Earth Scientist

2008 Issue

THE UNIVERSITY OF OKLAHOMA

ConocoPhillips School of Geology and Geophysics

WANTED

Photographs, class lists, and curricula from past OU Geology Summer Field Camps.

ALUMNI!!! Do you have any old photos from your summer at OU's field camp squirreled away in a drawer? Any list of who attended field camp with you or perhaps the field camp curriculum tucked away in a dusty file?

If you do, Neil Suneson would like copies (or originals and he will make copies) for a history of OU's field camps that he is compiling. Depending on the response, the history and the best photos will be made into hard copies for distribution; a more detailed history and all the photos will be put on a CD.

For more information, please contact Neil (nsuneson@ou.edu).

Stratigraphy and Depositional Systems field trip sponsored in part by Chesapeake Energy. Sept 19-21, 2008 to Guadalope Mts. in West Texas. THANK YOU, CHESAPEAKE!

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The *Earth Scientist* is published annually, reporting on research, activities and programs related to OU's ConocoPhillips 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, ConocoPhillips School of Geology and Geophysics, 100 East Boyd Street, 810 Sarkeys Energy Center, Norman, OK 73019-0628.

ON THE COVER

AAPG 2008 Imperial Barrel award-winning team from University of Oklahoma. (Standing left to right): Carlos Santacruz, Elizabeth Baruch, Roderick Perez; (Seated left to right): Carlos Russian, Romina Portas. Story on page 68. *(Photo courtesy of Bob Taylor, OU)*

Earth Scientist

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R. DOUGLAS ELMORE

Director, ConocoPhillips School of Geology and Geophysics
Eberly Family Chair Professor, Associate Provost

Director's Corner

The 2007-2008 academic year brought more new changes to the ConocoPhillips School of Geology and Geophysics (CPSGG). Three new faculty members and one new staff member joined us in August 2007. The geophysics program was strengthened by the addition of Dr. Kurt Marfurt who holds the Schultz Chair in Exploration Geophysics. We also hired Tim Kwiatkowski as a computational geophysicist to help run our high-end computing facility. In our continuing effort to build the geophysics program, Kurt will be chair of the search committee for a junior level geophysicist we plan to hire this coming year. Dr. Megan Elwood Madden, a low-temperature geochemist, works on methane hydrates as well as in planetary fluid geochemistry, and Dr. Andy Madden, an environmental geochemist who works on uranium biotransformation for environmental remediation and on nanoscience geochemistry, also joined the faculty in August 2007.

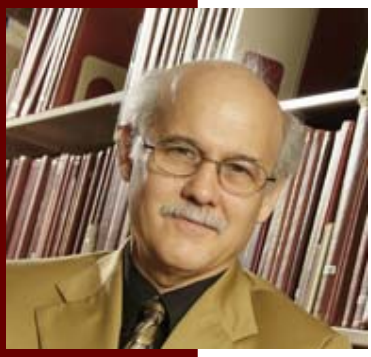
Both our undergraduate and graduate enrollments are increasing. We are continuing our initiative to better compete with other institutions for high-quality graduate students and to increase the number of graduate students in CPSGG. The funds provided by generous donations of our alumni as well the match provided by Mr. Curtis Mewbourne as part of the College Campaign have allowed us to increase the number of fellowship/assistantship offers. We expect to have about 20 new graduate students in the fall of 2008. The funds from the Campaign have also allowed us to increase our undergraduate scholarship amounts.

Other notable events:

- Five students won first place in the Imperial Barrel Competition at AAPG this year. Team members included: Carlos Santacruz, Elizabeth Baruch, Roderick Perez, Carlos Russian, and Romina Portas. Their advisors were Roger Slatt, Kurt Marfurt, and Larry Grillot.

- External funding increased from below $1 million in FY05 to more than $2.5 million in FY07.

- Our generous alumni and friends have set up many new endowed funds to provide more scholarships and graduate fellowships (see the list on page 61). Several of our labs have also been named with generous donations, including the Ackerman Paleontology Laboratory and the ConocoPhillips Introductory Laboratory.



- Last fall we had 27 companies interview on campus, and based on the companies we already have scheduled, we expect another high number this fall. Our students continue to be in high demand with many getting multiple internships and full-time offers. The AAPG-SEG Spring Break Student Expo was a success again this year with 33 company sponsors and 213 students from 52 universities.

- Last spring we offered the undergraduate Subsurface Methods course for the first time in many years. The course was taught by Neil Suneson, Rick Andrews, and Dan Boyd from the Oklahoma Geological Survey.

- We are continuing the process of upgrading our labs, including additional microscopes for mineralogy and petrology courses to address increased enrollments, a teaching flume for the sedimentology courses, and new geophysics equipment for field camp. We are also in the process of purchasing two new vans.

- In collaboration with the English Department and the Writing Center at OU, we have started an initiative to improve the writing abilities of our undergraduates.

ConocoPhillips SCHOOL OF GEOLOGY & GEOPHYSICS The University of Oklahoma

R. DOUGLAS ELMORE

Director, ConocoPhillips School of Geology and Geophysics
Eberly Family Chair Professor, Associate Provost

- Our students continue to receive awards. See the highlights on pages 65 and 66.

- At our spring picnic and honors event, we acknowledged Katie Gunderson with the Charles N. Gould Award. Katie also received several highly prestigious awards, including Goldwater, Udall and Gates scholarships. Nicole McMahan received the David W. Stearns Award, Rika Burr received the Alan Witten Award, and Matt Hamilton and Juliana Gay received an Eastwing Hammer award. The staff awarded the "Student Rock Award" to Vincent Heesakkers. Kristen Marra received the Stan Cunningham Outstanding Teaching Assistant Award and Ben Drenth received the first Ben Hare Prize for the student who demonstrates through independent research the most creative application of geological and geophysical principles. Both Stan and Carol Hare were present to help present the awards. Several other "unofficial" awards were also given, including Grant Heard for the best gringo salsa dancer and Carlos Russian and Roderick Perez for the "best" answer to a question at the SEG challenge bowl.

- In addition to the courses we teach for our majors, the CPSGG faculty members teach about 1400 students in introductory general education courses as well as courses for MPGE and the Price Business College. Stan Cunningham was a big help to CPSGG by teaching the Petroleum Geology course for the business college.

- In 2008, we reintroduced the freshman field trip. David Stearns, Charles Gilbert, and Barry Weaver led a successful trip to Colorado, Utah, and New Mexico.

- We held our field camp with OSU again at the old camp outside of Canon City, CO. We had 12 out of the 58 students at the camp. The camp has been upgraded with new facilities that are much appreciated by the faculty and students. Neil Suneson, Tom Stanley, and Randy Keller participated. Although the joint camp with OSU is working well, we are starting to evaluate our long range plans.

- Dr. Ze'ev Reches has accepted the Structural Geology position that he interviewed for last year. He is now a tenured professor.

