oswego has higher porosity whereas densities for Oneida and Oswego sandstones are similar. Water saturations in the Oswego sandstones were found to be higher than in the Oneida sandstone. The mean sidewall core porosities for Oneida and Oswego sandstones are lower than mean porosities calculated from well logs, but the range of values is similar. Thin sections from the sidewall cores show that both Oneida and Oswego sandstones are fine-grained with Oswego being more clay-rich. Illite and chlorite make up the clays in both sandstones.

Characterization of Bradley Brook Field will help in identifying possible directions to be taken in order to extend this play. This study will also help to identify and serve as a model for traps of similar nature on the eastern flanks of the Appalachian Basin.

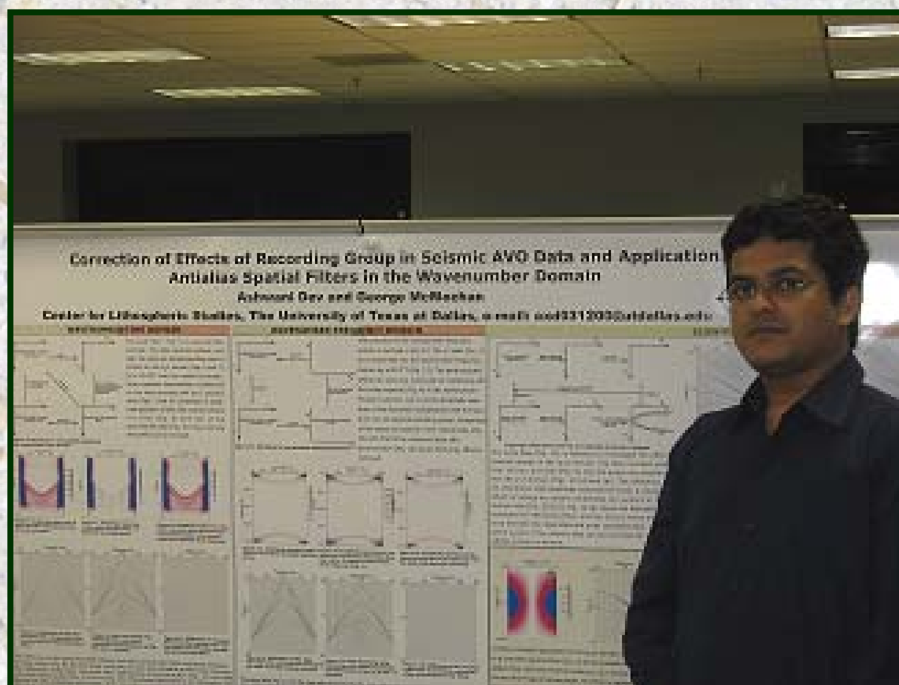
Khurrum receiving his award from Alumni Judge Dave Campbell.

GEOPHYSICS 1ST PLACE WINNER

ASHWANI DEV, PhD in Seismology, University of Texas at Dallas

CORRECTION OF EFFECTS OF RECORDING GROUP IN SEISMIC AVO DATA AND APPLICATION OF ANTIALIAS SPATIAL FILTERS IN THE WAVENUMBER DOMAIN"

Dev, A., McMechan, G., The University of Texas at Dallas



The effect of recording groups on amplitudes, in the context of AVO, is analyzed in the wavenumber domain. Synthetic common source gathers are simulated with and without recording groups of 5 and 25 elements. The data recorded with and without the arrays, are transformed to the wavenumber–time, wavenumber–frequency and slowness–frequency domains. Comparison of the spectra of the transformed data, in each domain, shows the effect of the array response on seismic amplitudes, and provides explicit definition of the filter required to correct for the array response. Amplitude corrections vary significantly with wavenumber and can change an AVO gradient from negative to positive. Antialias spatial filters designed in slowness-frequency domain remove aliasing in the spatial direction. Thus, array corrections can be applied to data before AVO studies, and antialias spatial filtering can be applied to remove aliasing.

Ashwani receiving his award from Alumni Judge Dave Campbell.

GEOPHYSICS 2ND PLACE WINNER

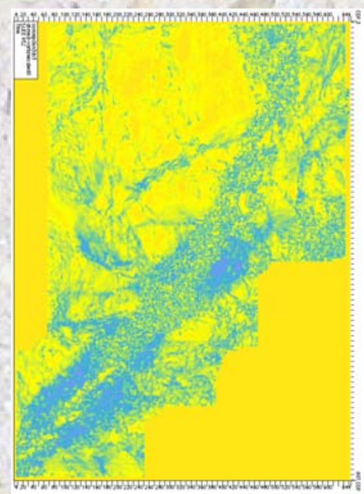
AHMED ALAHDAL, PhD in Geophysics, University of Oklahoma

SEISMIC DETECTION OF FAULT CONDUIT/SEAL QUALITY: EXAMPLE- LA CONCEPCION FIELD, LAKE MARACAIBO, VENEZUELA

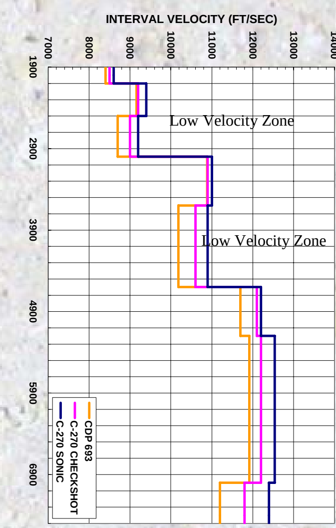
Ahmed O. Alahdal and John D. Pigott
School of Geology and Geophysics, University of Oklahoma

The 3-D Post-Stack Time Migrated Seismic Data of La Concepcion Field, Maracaibo Basin, Venezuela cover an existing field with known oil and gas pay zones. The question of whether the seismic response is indicative of the presence of fractures and/or the gas-saturation of the fractures is considered. An interpretation technique for predicting fractures and gas saturation is developed based upon velocity anomalies associated with fractures. The approach combines seismic attributes, image ray perturbation analysis as an interval velocity estimation method, and windowed Fourier transform analysis.

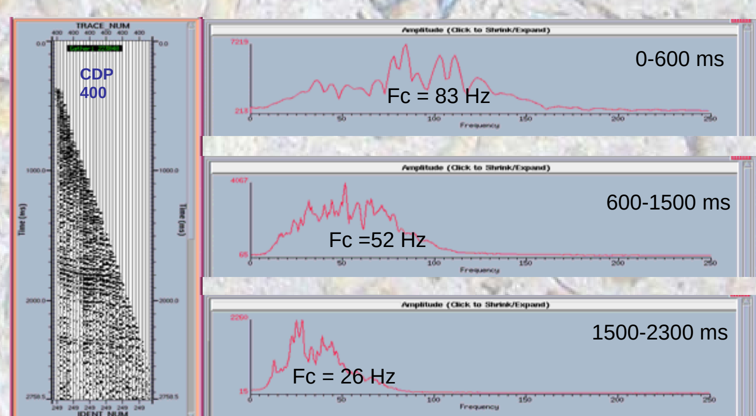
Application of variance cube attributes emphasizes the location of subtle fault zones in La Concepcion Field. Comparison of interval velocity anomalies along seismic lines of surface seismic survey with sonic and checkshot interval velocities in a borehole across the Misoa Formation suggests locations of leaking fault zones. Finally, windowed Fourier transforms of CDP gathers along seismic lines indicate central frequency shifts of low frequency within the fractured zones across the Misoa and Guasare Formations consistent with attenuation owing to the possible presence of hydrocarbons.



Seismic Attributes – Variance cube using ISEX (GeoFrame). This time slice at 952ms shows fracture locations along the NE-SW structural trend.



Fracture effects on seismic response. The velocity profiles across the Misoa Formation illustrate low velocity zones as a result of fracture effects.



Fracture effects on seismic response. The peak Frequency Shift (Windowed Fourier Transform) using Omega software shows the amplitude spectrum and how the values of peak frequency shift across unfractured zone decreases with time.

Ahmed receiving his award from Alumni Judge Dave Campbell.

GEOPHYSICS 3RD PLACE WINNER

HEIDY A. CORREA, MS in Geology, University of Oklahoma

FACIES CHARACTERIZATION OF A CHANNEL SYSTEM DERIVED FROM GPR AND MEASURED SECTIONS, RATTLESNAKE RIDGE WYOMING

Heidy A. Correa Correa and Dr. Roger A. Young, University of Oklahoma

The Rattlesnake ridge is an outcrop of the Lewis Shale in Wyoming that has been extensively used as a reservoir analog for deepwater systems. As a system, the Rattlesnake outcrops represent a channel levee overbank complex. The rapid changes in the channel-fill deposits over short distances makes this outcrop relevant in terms of reservoir heterogeneity studies. Due to variable scale, the heterogeneities exposed in this outcrop could not be identified by using a single technique. An integration of measured sections, well logs and Ground Penetrating Radar (GPR) can provide a better description of the internal architecture of this outcrop. The high resolution of GPR (about 1ft) enhances the identification of features beneath seismic resolution.

.

From the measured sections descriptions by a previous thesis (Blacklein, 2000), six different lithofacies have been identified in this system: high density turbidity current (HDTC, sand prone, Ta-Tb Bouma), low density turbidity current (LDTC, mud prone, Tc, Td Bouma), mudstone, slump, debris flow, highly organic thin bedded facies. Most of the sections show an alternating sequence of HDTC and LDTC with small intervals of the other facies.