- Some of you may remember the large geologic map of Oklahoma that was hanging between the second and third floors in the stairwell at the southwestern corner of Gould Hall, our old building. Gould Hall is undergoing a major renovation for the College of Architecture and with the help of several students, we recently rescued the map. It is in pretty good shape for a 1938 map. We plan to hang it in the Energy Center, and we are currently looking for a good wall.

ConocoPhillips SCHOOL OF GEOLOGY & GEOPHYSICS The University of Oklahoma

LARRY GRILLOT

Dean, Mewbourne College of Earth and Energy
Director, Sarkeys Energy Center and Lester A. Day Family Chair

Dean's Corner

As I write this, we are close to the start of fall, 2008 classes. It's always a busy but good time when the students are back on campus. The summer "break" is nice, but the campus is clearly more like a university should be with the students here.

And speaking of students, we expect our enrollments to increase, both in geology & geophysics and petroleum & geological engineering. We have been preparing for this continued increase by upgrading our teaching lab facilities in both of the schools. This has included both space and equipment upgrades, which are made possible by the support of alumni, industry partners and other constituents.

We have also been focused on increasing our faculty to address the higher enrollments, and are pleased that we have added four new faculty members (one in G&G and three in P&GE). And we are continuing our efforts to build our faculty with additional searches in both schools. We are also continuing our search for the Director of the Oklahoma Geological Survey, so recruiting is an important activity throughout the college.

This year we will be announcing the first Distinguished Alumni and Distinguished Service awards for the college. The awards ceremony will be held in conjunction with the various advisory board meetings on November 21st, 2008. On the afternoon of November 21st (Friday), we are planning to hold a reception celebrating the 100th anniversary of the Oklahoma Geological Survey. More details regarding these events will be provided in the near future.

We are pleased and thankful for the progress with the college capital campaign, and we continue to work to obtain the necessary funding to remodel the Sarkeys Energy Center Tower. We are very close to our goal, but have also had a bit of a "moving target" with inflation and some increased scope to address our higher enrollment. We will continue to work to get this part of our plans for the college accomplished as soon as possible.

Overall, I believe we continue to make progress with our programs in the Mewbourne College of Earth & Energy. Again, I thank all of our alumni, industry partners and other constituents for their interest and support. I look forward to a successful 2008-2009 academic year.

ConocoPhillips SCHOOL OF GEOLOGY & GEOPHYSICS
The University of Oklahoma

JOHN W. RITZ

Former Assistant Dean of External Affairs
Mewbourne College of Earth and Energy

Development Update

We are proud to announce that since the launch of the Mewbourne College of Earth and Energy capital campaign in November of 2006, over $55 million has been contributed. In addition, from November 2006 through March 2008, Mr. Curtis Mewbourne matched $5,108,319 from over 1360 gifts. It is with the funds of these many generous donors that the Mewbourne College of Earth and Energy ConocoPhillips School of Geology and Geophysics is better equipped to reach its goals and provide for the educational needs of the students.

Since January, 2008, there have been several significant gifts to the Sarkeys Energy Tower Renovations, the program in Natural Gas Engineering and Management, and student enrichment. These recent gifts include:

$1.5 million gift from ONEOK, Inc. to establish the ONEOK, Inc. Chair and program funds in Natural Gas Engineering and Management

$1 million gift from Mr. Aubrey McClendon and Chesapeake Energy to name and renovate the Sarkeys Energy Center Atrium and College student services center, now the Chesapeake Student Services Center and Lounge

$1 million gift from Mr. Gene Van Dyke to name and renovate the Sarkeys Energy Center Plaza, now the Gene Van Dyke Plaza

Nearly $16 million in computer software and hardware, including:

- $8.3 million in software and hardware from Schlumberger
- $6 million in software from Halliburton
- $1.6 million in software from Kingdom Suite

The campaign goals and current numbers, as of March 31, 2008, break down as follows:

Mewbourne College of Earth and Energy Campaign Totals

As of March 31, 2008

Campaign Breakdown	ACTUAL	MCEE	CPGG	MPGE
Fellowship and Scholarship Endowments	$14,538,837	$2,065,067	$8,341,346	$4,132,424
Mewbourne Endowed Match	$4,715,592	$780,796	$2,389,913	$1,544,883
Annual Scholarships	$878,422	$55,000	$334,183	$489,239
Mewbourne Annual Match	$106,117		$9,682	$96,435
Faculty Endowments	$6,000,000	$1,000,000	$2,000,000	$3,000,000
Facilities and Resources				
**Sarkeys Energy Tower Renovation*	$7,600,000	$5,600,000	$1,000,000	$1,000,000
**Laboratory & Classroom Resources & Endowments*	$7,463,045	$908,000	$755,045	$5,800,000
**Oklahoma Petroleum Information Center*	$90,000	$90,000		
Mewbourne Laboratory Resources Match	$125,000			$125,000
Enrichment Endowments				
**Student Enrichment*	$18,386,165	$175,706	$8,826,118	$9,384,341
**Faculty Research Enrichment*	$30,000	$30,000		
**Library Endowment*	$1,076,070	$1,076,070		
Mewbourne Enrichment Match	$161,610	$43,348	$83,517	$34,745
Other	$153,288	$2,600		$150,688
Mewbourne Total Match	$5,108,319	$824,144	$2,483,112	$1,801,063
Total	$56,215,827	$11,002,443	$21,256,692	$23,956,692

For more information on development opportunities, please contact the Dean's office at (405) 325-3821.
Subsequent to this report, John relinquished his position at OU to return to his roots in the oil industry.

EMMITT LOCKARD

Alumni Advisory Council President 2007-2008
ENI Petroleum

AAC Update

This was a very exciting and important year for the Alumni Advisory Council as we evolved to better support the students, faculty and administration of the ConocoPhillips School of Geology and Geophysics and the Mewbourne College of Earth and Energy. They are both taking great strides along the path to an eminent position in energy and earth science education.

The goals that the Council set for itself at the beginning of the year were to revive our committees, increase the participation of the council members in the support of students and faculty and improve our communication with alumni.

We now have our Curricula Development, Industry Contact, Gifts and Endowments and OU Worldwide Committees active again, and we also created the Geological Survey Committee. Each committee is headed by an energetic chairperson with an abundance of members from the council who have great ideas and enthusiasm for supporting the work of the school.

We also welcomed twelve new members to the Alumni Advisory Council this year, and I am happy to report that they are all looking forward to serving on the Council.

The response from our alumni to Mr. Mewbourne's generous offer to match our contributions for scholarships in the college was outstanding. We donated over $2,400,000 and formed 10 new endowed funds to support students in the ConocoPhillips School of Geology and Geophysics.

There are many more things to tell you about than space permits, so I would like for you to visit another of our accomplishments this year to learn more about the Council and its activities. Please visit the official Web site of the alumni of the ConocoPhillips School of Geology and Geophysics:

www.ougeoalumni.com

You will find information about the work of the committees, upcoming events, memorials and much more. I encourage you to take the time to visit and contact us to let us know what you would like to see included. Most of all, we would like for you to use some of the features we've included to improve our communication with one another.

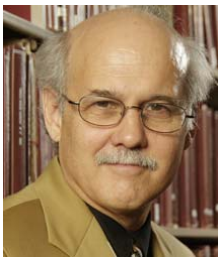
I take a great deal of Sooner Pride in the way in which the Council came together this past year to achieve the goals we set for ourselves, and I can honestly say that this is just the beginning.

I am very proud to have served as President of the Alumni Advisory Council.

Faculty

ConocoPhillips School of Geology and Geophysics

DIRECTOR



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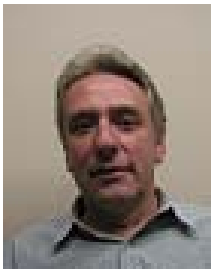

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Robert Turner
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In Loving Memory

Bob pictured here with Charles Gilbert at the 2006 Back-to-School Mixer

Dr. Robert Lee DuBois

Emeritus Professor Robert Lee DuBois, 84, of Norman, Oklahoma, died on March 2, 2008, in Tulsa, Oklahoma. Bob was on the faculty for more than 20 years, and his research was in the area of geomagnetism and, particularly, in archeomagnetism. He was active in a number of community organizations, including serving as President of the Sons of the American Revolution, Norman Chapter. Dr. DuBois also served as a researcher for the NASA SPACETEAM. He was featured in the *National Geographic* as the world's foremost researcher in "Archi-Mag." In 1981, he was named assistant director of the school, a position held until his retirement in 1988. Many students from the 1980s will recall that he was the principal undergraduate advisor.

Dr. DuBois spent his life serving God, Country, fellow man, and family. He will be deeply missed by his family and friends and many in the ConocoPhillips School of Geology and Geophysics.

FACULTY/STUDENT ARTICLES

"A bad day in the field is better than a good day in the office!"

Minerals

Case Studies

Adventure

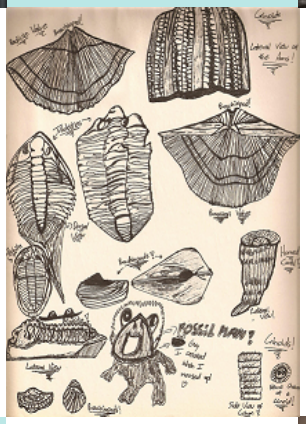
EXPLORE

EARTH

Research

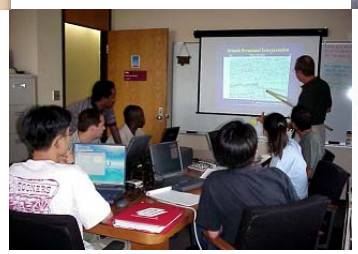
Field Trips

Fossil Hunting



Student ABSTRACTS

FACULTY Abstracts



ConocoPhillips SCHOOL OF GEOLOGY & GEOPHYSICS The University of Oklahoma

The GEOL 3003 Reservoir Strata and Structures Field Trip 2007 Version

Neil Suneson, Rick Andrews, and Dan Boyd
Oklahoma Geological Survey

"Geology carries the day. I find in Geology a never failing interest; it creates the same grand ideas respecting this world which astronomy does for the universe" ~~Charles Darwin (1835)

In 2007, the eagerly anticipated 3003 field trip "Reservoir Strata and Structures" was held on the weekend of October 20 and 21. It's hard to believe the trip could be any better than last year's, but it was. Thanks to student suggestions, we added two stops to look at petroleum production facilities, which necessitated eliminating a couple of rock stops. This was fine with this year's students – who needs to look at turbidites, anyway? (with apologies to Roger Slatt). For some reason, the same faculty (Rick Andrews, Dan Boyd, and Neil Suneson from the OGS, and Jeff Callard from MPGE) volunteered to do the trip again. But three untainted and uninitiated grad students assisted – Alice Stagner (SGG grad student and TA for 3003), Grant Heard (SGG grad student), and Jason "Gone-to-the-Dark-Side" Moncrieff (SGG graduate and now MPGE graduate student). This proves that age and experience does not necessarily equate to intelligence.

Because leaving the Lloyd Noble parking lot in the dark at 7:00 a.m. was so popular with the students last year, we did it again this year. The drive to the first bladder break at McDonald's in Eufaula was done largely in silence; no doubt the excitement of the impending trip prevented most of the students from getting much sleep the night before and the two-hour drive was welcome. Or perhaps, as good PE students, they were all up studying their 3003 notes so that they could ask some stimulating questions. Whatever the reason, the now-relieved and -fed students seemed anxious to attack some outcrops.

Stop 1. Red Fork Sandstone, Boggy Formation. Along Hwy 9 just east of Eufaula and just before crossing the lake. After Neil and Rick waxed eloquently on geologic basins (here, the Arkoma), log signatures, and sequence stratigraphy (incised-valley-fills), the students were turned loose to examine the dark marine shales, the sharp erosional contact at the base of the sandstone, rip-up clasts, and cross-bedding. We talked about rapid lateral facies changes, reservoir heterogeneity, and snakes and chiggers. Perhaps most interesting to some of the students were the large siderite nodules of all shapes and sizes in the shale; no … they are not dinosaur secretions, they are concretions.

The OU–Iowa State game started between stops 1 and 2 so few students fell asleep. Also, the drive took us through the not-to-be-missed towns of Quinton and Kinta. **Stop 2**, just south of Lequire, is a fantastic delta-plain sequence in the Savanna Formation, made "famous" in a "seminal" (ahem) paper by

FIGURE 1: Two PE students examine the mold of a large "in situ" lycopod in the Savanna Formation. The surface of the mold is coated with carbonized organic material. The lycopod grew in an interdistributary bay (now preserved as shale, siltstone, coal) and was chopped-off and buried by flood deposits (crevasse-splay sands). *Photo by Jason Moncrieff*

Andrews and Suneson (2002, OGN, v. 62, pages 4-18). Although not great reservoir strata, the crevasse-splay sandstones sandwiched between the interdistributary-bay siltstones, shales, and coals exhibit a classic fining-upward character easily recognizable on logs. The down-cutting distributary channel near the top of the outcrop allowed the leaders to talk, once again, about rapid lateral facies changes and the coal beds prompted discussions of recent advances in drilling (as in horizontal) for coalbed methane. Some students collected plant fossils and took pictures of the *in situ* lycopod stumps (Fig. 1). Perhaps the most important aspect of stop 2 was that it was clear OU was having trouble beating last-in-the-Big-12-North Iowa State and that it would be critical to listen to the rest of the game. This wasn't a problem because Red Oak appeared to have only one working bathroom to serve our 50-plus crowd.

Stop 3. Incised-valley-fill sandstone, Hartshorne Formation, Rick Andrews led a discussion of the marine-bar strata along the road (lousy reservoir strata) and then took the PE students on a walk through the woods. Judging from the students' comments, this was the first time some of them had ever done this. (To quote - "Oh, so that's what poison ivy looks like!) At the end of the walk was an 80-ft-high cliff of Hartshorne sandstone. Rick directed most of the troops to the bottom of the cliff and elicited more discussion about falling sea levels and rivers chasing shorelines. He also emphasized how quickly the reservoir character of the Hartshorne changed in a short distance and how critical careful seismic interpretation and drilling are to successful exploration and development. Those who remained on top of the cliff resisted the urge to dislodge boulders onto those beneath them and enjoyed the superb view instead.