Fifteen 2D GPR lines and 5 measured sections are used in this study. After processing, the GPR lines were correlated to the measured sections. Most of the boundaries described in the measured sections were identified in the GPR profiles, particularly those which separate layers thicker that 1 ft. Three different types of facies, according to Gawthorpe et al. (1993), were recognized from the GPR reflection signatures. First order facies, identified by lateral variations in amplitude and poor continuity of reflections, correlated to changes in grain size. Second order facies, identified as continuous reflections with low amplitude variation, represent lithologic changes such as sand/shale boundaries. Finally, third order facies represent larger boundaries such as channel-levee contacts and are identified through reflection terminations such as onlaps, downlaps and truncations.

Heidy receiving her award from Alumni Judge Dave Campbell.

School of GEOLOGY and GEOPHYSICS

FACULTY CHAIRS & SPECIAL FUNDS

Applied Structural Geology
For research in applied geology

Bartell Professorship in Geosciences
To endow a chair

Basin Analysis Study Program Fund
To provide support to establish a Basin Analysis Study Program in the School of Geology & Geophysics

Beginning Geology Labs
To support teaching activities in beginning geology labs

Carl E. & Thelma Gungoll Family Chair in Petroleum Geology & Geophysics
An endowed fund to establish & support an endowed chair

Charles W. Harper Field Camp Endowment
Provide support for student scholarships & operational expenses for summer field camp (GEOL 4346)

Clyde Becker, Sr. Endowed Chair in G & G
Established to fund an endowed chair

Eberly Family Chair in Geology & Geophysics
An endowed fund to support the Director of G&G

Edward Lamb McCollough Chair
An endowed fund to support the Chair

Frank A. Schulz Fund
An endowed fund to support the Chair

Dr. Roger Slatt Startup Fund
To establish & support personal research programs and professional activities

Director's Research General Support Fund
To provide support for faculty & students engaged in research areas that will offer educational & scientific benefits to those Interested in the earth sciences

Geology & Geophysics Enhancement/Enrichment Fund
Supports development & enrichment of the School's instructional, research, and service programs

Hugh E. Hunter Fund
An endowed fund to support teaching, research, and other relevant activities in hard-rock petrology and mineralogy

Industrial Research Exploration
To support research in the field of exploration seismology

Joe & Robert Klabzuba Chair
To establish and support an endowed chair

Kerr-McGee Centennial Professorship in Geology
An endowed fund to support the professorship

Lissa & Cy Wagner Professorship of G & G
An endowed fund to support the professorship

Middle East Basin Analysis – Seismic Stratigraphy
To pay any and all expenses incurred for Middle Eastern basin analysis and seismic stratigraphy research and training conducted by visiting scholars

Norman R. Gelphman Professorship in G & G
To enhance SGG's ability to attract and/or retain faculty of highest quality and reputation

Paleomagnetics & Diagenesis Industry Program
To support Diagenetic Magnetite research in the School of G & G

Petroleum Geochemistry
To support petroleum geochemistry

Presidential Young Investigator Award
A fund to be used for the Presidential Award Matching Funds

R.E. & Doris Klabzuba Chair of G & G
An endowed fund to support the Chair

Structural Geology & Geophysics
To support research in structural geology including graduate fellowships, travel, expendables, and equipment

Texaco, Inc. X-Ray Laboratory
To support the Energy Center X-Ray Laboratory

Unocal Centennial Professorship
An endowed fund to support the Professorship

Victor E. Monnett Chair
Endowed fund to support the Chair

Victor E. Monnett Chair in Energy Resources Enhancement Fund
To support and enhance State Regents Matching Fund

Willard L. Miller Professorship in G & G
An endowed fund to support the Professorship

Youngblood Geology Library Endowment
An endowed fund to support the library

DEGREES AWARDED

FALL 2005

Master of Science in Geology

Carlos E. Escalante-Saldana
Thesis: "Integrated Seismic Stratigraphic and 1-D Basin Analysis of the Tayrona Depression – Offshore Baja Guajira Basin, Colombia"

Olatunde "Demola" Ademola Soyinka
Thesis: "Thin-Bedded Turbidite and Hyperpycnite Mudstones in the Cretaceous Lewis Shale, Carbon County, Wyoming

Louise Anne Totten
Thesis: "Geochemical and Paleomagnetic Assessments of Organic-rich Lithologies in the Disturbed Belt, MT

Master of Science in Geophysics

Ngoc Thi Bich Hoang
Thesis: "Two-dimensional Basin Analysis of La Concepcion Field, Maracaibo Basin, Venezuela

Abbie Lee Negrey
Thesis: "Geophysical Evaluation of a Deepwater Channel Prospect Using Spectral Decomposition: Permian Wolfcamp Limestone, Midland Basin, Glasscock County, Texas"

SPRING 2006

Master of Science in Geology

Ramon Jose Asuaje
Thesis: "Pore Pressure Estimation Based On Well Logs and Seismic Data"

Sara Elizabeth Austin
Thesis: ""Carbonate Sedimentology of the Hope Gate Formation, Pliocene, Discovery Bay, Northern Jamaica"

Carlos Bahamon-Velasquez
Thesis: "An Integrated Sequence Stratigraphic Framework for Geological Reservoir Characterization and Development Plan of a Gas Reservoir in the Southern Gulf of Mexico"

Rodrigo Eduardo Bastidas
Thesis: "Reservoir Characterization of Balcon Field, Colombia"

Walter Sebastian Bayer
Thesis: "Structural and Stratigraphic Evaluation of the Southern Belgian Anticline Area, North Midway – Sunset Field, San Joaquin Basin, California"

Heidy Alejandra Correa Correa
Thesis: "3D Characterization of a Channel System in an Outcrop Reservoir Analog Derived from GPR and Measured Sections, Rattlesnake Ridge Wyoming"

Sarah Elizabeth Hamilton
Thesis: "Cause of Lost Circulation in Lewis Shale Wells, South Central Wyoming"

Sara Ann Kaplan
Thesis: "Revealing Unaweep Canyon: The Late Cenozoic Exhumation History of Unaweep Canyon as Recorded by Gravels in Gateway, Colorado"

Tyler Jeffrey Maughan
Thesis: "Facies Analysis of the Caney Shale, Western Arkoma Basin"

Shannon Ann (Dulin) Myers
Thesis: "Paleomagnetic Investigation of Impacts in Carbonate Target Rocks"

Vanessa Jean O'Brien
Thesis: "Timing and Origin of Orogenic Remagnetizations in Mississippian Carbonates, Sawtooth Range, MT"

Aaron Craig Rothfolk
Thesis: "Characterization of a Fractured, Turbidite Channel Sandstone: The Jackfork Group, Hollywood Quarry, Arkansas"

Adam Charles Shear
Thesis: "The Cretaceous-Pennsylvanian Unconformity at DeGray Lake, Arkansas: Model for an Unconformity Hydrocarbon Trap"

Pamela Gerrez Taneza
Thesis: "The occurrence of Polycyclic Aromatic Hydrocarbons (PAHs) in Iloilo River, Philippines"

Carla Caromai Valerio
Thesis: "Evaluation of Spectral Inversion and Spectral Decomposition Methods: Pennsylvanian Granite Wash Reservoir Characterization Case Study, Texas"

Joni Dawn Verrett
Thesis: "Structural and Compositional Analyses of Fault Rocks of the San Andreas Fault at Tejon Pass, CA"

Master of Science in Geophysics

Deane Bernice Browning
Thesis: "Investigating Well Production in the Barnett Shale"

Nicholas Mason Gregg
Thesis: "A Comparison of Shallow Seismic Data Processing Using the Common Midpoint Stack and Plane Wave Synthesis at Hollywood Quarry, Arkansas"

David Alejandro Ramirez Mejia
Thesis: "Fracture Orientation Determination in Sedimentary Rocks Using Multicomponent Ground Penetrating Radar Measurements"

Olabukola Tolulope Ojo
Thesis: "Characterizing Complex Lithology and Architecture of Seismic Volumes of Leveed Channel Complex Using Scaled Analog Outcrop"

Matthew Alan Sparkman
Thesis: "Shale Anisotropy"

Yoscel De Las Mercedes Suarez
Thesis: "Seismic Acquisition, Processing and Modeling of Refraction and Reflection Shallow Seismic Profiles From Unaweep Canyon, Colorado"

Ricardo Zavala-Torres
Thesis: "AVO and Spectral Decomposition in the Pipila Field, Burgos Basin, Mexico"

Doctor of Philosophy in Geology

Michael Hsieh
Dissertation: "Geochemical Characterization of Organic Matter in Victoria Harbour Sediments, Hong Kong Special Administrative Region of China"

Dongwon Kim
Dissertation: "Geochemical Characterization of Solid Bitumen Deposited in the Mississippian Sandstone Reservoir of the Hitch Field, Southwest Kansas"

Doctor of Philosophy in Geophysics

Ahmed Omar Alahdal
Dissertation: "Seismic Detection of Fault Conduit/Seal Quality: Example – La Concepcion Field, Lake Maracaibo, Venezuela"

Bachelors of Science in Geology

Brooke Elise Anderson
Inyene Allen Awakessien
Charles Gordon Baker
Aaron Stephen Bell
Eric A. Carter
Regan Drain
Joshua Scott Garrett
Lydia Jorgenson
Oluwadara B. Koleowo
Meghan Therese Magill – *With Special Distinction*
Robert Joseph Wilson
Haziretali Wushur
Gbenga Shedrack Yemidale