Following Stop 3, we could breathe more easily; OU beat Iowa State 17–7. And we could focus on the last stop of the day.

Stop 4. In the westernmost of the Twin Cities, Haileyville, we met Steve Billingsley of Samson, who led us to one of his company's gas-production facilities near Bond. There we met Orville Davis who helped Steve distribute hard hats, toe guards (very cute!) (Fig. 2), and safety glasses to everyone. In addition, they'd brought along a much-appreciated cooler full of soda and water. Steve and Orville explained what the purpose was of all the pipes coming out of the ground and then going back into the ground and what the building with the giant fans making all the noise was (a compressor). Jeff was in heaven at this stop and told the students that this is the real-life example of what he talks about in his classes. The Samson folks treated us extremely well and let those students who didn't already have one keep their hard hat, with the Samson logo front and center.

Next stop – dinner at the Brangus Feedlot in McAlester. Somehow they were able to accommodate all of us at once. And then a "short" drive to the Microtel in Ada, with a brief moment of chaos because some students couldn't remember who they were rooming with, and sleep.

Sunday morning (October 21) we all rose early for a +/-7:00 a.m. departure. **Stop 5** was the basal sand (and yes, it really is a sand and not a sandstone) of the Ordovician Oil Creek Formation. Mr. Charlie Goodson led us into the quarry where U.S. Silica was hydraulically

FIGURE 2: The Fall 2007 "Structural Geology and Stratigraphy for Petroleum Engineers" class at Samson's gas-production facility near Bond. Note the footwear! (Photo by Dan Boyd)

quarrying the sand (Fig. 3). Dan described the excellent reservoir qualities of the unit (~30% porosity, darcies of permeability), its mineralogy (almost pure quartz), its origin (eolian sands reworked into shallow-marine deposits), and distribution (very widespread). Like last year, several students tried to collect specimens to take back to Norman, but failed miserably.

Stop 6 is an old favorite of many OU geology graduates and of other geology departments in Oklahoma and probably other states. The Hunton Anticline is well exposed in a quarry just off the road to the Goddard Youth Camp. Riprap from the quarry was used to build the dam that holds in Lake of the Arbuckles. Here, we looked at a real (in the field, not in a book) fold, impermeable carbonates, and fractures – our only hope for producing hydrocarbons from such tight rocks. A short walk took us to Oklahoma's favorite source rock and now one of its hottest reservoirs – the Woodford Shale. Rick talked about the different rock types within the Woodford (chert, shale) and how each behaves when fracture-stimulated. He also talked about the natural fractures within the unit and had the students smell the oil in fresh pieces of the rock. So this is what money smells like!

The last rock stop, **Stop 7**, (we save the best for last) is the Dougherty Rock Asphalt Quarry (U.S. Asphalt No. 2 Quarry). Here, the students examined an exhumed oil reservoir - oil-soaked Viola Limestone (Fig. 4) and asphalt dripping out of fractures and vugs on the highwall. The reservoir here is a conventional fractured and faulted anticline that probably formed and was charged in the Middle Pennsylvanian. Late Pennsylvanian uplift and erosion breached the seal and most of the oil escaped from the reservoir. What was left (what we see today) is biodegraded, devolatilized, and buried by the Vanoss Conglomerate. All the students had their pictures taken in front of the small asphalt "stalactites", some of which were removed and subjected to "oxidation" experiments. The relations and photographic opportunities at this quarry are truly impressive.

The final stop of the trip, **Stop 8**, was added this year based on suggestions by last year's students. OU grad (1977, MS in PE) Andy Jackson, who now works for Quinton-Little Company, showed us the production facilities at his company's Hare No. 1 well on the south side of the Arbuckles in the Ardmore Basin (Fig. 5). Between Andy's and Jeff's explanations, the students got a good picture of what makes up a small oil production operation. And with oil approaching $100/barrel, even stripper wells like this can quickly pay for one's tuition (and fees!).

Two beautiful days.... Good geology....

Good tours.... Great company....

Good food....

And OU won the football game!

Neil Suneson

Now THAT'S a weekend to remember!

FIGURE 3: Hydraulic mining of the Oil Creek Sand at U.S. Silica's quarry near Mill Creek. *(Photo by Jason Moncrieff)*

FIGURE 4: Hydrocarbons everywhere! The Viola Limestone rubble is saturated with biodegraded oil and asphalt has seeped out of the quarry wall. *(Photo by J. Moncrieff)*

FIGURE 5: The Quinton-Little No. 1 Hare well with stock tanks and small compressor for gas in background. *(Photo by Jason Moncrieff)*

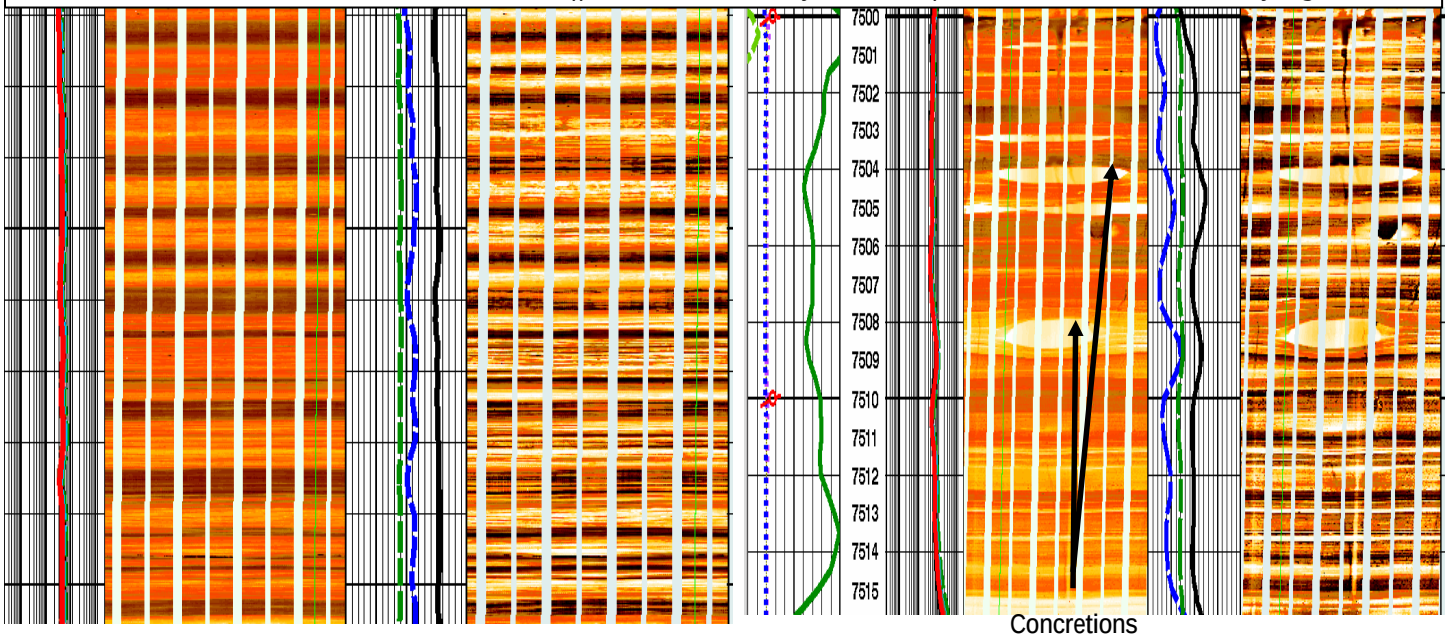
Some Petroleum Geology-Geophysics Activities in the School of Geology and Geophysics and Sarkeys Energy Center Institute of Reservoir Characterization

Roger M. Slatt
Ward Chair Professor of Reservoir Characterization,
Director, Institute of Reservoir Characterization
The University of Oklahoma

This was another very good year for students studying petroleum geology and geophysics with me at OU, through both the ConocoPhillips School of Geology and Geophysics (CPSGG) and the Sarkeys Energy Center Institute of Reservoir Characterization. My students, as well as those working with other faculty in the petroleum area, are being exposed to an increasing variety of courses and thesis topics, and employment offers in the petroleum industry continue to be plentiful both for full-time professional positions and for internships. Most graduate students are receiving multiple employment offers well before their graduation date. Below, the activities of the students are highlighted.

The Barnett-Woodford Shale unconventional gas research program continues to flourish, in large part due to continued substantial financial support from Devon Energy Co. There are currently several students working to develop a regional sequence-stratigraphic framework for the Barnett Shale. **Prerna Singh (Ph.D.-Dec. 2008),** the lead student researcher, is completing her dissertation on the litho- and sequence-stratigraphic framework of the Barnett Shale in north Texas. Her research to date has garnered significant international and local interest, and she has made presentations to a number of U.S. organizations, in addition to the International Geological Congress, Norway, and the Conventional & Unconventional Hydrocarbon Resources International Congress (Cartegena). **Roderick Perez (M.S.-Dec. 2008)** and **Elizabeth Baruch (M.S.-May 2008)** are relating seismic characteristics from 3D-seismic surveys in north Texas to the stratigraphy developed by Prerna. **Julieta Vallejo (M.S. - Dec. 2008)** and **Nabanita Gupta (Ph.D.)** are relating detailed core lithofacies to borehole-image-log data in an attempt to utilize image logs for quantitative evaluation of lithofacies and fracture distribution **(Figure 1). Angel Gonzalez (M.S.-Dec. 2008)** continues to utilize a sophisticated cluster-analysis program to quantitatively relate stratigraphy to well logs in uncored wells. **Nichole Buckner (M.S.-Dec. 2008)** is completing her thesis on the stratigraphy of the Woodford Shale from observations in a superb quarry **(Figure 2)**, coupled with a behind-quarry core/log suite obtained in late 2006. **Romina Portas (M.S.-May, 2008)** has completed a LIDAR survey in the quarry to quantify fracture distribution and orientation and has shot several seismic lines to image the topography on the underlying

FIGURE 1: *Laminated heterolith with different mean resistivity; not identifiable in conventional resistivity log.*



Hunton unconformity in order to relate paleotopography to fracture distribution. **Dwayne Veach (M.S.)** is conducting a subsurface stratigraphic study of the Woodford Shale.

Not all of the student theses are directed at unconventional gas reservoirs. **Gustavo Diaz (M.S.-Dec. 2008)** is completing a seismic stratigraphic study of a key turbidite reservoir in Mexico (onshore) that is destined to be a top supplier of oil to that country. **Natalia Leon (M.S.-Dec. 2008)** **(Figure 3)** is completing her thesis utilizing seismic sequence stratigraphy to identify gas sands in an area of offshore southern Mexico. **Byron Solarte (M.S.)** has begun a thesis to evaluate transition zones in Oklahoma-Texas carbonate reservoirs. **Faiz Ali (M.S.-Aug. 2008)** recently defended his thesis utilizing sequence-stratigraphic concepts to develop some new play concepts in the lower Red Fork Sandstone. **Juan Guzman (M.S.-Aug. 2009)** has begun a similar sequence-stratigraphic study on the middle-upper Red Fork in the same area. **Diana Parada (M.S.)** has initiated a seismic sequence stratigraphic analysis of an area in the western Gulf Coast. Other M.S. students just beginning their thesis research include

FIGURE 2

Levi Pack, Carlos Santacruz, Austin Heape, John Hull, and **Jarred Tarkington**. In addition to **Prerna** and **Nabanita**, mentioned above, at the Ph.D. level, **Gloria Romero (Ph.D.-Dec. 2008)** is completing her studies of deepwater depositional processes in the Caribbean offshore of Colombia for application to exploration in that subsurface area **(Figure 4)**. **Efrain Mendez (Ph.D.-Dec. 2008)** is completing his dissertation on application of sophisticated geophysical techniques for gas-sand detection and mapping in an area of offshore southern Gulf of Mexico. **Supratik Sarkar (Ph.D.)** is beginning his research in quantification of seismic attributes for lithology/ stratigraphy analysis of 3D seismic volumes **(Figure 5).**

One of the other activities that involved four of my students, and me as project advisor, this past year was the AAPG Imperial Barrel Team Competition. The