Bachelors of Science in Geophysics

Ellen Gilliland – *Cum Laude*

UNDERGRADUATE SPONSORSHIPS

Fall 2005, Spring 2006

Amir Allam	**Robert Edward Lowry Scholarship Fund in Geology, Engel Presidential Young Investigator**
Miguel Angelo	**Exxon Education Fund – Geology**
Inyene Awakessien	**Exxon Education Fund – Geology**
Henry Badra	**Robert Edward Lowry Scholarship Fund in Geology, OERB**
Aaron Bell	**Harry J. Brown Memorial Scholarship, Hubert E. Clift Memorial, Frank Gouin Geology Scholarship**
Paul Bowen	**Patrick K. Sutherland Memorial Scholarship Fund**
Gregory Dean	**OERB, Exxon Education Fund – Geology**
Regan Drain	**OERB**
Juliana Gay	**Robert Edward Lowry Scholarship Fund in Geology, Questar Corporation Geology & Geophysics Scholarship**

Ellen Gilliland	Robert Edward Lowry Scholarship Fund in Geology
Christopher Grimm	Robert Edward Lowry Scholarship Fund in Geology
Katie Gunderson	Harry J. Brown Memorial Scholarship, Questar Corporation Geology & Geophysics Scholarship
Evan Hamilton	Robert Edward Lowry Scholarship Fund in Geology
Jason Harms	Harry J. Brown Memorial Scholarship, Robert Edward Lowry Scholarship Fund in Geology
Rika Hood	Robert Edward Lowry Scholarship Fund in Geology, Marathon Scholarship
Nathan Johnson	OERB, Marathon Scholarship
Tiffany Legg	Harry J. Brown Memorial Scholarship
Megan Magill	OERB
Christopher McLaughlin	OERB
Nicole McMahon	Energy Cup Scholarship
Colt Nickel	Harry J. Brown Memorial Scholarship, Exxon Education – Geology
Melissa Orr	Robert Edward Lowry Scholarship Fund in Geology, Harry J. Brown Memorial Scholarship
Matthew Totten, Jr.	Robert Edward Lowry Scholarship Fund in Geology, Marathon Scholarship, OERB, Energy Cup Scholarship

GRADUATE SPONSORSHIPS

Fall 2005, Spring 2006

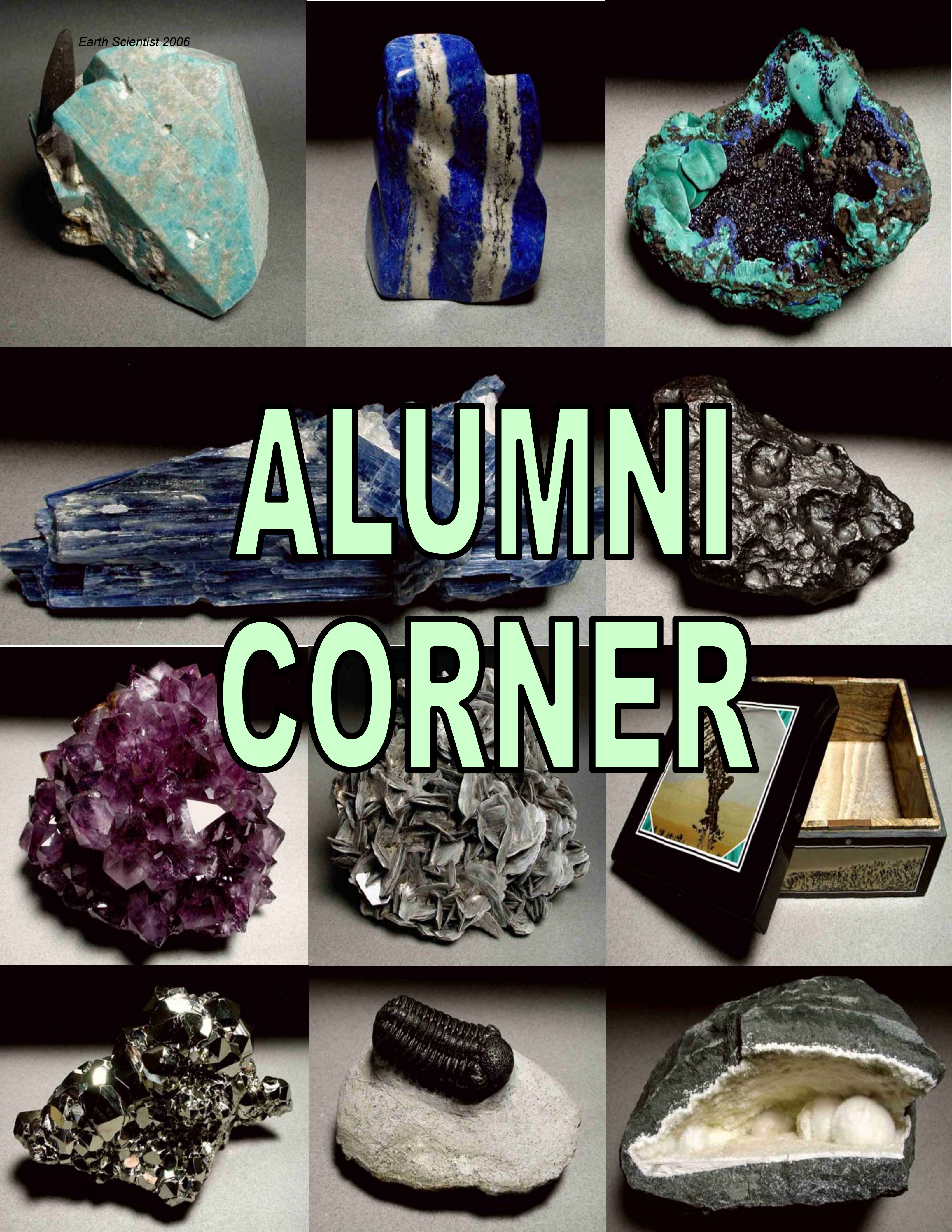
Ahmed Alahdal	International Petroleum Exposition Geology, Orville R. Russel Scholarship Field Geology, Gene & Astrid Van Dyke Scholarship
Carlos Bahamon	Geology & Geophysics Program Enhancement/Enrichment
Subhotosh Banerjee	Conoco Geology & Geophysics Scholarship
Walter Sebastian Bayer	Geology & Geophysics Program Enhancement/Enrichment
Carisa Bomberger	William B. Arper Memorial Fund
Gabriel Borges	Donald J. Duffy Memorial, O.H. “Ike” Hill Enrichment Fund
Shamik Bose	Conoco Geology & Geophysics Scholarship
Matthew Boyce	Director’s Research General Support
Heidy Correa	Geology & Geophysics Program Enhancement/Enrichment, Amoco Education Fund for the School of Geology & Geophysics, Industrial Research Exploration Series, G&G Director’s Startup
Devin Dennie	George Huffman Endowed Scholarship, Richard V. Hollingsworth Memorial Scholarship, Eli Stephen Parker, Edward Lamb McCollough Endowment
Shannon Dulin (Myers)	Gene & Astrid Van Dyke Scholarship
William Duran	Geology & Geophysics Program Enhancement/Enrichment
Belinda Ferrero	Marathon Scholarship
Kajari Ghosh	Jaye & Betty Dyer Endowed Scholarship, Conoco Geology and Geophysics Scholarship
Vincent Heesakkers	James Leland Morgan Endowed Scholarship, Roger Denison Endowment

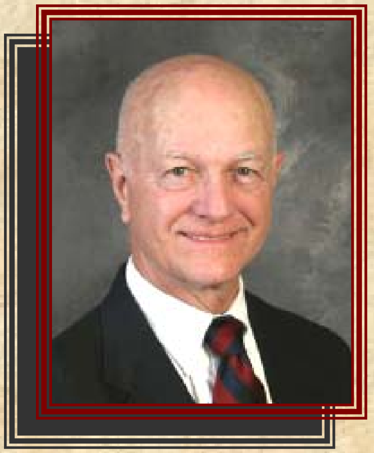
Ngoc Hoang	Edward Lamb McCollough Endowment
Sara Kaplan	Eberly Family Chair in Geology & Geophysics
Ha Mai	Edward Lamb McCollough Endowment
Christian Marine	MAP Exploration, Inc.
Tyler Maughan	Edward Lamb McCollough Endowment
Michelle McCarthy	Eberly Family Chair in Geology & Geophysics, Beginning Geology Labs
Jim Miller	Conoco Geology & Geophysics Scholarship
Katherine Moore	Amoco Education Fund for the School of Geology & Geophysics
Martin Morales	Edward Lamb McCollough Endowment
Vanessa O'Brien	Bob & Doris Klabzuba Chair in Geology & Geophysics
Olubukola Ojo	Gene & Astrid Van Dyke Scholarship
Javier Perez Perdomo	Pathfinder Graduate Fund, Geology & Geophysics Program Enhancement/Enrichment
Kulwadee Pigott	Middle-East Basin Analysis-Seismic Stratigraphy
David Ramirez-Mejia	Conoco Geology & Geophysics Scholarship, Industrial Research Exploration Series
Jamie Rich	Director's Research General Support
Norelis Rodriguez	Chevron Geology & Geophysics Graduate Fellowship
Gloria Romero	Geology & Geophysics Program Enhancement/Enrichment
Aaron Rothfolk	Geology & Geophysics Program Enhancement/Enrichment, Stanley L. Cunningham Excellence/Teaching, Frank A. Melton Memorial Geological Research Awards
Adam Shear	Chevron Geology & Geophysics Graduate Fellowship
Sohini Sur	Amoco Education Fund for the School of Geology & Geophysics, AAPG Garth W. Caylor Memorial Grant
Dustin Sweet	Cecil Von Hagen Geology Scholarship
Dileep Tiwary	ConocoPhillips SPIRIT Scholarship, SEG Charles G. McBurney Memorial Scholarship
Carla Valerio	Director's Research General Support, Eberly Family Chair in Geology & Geophysics
Joni Verrett	Amoco Education Fund for the School of Geology & Geophysics
Raina Waskiewicz	Alumni Advisory Council Scholarship
Brooke Wilborn	Patrick K. Sutherland Memorial Scholarship
Matthew Zechmeister	Gene & Astrid Van Dyke Scholarship