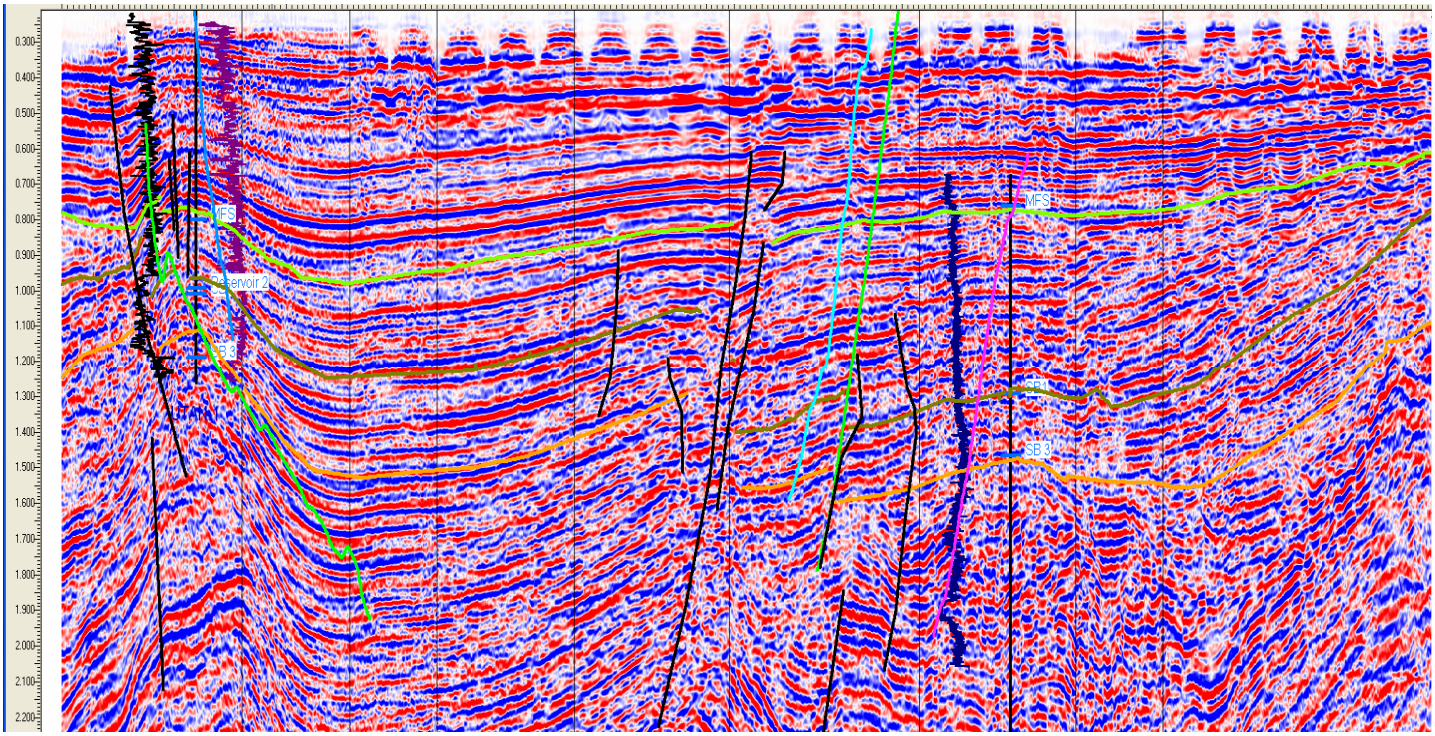
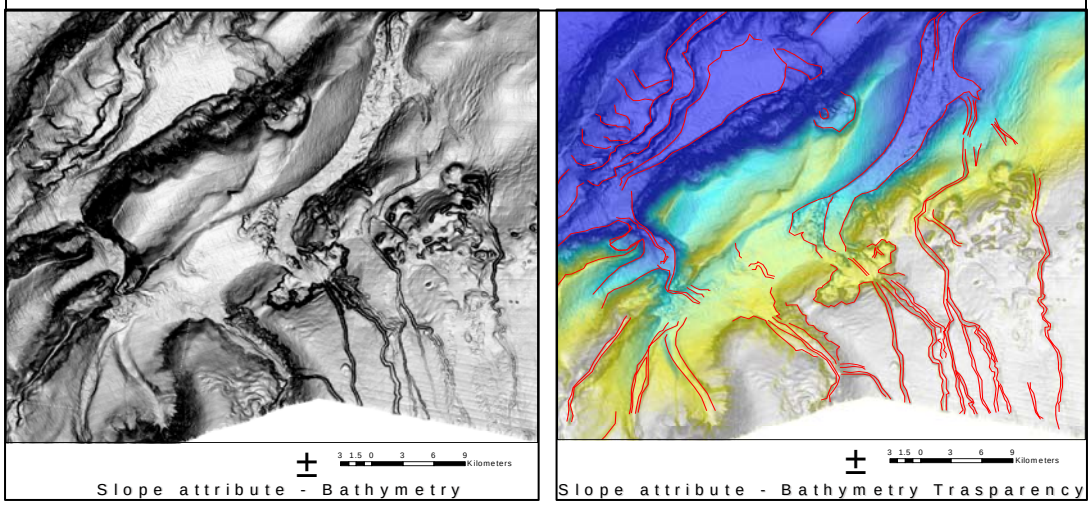


FIGURE 3: *Use of biostratigraphy to identify and map sequence boundaries (SB) and maximum flooding surfaces (MFS) across structures.*

CPSGG team of five graduate students won First Place in this international competition **(Figure 6).** This is the second year of the AAPG-sponsored competition, which attracted geoscience teams from 34 universities around the world. Each team is assigned an exploration area, from which they must develop a play and prospect portfolio over an 8-week period, and present their findings to a panel of petroleum industry experts, who judge the presentations. Our winning team worked Australian basins. Once again, our students have demonstrated their excellence and have brought significant international publicity to the School of Geology and Geophysics.

FIGURE 4: *Sea-floor morphology of the Magdalena fan, offshore Colombia – Gloria Romero, Ph.D .Dissertation*



Finally, during the past year, I was able to make numerous presentations and short courses to a variety of professional society, industry, and academic organizations from the U.S. and various parts of the world. One of the nicest presentations made was to a group of 60 students from 3 Indonesian universities **(Figure 7).** They attended a one-day short course on sequence stratigraphy sponsored by the Indonesian Petroleum Association. The course was held on my birthday, and the appreciative students presented me with a birthday cake at the end of the day.

The research program described above has benefited greatly by the addition of Dr. Kurt Marfurt to the faculty of CPSGG. His geophysical expertise is allowing many of my and other graduate students to enhance their thesis work by incorporating sophisticated new geophysical technologies. Also this year, relations with Schlumberger in Oklahoma City have been strengthened considerably, mainly through the efforts of Senior Geologic Advisor Bob Davis. One such action is the installation of a new computing laboratory fully equipped with Petrel software, coupled with training for our students by Schlumberger personnel **(Figure 8).** Also, Eric Eslinger, President of Eric Geosciences Ltd. has provided a software program GAMLS for cluster analysis of well-log data that has numerous applications to well-log analysis **(Figure 9);** he continues to teach our students to use GAMLS, which he has provided to the Institute of Reservoir Characterization at no charge. And of course, many companies such as Devon Energy and Indian Exploration, as well as individuals, contribute financial support which is essential to attracting quality graduate students to the program. Because of all of these activities and support, a number of new M.S. and Ph.D. students will become involved in the research program beginning Fall 2008. Thus, 2008-09 promises to be a busy, but exciting year for petroleum geology and geophysics students. ■