> *"Let us think of education as the means of developing our greatest abilities, because in each of us there is a private hope and dream which, fulfilled, can be translated into benefit for everyone and greater strength for our nation."*
>
> John F. Kennedy
> 35th president of the United States

2006 CONVOCATION

ALUMNI CORNER





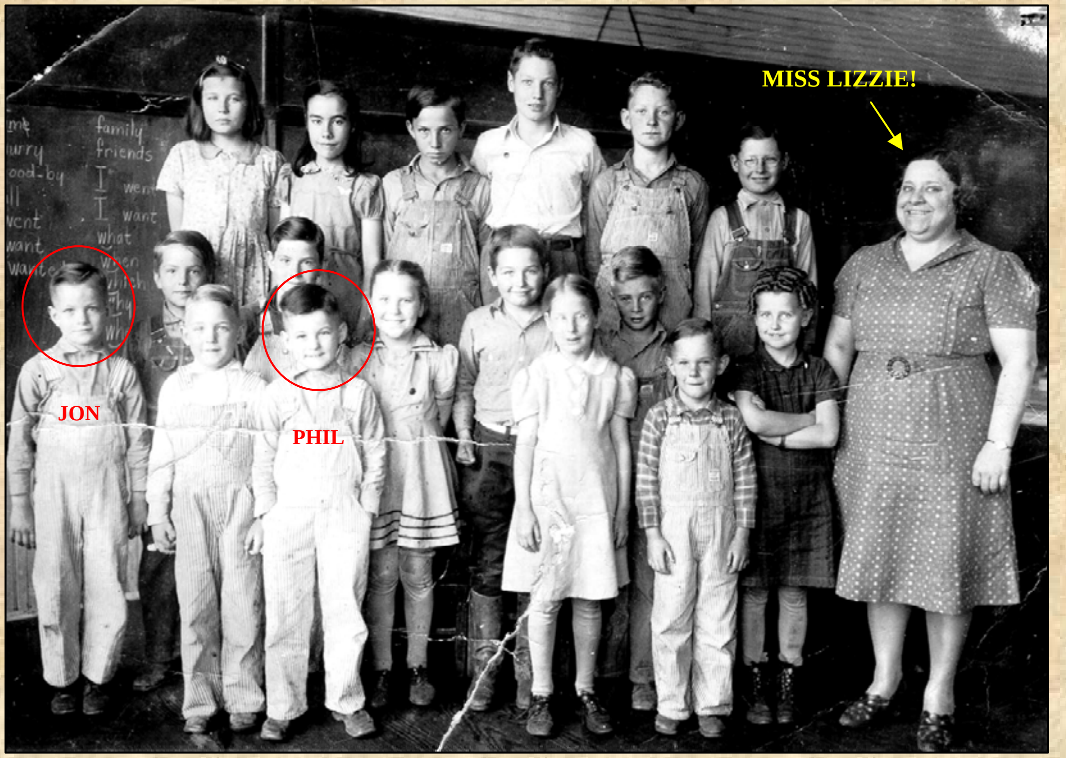
ALUMNUS PROFILE

JON R. WITHROW, "The Loyal Knight of Old Trusty"
Petroleum Engineering BS 1954
Geological Engineering MS 1963

Article by Phil C. Withrow
June 21, 2006

Jon Withrow was born in Seminole, Oklahoma, early in 1933. Our father worked in the Production Department of Amerada Petroleum Corporation, and we grew up in several oil field camps in Seminole County in oilfields like Seminole, Bowlegs, Cromwell and Earlsboro.

The oil field where we lived in 1940 was called Northeast Earlsboro, in the far northwestern corner of Seminole County. It is possible that Jon's ferocious dedication to scholastic achievement began there in a One-Room school called Plover Hill. We had one teacher, fifteen students, and six grades, all in that one big room. In 1940, our teacher was a big, tough woman called Miss Lizzie Porter. Miss Porter gave us some strict orders on the very first day of school, and she demanded that we follow those orders for as long as she was there. Then she gave everyone in all six grades a homework assignment for the next day. She gave us Second Graders an easy assignment which we did in a few minutes. She gave the Third Grade boys (just across the aisle) some Arithmetic homework that must have been a little more difficult. Nobody worried too much about it. After all it was just the first day of school.



When we got to school the next day, Miss Porter started taking up the homework papers. The First Graders gave her their work, and we handed in our easy Second Grade assignment. When she got to the Third Grade, nobody had done their assignment. Nobody! Then, Miss Porter got mad! Really mad! She marched those four boys to the front of the room and made them bend over the desks. Then she got her big paddle that looked like a fairly heavy, solid wood tennis racket, and she beat each one of those little boys until they were all screaming, and the rest of us in the room were about to cry, too. That was a pretty good lesson for all of us there that day. Nobody at Plover Hill ever missed another assignment (or anything else) that Miss Porter told us to do. And that was the only time Jon ever got a whipping in school. And as near as we can tell, it was the last time he ever missed getting any assignment done on time in all the schools he attended from then until now – especially Arithmetic.

Jon seemed to work day and night on his lessons after that day at Plover Hill. He graduated from Seminole High School in 1950 with an outstanding scholastic record. He was also the singles tennis champion of the Sooner Star Conference for two years, and won several invitational tournaments during that time. He was a very dedicated student, even when most guys our age were not too interested in scholastic stuff.

When Jon finished high school, he never had any doubt about what came next. He attended Seminole Junior College for one year and entered the University of Oklahoma in 1951. His scholastic record at OU was outstanding, as it had always been. In addition to becoming a member of Sigma Nu Fraternity, Jon was a member of the honorary, secret engineering society called "The Loyal Knights of Old Trusty" (LKOT), and Sigma Tau and Tau Beta Pi Honorary Scholastic fraternities. He maintained his usual high grade average all the way through the School of Petroleum Engineering. In Jon's "spare" time at OU, he was elected to the University of Oklahoma Student Senate in 1952, and was President of that group in 1953. He received a scholarship from Humble Oil and Refining Company in 1952.

After graduation from the university in 1954, Jon worked for Humble Oil Company for four years in their Production Department in West Texas. He returned to Graduate School at OU in 1958, and received his Master's Degree in Geological Engineering in 1963. His thesis title was "*Subsurface Geology of the Tuscaloosa Sandstone in Tensas Parish, Louisiana*". He wrote *"Subsurface Geology of the Fitts Oil Field, Pontotoc County, Oklahoma"* which was published in the Bulletin of the American Association of Petroleum Geologists in 1968.

From 1962 to 1972, Jon worked for the S. J. Sarkeys Company, mainly in the Anadarko Basin of western Oklahoma. He has been a very successful independent geologist in Oklahoma City since that time. During all the past years Jon has always gone out of his way to support any and all members of our family when they were in any kind of trouble financially or in any other way possible. **We are proud that Jon is part of our family.**

Photos courtesy of Phil Withrow

The Withrow brothers…….check out that football! The photo was taken in front of housing provided by Amerada Petroleum Corporation in the Bowlegs oilfield, Seminole County in 1936. Jon is the tyke holding the football.

ALUMNUS PROFILE

JAMES A. GIBBS, "A Man for All Seasons"

Geology BS 1957
Geology MS 1962

Article by Tom Mairs
June 27, 2006

James A. Gibbs, who graduated from The University of Oklahoma in 1957 with a B.S. degree in geology, has enjoyed a long and successful career as a geologist involved in petroleum exploration and production, corporate management and in dedicated contribution to his chosen profession, his community, and his church. **ROBUST ENERGY** and **FOCUSED ENTHUSIASM** define Jim's lifelong philosophy. I first met Jim in August, 1955 at a fraternity rush party. Being a fresh young high school graduate from a small town in Kansas, I was very impressed by the easy-going nature and sophisticated demeanor of this big city fellow from Dallas, Texas – so much so that I elected to join the pledge class of the Phi Delta Theta fraternity under the tutelage of Jim, who became the *pledge trainer*. His easy-going demeanor quickly metamorphosed into one of a demanding task master in an attempt to polish our manners and to mold us into "cool" college men.

Jim was born in Wichita Falls, Texas, graduated from high school in Dallas, and enrolled at OU in 1953. Upon graduation in 1957, he served a two-year stint in the U.S. Naval Reserve as a Lieutenant and communications officer assigned to the U.S.S. Intrepid in Norfolk, Virginia. Upon completion of naval duty, Jim continued his geologic education attending graduate school at The University of Texas at Austin from 1959-1960, and then returned to OU where both of us earned our Master of Science degrees in 1962.

During the period from 1958 through 1961, the oil and gas industry was in a *doldrums* cycle and employment opportunities were extremely limited, which forced many of us to attend graduate school. When the major companies once again resumed employment interviews, they were only interested in meeting with the top 10-15% GPA's in graduate school. Consequently, we became very competitive in hopes of impressing our professors. Many of us would spend countless hours memorizing little known mineralogic and stratigraphic terms, such as arfvedsinite, riebikite, epieugeosynclines, etc. Once again the cycle changed, and the oil and gas industry began slowly and selectively hiring geologists with graduate degrees. Jim was employed by the California Company (Chevron/Texaco) assigned to their Gulf Coast District in New Orleans and Lafayette, LA from 1961-1964. In 1964, Jim decided to initiate his career as an independent and opened an office in Dallas as a consulting geologist and independent oil and gas producer. Prior to founding Five States Energy Company, LLC, in 1984, Jim consulted exclusively for Petrus Operating Company (1975-1978); Cornell Oil Company (1978-1981); and Lyco Energy Corporation (1981-1983). During his tenure as an independent, he initiated drilling prospects, purchased and sold oil and gas leases, operated wells, and participated in more than 600 wells, primarily in Texas, Louisiana, and Oklahoma. Today, Jim serves as Chairman of Five States Energy Company, LLC. Five States is an extremely successful partnership which specializes in purchasing oil and gas properties.