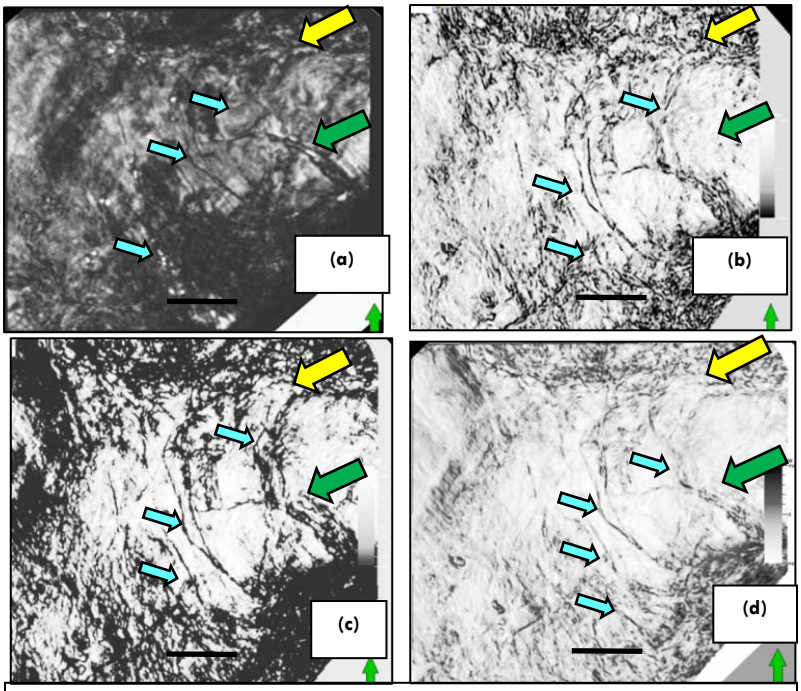


FIGURE 5: *Stratal slices along the base of the MTD through the (a) coherent energy, (b) generalized Sobel filter, (c) eigenstructure coherence, and (d) variance volumes*

The University of Oklahoma

L to R: Roderick Perez, Elizabeth Baruch, Carlos Santacruz, Romina Portas, and Carlos Russian

Thanks

FIGURE 7: *Slatt presenting one-day course in Bandung, Indonesia and receiving a birthday cake from the class.*

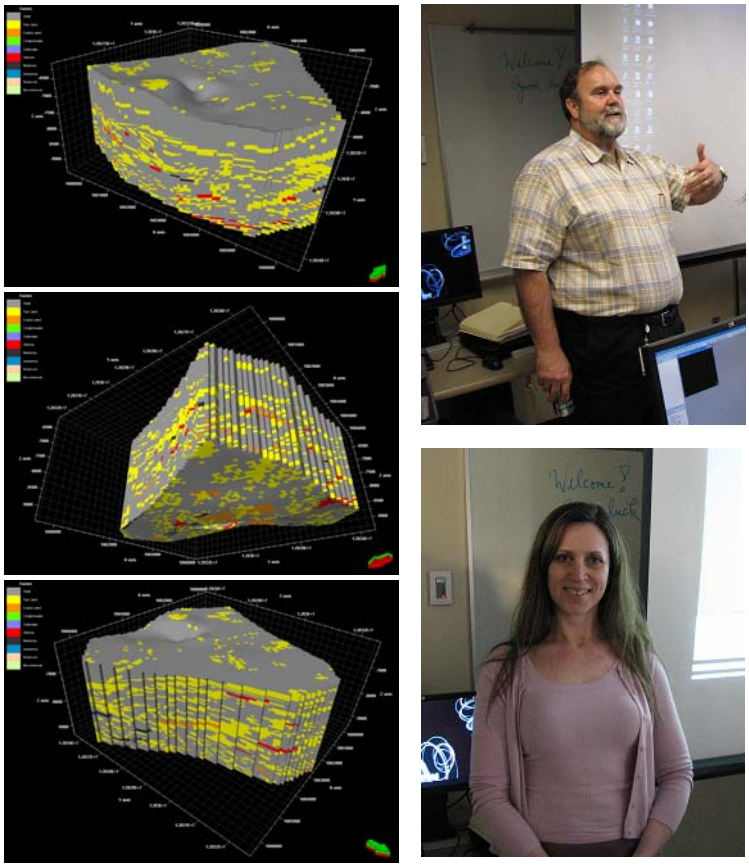


FIGURE 8: *Petrel model of facies distribution within a field; part of a Schlumberger training course in Petrel for our students. Course facilitators are Bob Davis (top right) and Eva Peza (bottom right) from Schlumberger.*

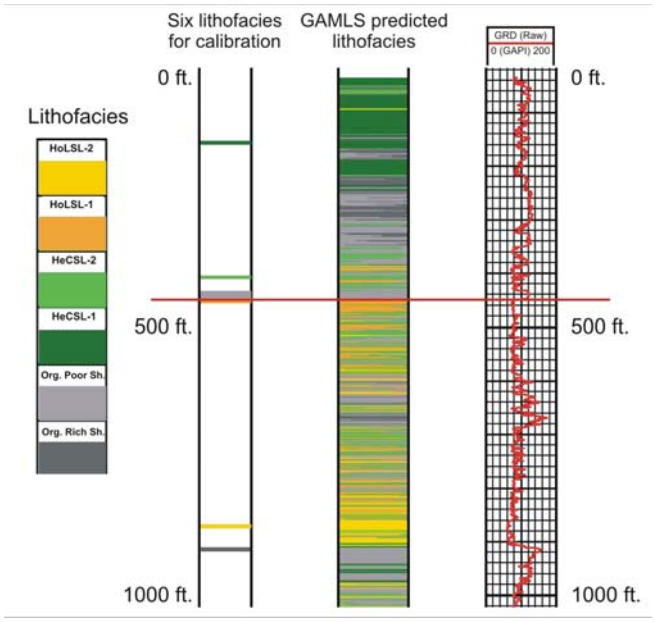


FIGURE 9: *GAMLS program to predict lithofacies in wells based upon multi-well-log characteristics (only gamma-ray log shown here)*

Jamaican Field Trip

Victor Parra-Galvis and **Diana Parada,** MS Candidates in Geology, The University of Oklahoma

During the fall semester of 2007, our basin analysis class conducted by Dr. John Pigott took a field trip to the exotic island of Jamaica. The purpose of this field trip was to analyze the tectonic evolution of the island as well as the different depositional systems that could be used as analogs of petroleum systems within a basin. During the six days of the journey Non, Tom, John and we (Victor and Diana), along with Dr. Pigott, were able to visit different locations of the island such as Montego Bay and Ocho Rios (were we stayed) on the northern side and all the way down to Kingston (capital of Jamaica) and Yallahs on the southeastern part of the island. This adventurous trip was organized based on different geological stops that were of interest in terms of the objective of the class. Prior to the trip, each of us would choose a specific location and research the geology of that area. Therefore, each student had the chance to be the leader for a day-long field trip.

View of the Ocho Rios Beach from our hotel.

Field trip number one was conducted by Non Pasapronon; it concerned the exposure of Holocene carbonate reefs in the form of terraces. The formations that were observed are the Pleistocene Falmouth Formation and the Plio-Pleistocene Hope Gate Formation. These two formations lie on top of each other forming such terraces. The observation made throughout this area is that the formation of reefs are being affected by the shape and thickness of the platform they are building on, as well as sea level fluctuations.

Field trip number two was conducted by John Hull; the location was the Yallahs fan delta. After a tortuous drive and tremendously harsh weather, we were able to get to the Yallahs River in good time. This river is considered one of the world's best examples of a river fan delta. First of all, the river has an extremely coarse bed load coming from the nearby Blue Mountains. Secondly, the river has a very high gradient that makes it unique. And finally, by observing the depositional sequence of its grain size, the river has inverse grain deposition (coarse grains on top of small grains). We were able to walk all the way to the mouth of the river. It was a wonderful experience to see the majestic fusion of the ocean and the active delta.