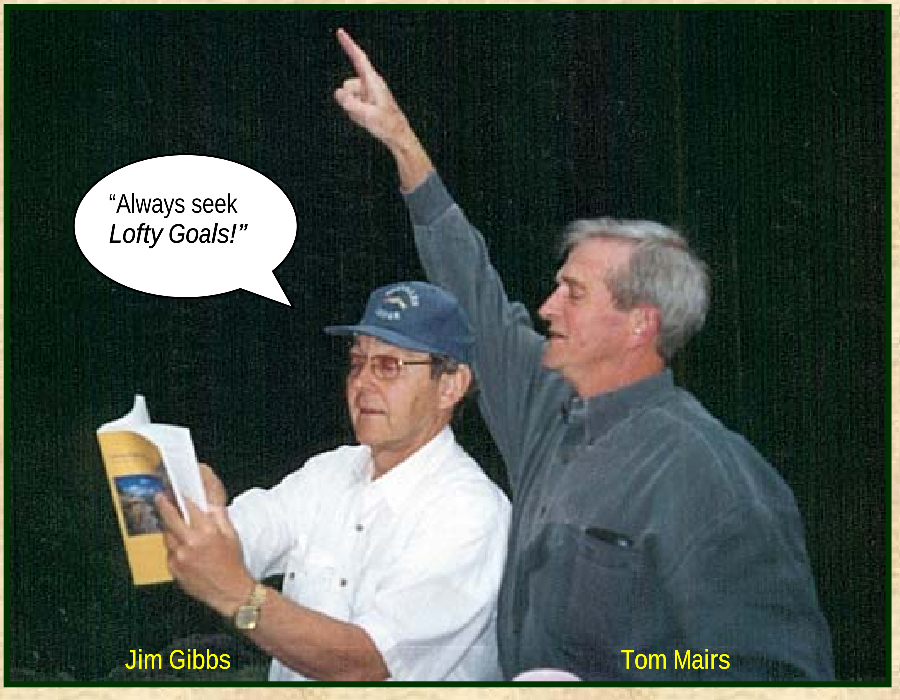
Jim is not only an active member of multiple professional organizations, but is also a devout contributor to the improvement and well-being of those organizations. His many accomplishments in these affiliations have brought much positive recognition to OU. As a long-time member of AAPG, he is a Certified Petroleum Geologist, has served on the Executive Committee as Secretary (1983-1985), as President (1990-1991), was awarded Honorary Membership in 1995, and continues his service as a member of the AAPG Foundation Board of Trustees and Committee work. Jim is also the author of ***Becoming an Independent Geologist: (Thriving in Good Times and Bad)***, published by AAPG in 1999. Other professional affiliations and awards include: AGI, Chairman of the Governmental Affairs Committee (1992-1997); recipient of the William B.

Heroy Outstanding Service Award in 1994, and a Foundation Trustee; President (1975-1976) and Honorary Life member (1987) of the Dallas Geological Society; member of the Board of Directors representing North Central Texas for the IPAA; and Chairman (1974-75) and Honorary Life Member of the Dallas Chapter of SIPES. Other memberships include the Dallas Geophysical Society, Explorers Club of New York, GSA, the National Petroleum Council, and TIPRO. Jim is also a licensed geoscientist with the Texas Board of Professional Geoscientists.

The University of Oklahoma as well as the School of Geology and Geophysics (SGG) have greatly benefited from the stalwart contributions and innovative ideas of James A. Gibbs, a stellar alumnus. He is well-known throughout the University community for his creation and support of several University and student programs. He is a founder of the Sarkeys Energy Center; a guiding force behind the 7.5 million dollar "Second Century Plan" for the School of Geology and Geophysics (SGG); has given long and diligent service to the SGG's Alumni Advisory Council and was Chairman of the Council in 1994-1995. In 1996, Jim was a recipient of the ***Regents' Alumni Award*** presented each year to honor alumni and friends for exceptional dedication and service to The University of Oklahoma. Jim has also served on the President's search committee for a geoscience dean and helped jump start the SGG's exquisite mineral display by donating specimens from his personal collection.

Other universities benefiting from Jim's tireless involvement are The University of Texas where he has served on the Geology Foundation Advisory Council since 1997 and the Texas Bureau of Economic Geology Advisory Board since 2000. *(I guess we can forgive him this one digression since he is a native son).* Southern Methodist University has also benefited from Jim's talents where he has served as a Trustee of the Institute for the Study of Earth and Man and on the Board of Advisors for the Edwin L. Cox School of Business. Jim is a member of "Who's Who in the Southwest and Who's Who in America. **WHEW!!!**

In my opinion, Jim's greatest accomplishment is his marriage to Judith A. Walker from Taylor, Louisiana, a distinguished graduate of LSU. *(Jim has been heard to mention that his longest airline flight was the return from our recent loss to LSU in the Sugar Bowl.)* Both are actively involved in the Education Foundation for the Highland Park Independent School District and the Capital Campaign Committee and Administrative Board of their church. Jim and Judy have two sons, one who lives in Dallas and one who lives in Austin.



In his limited spare time, Jim enjoys the great outdoors, including such activities as bird hunting, fishing, hiking in the mountains, and mineral collecting. He is perfectly happy rusticating or driving through the Texas countryside counting pump jacks and seeking oil field purchase opportunities.

After all these years I still remain impressed by Mr. James A. Gibbs. I am continually impressed with his strong commitment, his encouragement to others to always aim high in setting priorities, and his diligence in obtaining these **lofty goals** (as depicted in the photo). I am further impressed by his focused energy; astute business acumen; dedicated service and generosity to his profession, academia, church, and community (Jim definitely dances with those who *brung* him); and, particularly, by his providing assistance, both advisory and financially, to his fellow geologists in supporting their ideas and drilling prospects. **Jim is truly a *man for all seasons!***

School of GEOLOGY and GEOPHYSICS

MEMBER UPDATES

H.W. "Dub" Peace II

President and CEO of Panhandle Royalty Company

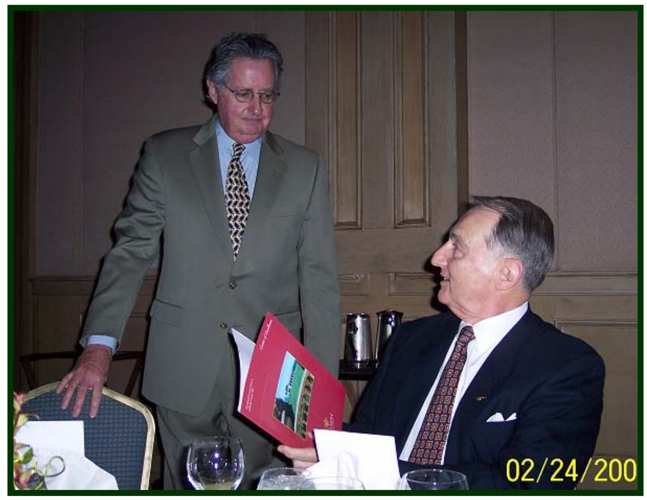
Retires from Panhandle Royalty and Establishes EXAD

Article and photos courtesy of Hugh W. Peace

H. W. "Dub" Peace II was born in Clinton, Oklahoma to Herman and Bernice Peace. His parents were both teachers, and during his childhood, the Peace family lived in several small Oklahoma and Texas towns. He graduated from Arnett High School in southwestern Oklahoma, and then attended the University of Oklahoma where he received bachelor's and master's degrees in geology.

After completing his bachelors degree at OU, he received a commission as an ensign in the United States Navy. Shortly thereafter, he married Norma June Williams, his wife of 45 years. As soon as they were married, Norma and Dub spent several years moving across the country during Dub's active duty service in the Navy. During his time in the Navy, Dub held many interesting assignments, including that of an air controller on the Navy's predecessor to the AWACS radarplane. During this assignment he and his wife Norma lived in Honolulu, Hawaii. After finishing his active duty service in the Navy, he spent 18 additional years in the Naval Reserve as a navigator in a Naval VR squadron and retired with the rank of Captain.

After completing his active duty Naval service, he returned to the University of Oklahoma for a master's degree in Geology. Upon receiving his master's degree, he began his professional geology career with the Union Oil Company of California. During his 16 years with Unocal, he was exposed to the geology of the Gulf Coast, Mid-Continent and Rockies with assignments in Houston, Lafayette, and finally Casper, Wyoming. He left Unocal to accept a position as Mid-Continent Exploration Manager with Cotton Petroleum in Tulsa. After spending several years with Cotton, he joined Hadson Petroleum Company in



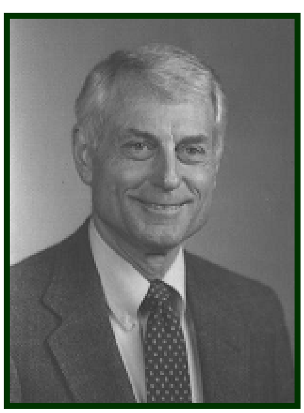
E. Chris Kauffman, Chairman of the Board of Panhandle with Dub at his retirement party.

Dub and Norma at the retirement party.

Oklahoma City as Vice-President of Exploration. In 1991 he became president and CEO of Panhandle Royalty Company. During his 15-year tenure at Panhandle, he led the company from a mostly reactive non-participating mineral owner to a very proactive exploration and production company. As a result of these changes, Panhandle's annual revenue and net income grew from $2.5 million and $312,000 in 1991 to more than $30 million and $9 million, respectively in 2005. During the last several years of his tenure as President, Panhandle was repeatedly highlighted as one of the top 10 publicly traded companies in Oklahoma.

Although Dub retired from Panhandle at the end of February, his love for the profession of geology and the oil business is so strong that he couldn't retire completely, and has established a geological consulting company (EXAD) in Oklahoma City. In addition to consulting, he plans to finally take time to play more golf, travel and spend more time at the lake. In addition to his professional career, he has been very involved in the OU School of Geology and Geophysics, having served as chair of the School's Alumni Advisory Council, and on several official and unofficial University committees. The couple has two children, Hugh Peace and Susannah Robinson, and two grandchildren, Austen and Brady Robinson, all of Dallas, Texas. ■

Back row, left to right: *Dub, Hugh and Jana Peace (newlyweds), and son-in-law Mike Robinson.*
Front row, left to right: *Daughter Susannah Robinson, mother-in-law Juanita Williams, and Norma.*



Robert Lord, BS 1952 and MS 1956, has joined the board of **World GTL**. **Lord** will advise on international energy strategy and assist in the acquisition of hydrocarbon reserves throughout the world.

World GTL's primary business is the conversion of natural gas to liquid hydrocarbons. The company has proprietary technology for the efficient and profitable production of a wide range of middle distillates.

World GTL in conjunction with its partner Petrotrin has a plant under construction in Trinidad and has just signed an agreement with YPFB in Bolivia for the use of gas reserves there. A **World GTL** and YPFB gas-to-liquids plant is expected to make a major contribution to the local oil product market.

AAC MINERAL AUCTION

April 28, 2006, in conjunction with the AAC Spring Meeting
Hosted by the SGG Pick and Hammer Club

The Mineral Auction was a HUGE success!

First of all, I would like to thank everyone who helped with the auction, those who helped prep minerals the night before, those who attended the AAC meeting to set up, execute, and check out winners, and John Guess and Rika Hood for snapping the great photos of the alumni. The T-shirts were also a huge success, so thanks to our shirt designers and Club President Ellen Gilliland for making that happen………the Alumni really got a kick out of it, and we sold several.

I would also like to send a special thanks to the School of Geology and Geophysics for providing the Club with some excellent minerals for the auction, to Dr. London for going to Tucson, AZ, to buy the Club those great minerals, donating specimens from his own personal collection and for all of his expert advice to really make it succeed, and to Niki Chapin for all of her generous help and time in preparing the auction.

I am happy to announce that the auction netted $3,975 for the Club. The income will help fund upcoming projects and activities for the new year. A big thank you to the following lucky Alumni who won the purchase of minerals:

Mark Potts
Joe T. Vaughn
Mark Leach
Dave Fleming
Bill Clopine
Emmitt Lockard
Jerry McCaskill
Charles Gilbert
Chuck Noll
Jon Withrow
Jody Foote
Vance Hall
Mike Pollok
Younane Abousleiman
Bill Reed
Patrick Williams
David Campbell

~~ Matthew Totten, Vice President
Pick and Hammer Club

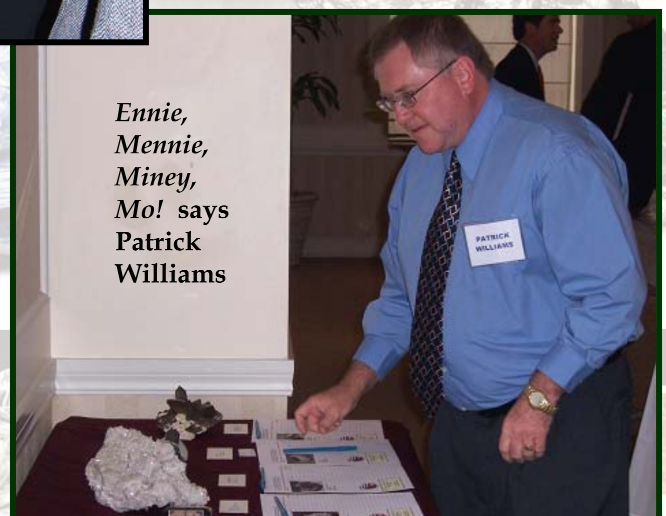
Council members viewing the mineral bidding sheets at the silent auction.

Above: The "Watchdog" …Dave Campbell proclaims time's up! What a character!

Above: Chuck Noll looks pretty pleased with himself …..he must have placed a winning bid!

To the left: Bill Clopine looks like he's bidding on a phacops or the barite roses.

Ennie, Mennie, Miney, Mo! says Patrick Williams



Gene Van Dyke writing down a silent bid while Pick and Hammer Club members observe.

David Campbell and Bill Reed review the mineral bidding sheets. Do you suppose they're secretly plotting to bid against each other?

A CENTURY OF LIVING, GIVING

"City Woman Looks Back on 100 Years"

Story by Ann DeFrange
Staff Writer, *The Oklahoman*
Reprinted from Thursday, May 25, 2006

Mildred Virginia Armor Frizzell in 1928. *(Photo courtesy of Elizabeth Holmes, The Frizzell Family.)*

Ask Mildred Frizzell about the Tulsa race riot. Ask about World War I. About Oklahoma's Dust Bowl years.

Long, elegant fingers wave through the air and a spirited laugh peals out on the heels of a vintage memory. "Oh, that was really something!" she exclaims.

Because she was there. She observed the major milestones of the past century; she created a few. On June 9, 2006. **she will be 100 years old**, and she retains an interest in the events around her and a casual acceptance of the extraordinary things she did.

Frizzell, who lives at Superbia retirement neighborhood in northwest Oklahoma City, was one of the first Oklahoma women to earn a degree in geology; the first to teach the subject on a college level. She was a civic leader of organizations that brought education and culture to women; a volunteer on the local arts and literary scenes.

Her early life was that of a rambling child whose father worked in the oil fields. John Sumner Armor was a division supervisor for the Gypsy Oil Co. The family followed the big booms and lived in Mounds and Cleveland and Tulsa before they arrived in Oklahoma City in 1921.

In fact, Frizzell traces her family history back to the day in 1859 when Col. Drake drilled the country's first oil well on the banks of the Allegheny River in Pennsylvania, and her grandfather was immediately enamored with the petroleum industry. He made his way to Oklahoma, where the petroleum business was fresh and exciting. He brought six daughters and one son.

The daughters found it necessary to make livings; eventually, they included a buyer for a Pittsburgh store, a counselor for "wayward girls" and a science teacher, according to Frizzell. The son became an oilman and Mildred's father. With clear recall, she claims her aunts tolerated few social barriers, and her father's daughter didn't either.

By 1912, when her father made rounds of the oil fields near Cleveland, OK, with a horse and buggy, his 6-year-old daughter sat beside him. When John Armor bought a car, she turned the starter while he cranked the motor. At 16, she got a license and drove herself.

"They wouldn't dare tell me I couldn't," she said.

In Oklahoma City, she attended Washington Irving Junior High and Central High, and started night school at Oklahoma City University in 1925. Three years later, she had a bachelor's degree in science. The curriculum included one class in geology; it was the one she loved.

"I was very ambitious. I wanted to do something related to my father's business," she said, and geology was the only entry for a female.

While no one made her way easier, no one discouraged her, she said. **Charles N. Gould**, a longtime geology professor at the University of Oklahoma, and **Charles Decker**, an OU paleontologist, were her mentors.

Mildred with her class from OCU on a field trip in the Arbuckle Mountains in 1930. *(Photo courtesy of Elizabeth Holmes, The Frizzell Family.)*

Frizzell was one of three women in the OU School of Geology.

"I wanted to get out and map formations," she said. In 1930, when the department took its annual field trip to the Arbuckle Mountains, the three had to bring their own tent and their own transportation.

On graduation from OCU in 1928, she was hired to teach that single geology class. At the same time, she enrolled in a master's program at OU. Mornings, she was the instructor at OCU; then she drove to Norman, where she was the student. Her father bought her a car for the daily commute, putting her in yet another uncommon position for a woman of the 1930s.

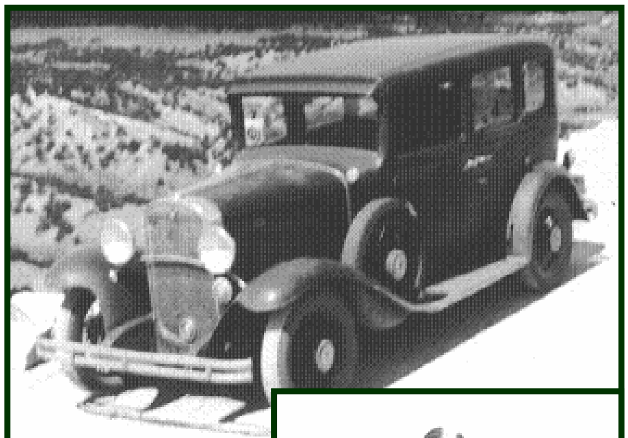
In 1933, she noticed a man sitting in her classroom, a bit older than the average student, fascinated by geology and the oil underneath Oklahoma. John D. Frizzell made money in real estate and development in the young state, and could now indulge himself in matters that intrigued him. Those were geology and the lady geologist. They married in 1933, while she continued to pursue her career.

In the late 1930s, she said, she retired to start a family and follow "the club circuit." She retained membership in the American Association of Petroleum Geologists and founded and produced a magazine for the Oklahoma City Geological Society. But, through Town Hall, Early American Glass Club, MacDowell Club of Allied Arts, Ladies Music Club, PEO, Oklahoma Art League, 20th Century Club and many others, she contributed to the city's intellectual and cultural wealth from the 1930s to the 1950s.

Today, she wears a 12X magnification for reading, but the tall woman with the elegant hands and the angular bones still combines the hardiness of a field geologist, the elegance of a society maven and the detachment of an academic.

Ask her about changes over a century. "Oh," she says, "that's easy! In my day, all the geologists worked outside and carried a compass and pick. ... Today, they do it all on computer."

Ask about great moments; she will tell about the discovery of the Oklahoma City pool. About personal achievements; she is proud of the "beautiful mineral and fossil collection" she left at OCU.



Top: The car her father bought her in 1928 to commute to Norman from Oklahoma City to study for her M.S.

Right: OCU Geology professor "Shorty" Armor (Frizzell), pictured here on a field trip in 1930's.

(Photos courtesy of Elizabeth Holmes, The Frizzell Family).

Above: Mildred today with her great granddaughter, Hannah Holmes Frizzell, 9 years old. Mildred is passing on her love of Geology to Hannah through her rock collections and experiences. *(Photo courtesy of Elizabeth Holmes, The Frizzell Family.)*

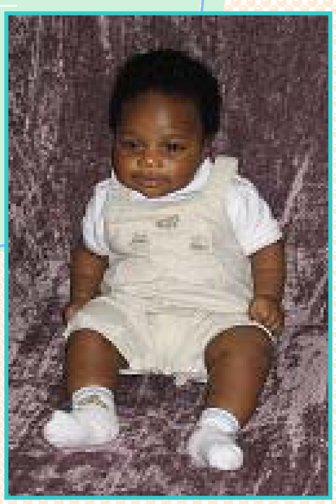
Ask about women in the science of geology. She will say: "Some of the best in the business are women now."

ALUMNI CORNER

Births

ISAAC LUKE KESSLER
Born: April 24, 2006
6 lbs. 5 ozs.
19.25 inches

Momma Jenni Kessler
(This explains why Jenni didn't attend AAC in April!)



LOIC URIEL NSOGA-MAHOB
Born: November 4, 2005
9 lbs. 3 ozs.
19.75 inches

Pappa Patrice Mahob

JORDAN & OWEN KUBERA
TWIN BOYS!
(Jordan on left, Owen on right)
Born: October, 2004

Parents Eric & Jill Kubera
(Both graduates of OU!)

School of GEOLOGY and GEOPHYSICS

ALUMNI CORNER

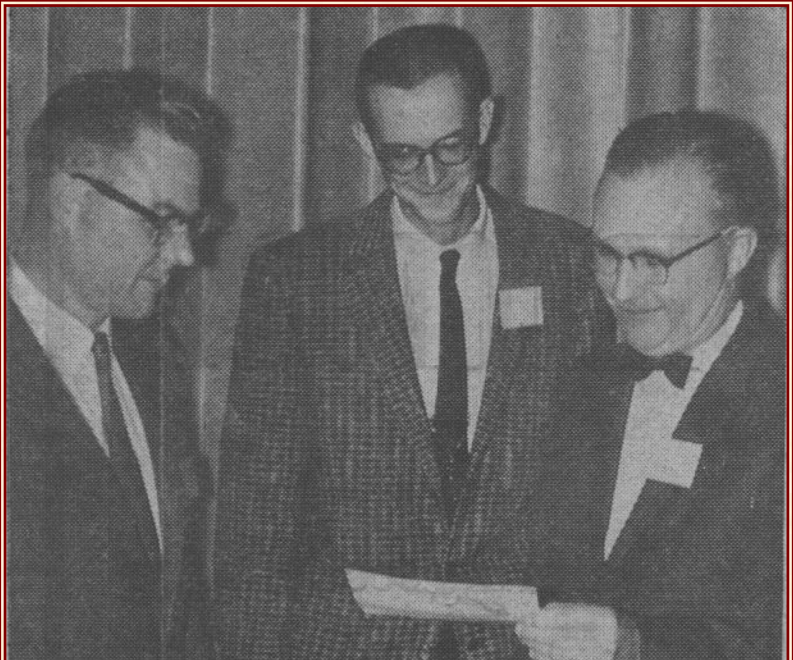
Deaths

Reported Deaths Since May, 2005

Roger L. Billings	MS 1956	07-21-2005	James H. Kitchen	BS 1950	01-22-2006
Eugene A. Bowman	MS 1956	07-04-2005	Irwin H. Kornfeld	BS 1959	03-29-2005
Albert H. Brooks, Jr.	BS 1949	02-19-2006	Capt. Glynn Q. Lane, Jr.	BS 1961	05-27-2005
Dr. John M. Brown	BS 1944	04-04-2006	Guy W. Leach	BS 1949	04-24-2006
Preston E. Carter	BS 1958	01-15-2006	Gwinn B. Lewis (McMahan)	BS 1953	03-11-2006
William John Coffman	BS 1956	03-23-2006	Charles L. McCall	BS 1943	03-05-2006
James W. Collins	BS 1949	11-24-2005	Tom J. McDonald, Jr.	BS 1957	07-21-2005
John W. Cooke, Jr.	BS 1950	05-23-2005	William E. McIntosh, Jr.	BS 1940	11-22-2005
William C. Cooley, Jr.	BS 1953	01-26-2005	Jack L. Morter	BS 1939	01-20-2006
Howard M. Cotton	BS 1952	03-27-2006	Phil J. Newkumet	BS 1948	04-18-2006
Richard D. Darnell	MS 1958	03-20-2006	Carl A. Nilsen	BS 1949	12-05-2005
Morris E. Dayton	BS 1950	11-20-2005	Robert E. Park	BS 1952	09-02-2005
Sherman N. Dillberg	BS 1938	12-27-2005	Ronnie C. Perkins	BS 1995	06-16-2005
Rudolph V. Ewing	BS 1939	11-28-2005	Walter S. Plant, Jr.	BS 1951	11-09-2005
Gary L. Garner	MS 1965	12-28-2005	Arthur J. Robnett	BS 1949	11-16-2005
Harold G. Grant	BS 1950	10-07-2005	I. D. Simpson, Jr.	MS 1951	07-12-2005
John M. Graves	BS 1955	07-30-2005	James T. Stringfield, II	BS 1950	05-13-2005
G. Carl Hale	BS 1950	06-21-2006	Barth P. Walker	BS 1940	12-31-2005
Daniel P. Hammond	BS 1979	05-26-2005	John H. Warren	BS 1952	07-16-2005
George B. Hanson	BS 1950	12-07-2005	Loyal H. Wells	BS 1929	09-15-2005
William V. Harlow, Jr.	BS 1956	04-03-2006	William J. Whaley, Jr.	BS 1948	09-20-2005
F. Dail Harper	BS 1955	10-31-2005	Will R. Wilson, Sr.	BS 1934	12-01-2005
Dr. William L. Hiss	MS 1961	04-12-2006	William H. Wise	BS 1948	09-23-2005
Paul H. Hyatt	BS 1946	07-03-2005	Roy A. Worrell	BS 1951	09-29-2005
Dr. Roy L. Ingram	MS 1943	10-03-2005			
Philip C. Kidd, Jr.	BS 1951	07-07-2006			

ALUMNI NOSTALGIA

Dr. Gilbert in 1959 as a graduate student!

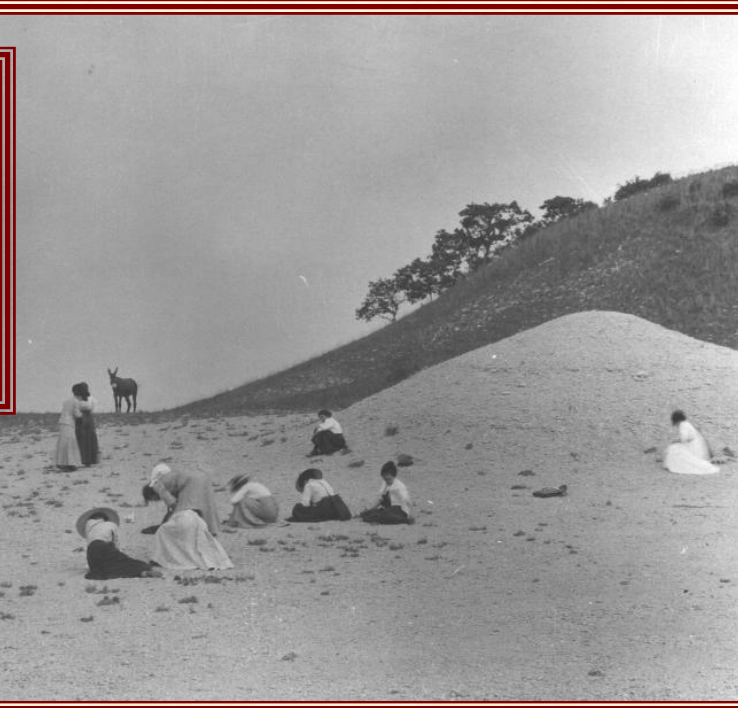


UNANIMOUS CHOICE — Charles Gilbert, Lawton graduate student, Anter, was elected unanimously by the geology faculty to receive the annual $200 Byron award. C. W. Byron, Houston, former OU student, gives this award to encourage original and creative thinking in geological problems pertaining to petroleum geology. Presenting the award is Dr. G. G. Huffman, faculty sponsor, and William Hiss, president of Sigma Gamma Epsilon, honorary geological fraternity. Gilbert was selected for his outstanding work in class and in the field.

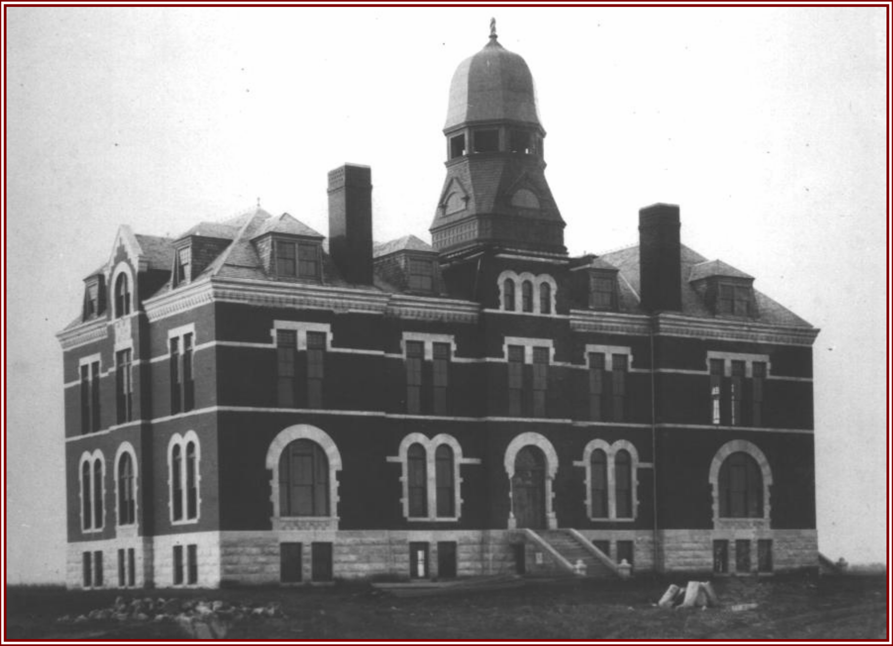
Below: ***Female OU students collecting fossils at White Mound in 1909!*** (Photo courtesy of Western History Collections, The University of Oklahoma Library)

(Excerpt from the "Oklahoma Geology Notes" Aug/Sept 1958) ***White Mound is famous as a collecting locality for Lower Devonian fossils, and collections from there are widely distributed throughout the world. ….It has also been examined by geology classes from universities scattered throughout the United States, and prior to its closing was visited each year by geology students at The University of Oklahoma.***

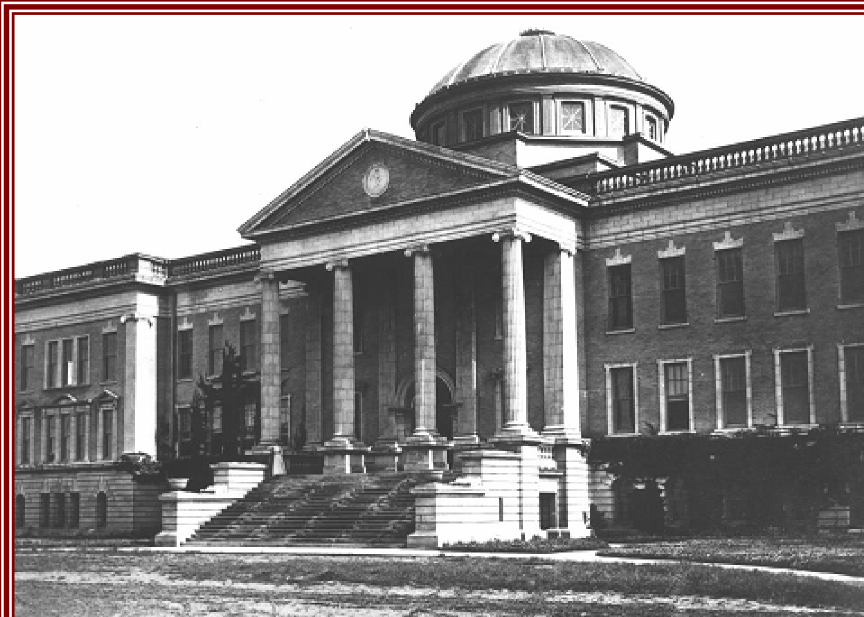
~~Article by Thomas W. Amsden



Inset photo above: ***Geology class of 1930 digging for fossils at White Mound.***



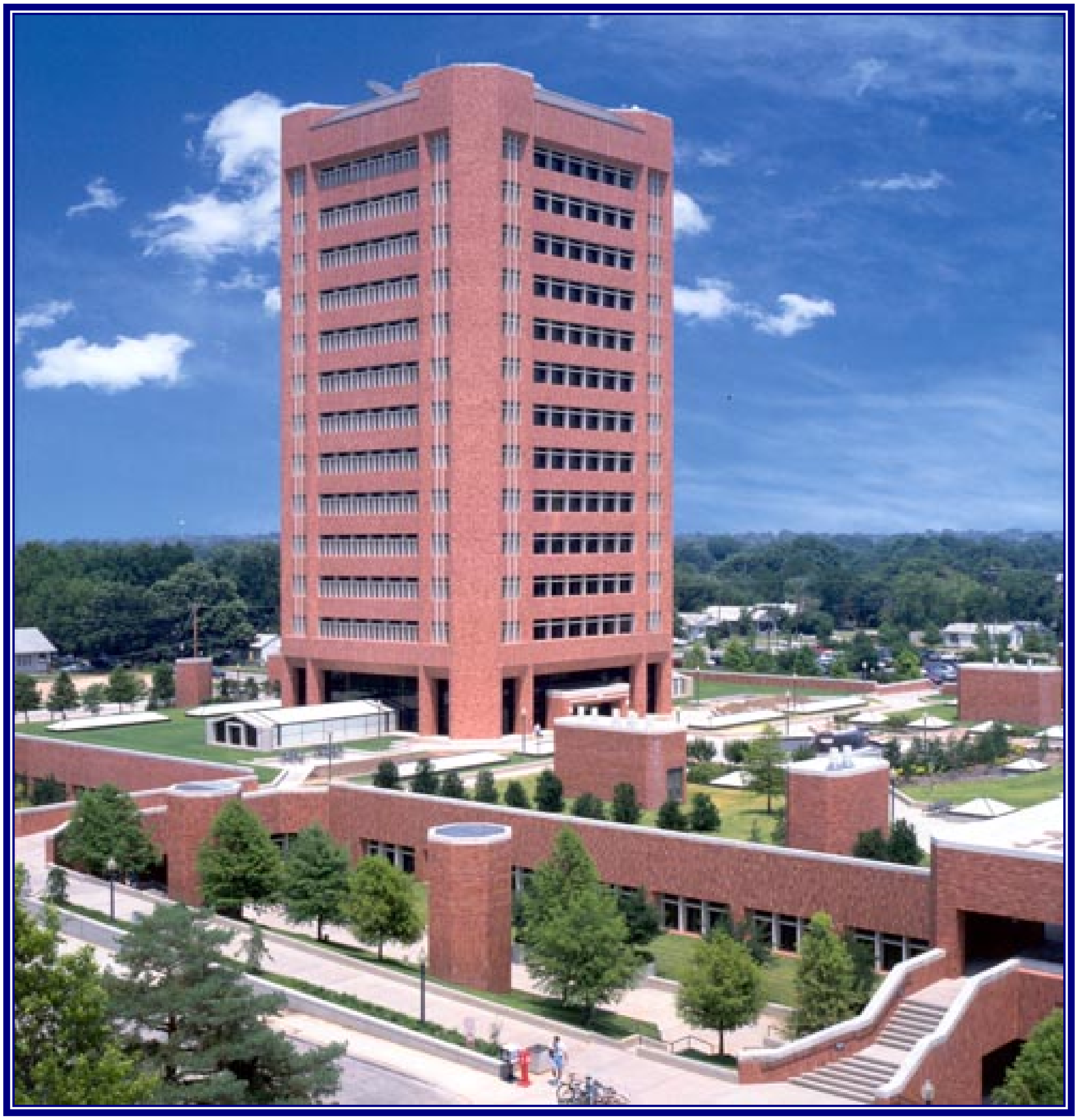
Left: ***The first administration building at The University of Oklahoma built in 1893. It was destroyed by fire in 1903.*** (Photo courtesy of the Western History Collections, The University of Oklahoma Library)



Right: ***University Hall, the second administration building, was also destroyed by fire in 1906.*** (Photo courtesy of the Western History Collections, The University of Oklahoma Library)

The University of Oklahoma Mission Statement

Always Remember: The mission of the University of Oklahoma is to provide the best possible educational experience for our students through excellence in teaching, research and creative activity, and service to the state and society.



SARKEYS ENERGY CENTER MISSION

The mission of the University of Oklahoma's Sarkeys Energy Center is to foster premier interdisciplinary energy research and education and, through various means of technology transfer, enhance regional economic growth and national energy and economic security.

EARTH SCIENTIST

The University of Oklahoma
SCHOOL OF GEOLOGY AND GEOPHYSICS
810 Sarkeys Energy Center
100 East Boyd Street
Norman, Oklahoma 73019-1009

Address Service Requested

Non-Profit Organization
U.S. Postage
PAID
The University of Oklahoma

School of Geology & Geophysics
The University of Oklahoma