Field trip number three was conducted by Tom Ward and was about the Wagwater Trough tectonics, located on the eastern side of the island between Port Maria and Attono Bay on the northern coast and just east of Kingston and Yallahs on the southern part of the island. The Wagwater Trough basically began to form as a graben feature within the emergent land mass that is now the island of Jamaica.

TRIP #1—Two of the terraces on the north coast of Jamaica

TRIP #2—Entrance of the river to the ocean

TRIP #3—Tectonic evidence of the Wagwater Trough

TRIP #4—Fresh water and vegetation covering the carbonates from the Pleistocene in the delta plain

TRIP #5—Outcrop of the White Limestone Formation

Diana Parada on horseback (the only girl).

Back row, l to r—Diana Parada, John Hull, Victor Parra, Tom Ward; Front row, l to r—John Pigott and Non Prapasanobon

Field trip number four was conducted by Diana Parada and concerned the Martha Brae Delta. At this stop we could see the transition from a carbonate to a siliciclastic environment. The Martha Brae River carries large quantities of sediments that are being deposited on the east side of the delta. Along the river's path we could observe parts of the Pleistocene carbonates being exposed due to the erosional action of the fresh water.

Field trip number five was conducted by Victor Parra, and it corresponded to the Montpelier Formation, which consists of chalk interbedded with marls and chert beds located in fresh outcrops along the northern part of the island. In these outcrops, we could observe architectural elements that represent a deep-water carbonate environment being deposited during the Miocene time.

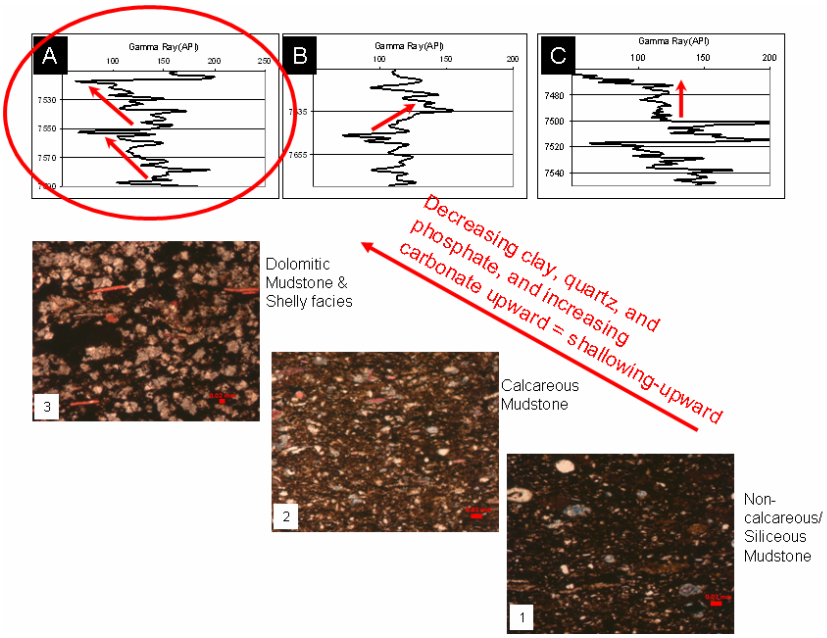
After these adventures, we concluded one of the most exciting field trips a geologist could take. Most of the time we were working, but this doesn't mean we didn't have time to admire the most beautiful beaches in the world. We also were able to enjoy the crystal clear water while snorkeling and even ride some horses at the beach… of course that only applied to the one girl in the group.

The Barnett Shale of North Texas, USA: Its Lithofacies, Depositional Environment and Sequence Stratigraphy

Prerna Singh[1], Roger Slatt[1] and William Coffey[2]
1 School of Geology and Geophysics, University of Oklahoma
2 Devon Energy Corporation, Oklahoma City

Ph.D. Candidate in Geology

Extending sequence-stratigraphic concepts to distal marine, clastic fine-grained rocks requires an understanding of spatial and temporal transport, depositional and post-depositional processes that differ from those of their coarser-grained counterparts. For example, processes of clay flocculation, suspension settling of inorganic and biogenic particles, precipitation of minerals from sea water, and early burial diagenesis are not nearly as well understood as are traction and gravity transport, rapid deposition, and cementation of sands. In this paper, we have developed a preliminary sequence-stratigraphic framework for fine-grained rocks comprising the Barnett Shale, north Texas. Integrated study of several long continuous cores and wireline logs led to defining nine distinctive lithofacies on the basis of their physical, chemical and biological characters: 1) Siliceous, non-calcareous mudstone; 2) Siliceous, calcareous mudstone; 3) Dolomitic mudstone; 4) Concretionary zones; 5) Calcite-rich laminated deposit (bottom current deposit); 6) Fossiliferous deposit; 7) Phosphatic deposit; 8) Silty-shaly (wavy) interbedded deposit; and 9) Micrite/Lime mudstone. These nine lithofacies record considerable variation in depositional environments and processes through time, from quiet-water deposition of low-energy, muddy facies to high-energy, phosphatic shelly lags and wavy-bedded mudstones.



Example of (A) upward- decreasing gamma ray-, (B) upward- increasing gamma ray-, and (C) constant gamma ray-parasequence patterns of the Barnett Shale from cored well B. Photomicrographs of an upward-decreasing gamma-ray parasequence shown in A are shown: 1) The base of the parasequence, at 7620.8' contains quartz as biogenic spicules and as terrigenous silt, a high amount of phosphate pellets preserved as compacted, elongate lenses in the matrix, and ferroan dolomite stained blue. (2) Middle of this parasequence, at 7606.4', is characterized by a high amount of detrital silt, pink-stained calcite detrital grains and relatively reduced amounts of clay matrix. (3) Top of the parasequence, at 7598.3', consists of dolomitic mudstone wherein originally fossiliferous mudstone has been diagenetically altered. Relatively high abundance of the broken macrofossil fragments is present in the matrix.

Stacking of these lithofacies occurs in systematic, cyclical patterns of: upward-increasing, upward-decreasing and constant gamma-ray-log API values. The cyclical stratal stacking style of lithofacies and corresponding API patterns has led to identification of high-resolution depositional parasequences within the Barnett Shale. Each parasequence is approximately 30 feet thick, laterally continuous and mappable. A typical upward-decreasing gamma ray parasequence is composed of upward-decreasing amounts of clay and phosphatic sediments accompanied by increasing allochthonous calcite grains, and capped with calcareous debris flows and fossiliferous deposits. This pattern is indicative of the upward-shoaling of the depositional environment during a very gradual fall in relative sea level followed by a rapid rise. Thus, an upward-increasing gamma-ray parasequence is suggestive of less calcareous sediment upward. Maps of these parasequences suggest a basinward deepening direction from northeast to southwest.

How Does One Generate the Tor Topography Seen in the Wichita Mountains of Southwest Oklahoma?

M. Charles Gilbert, *Professor Emeritus*
ConocoPhillips School of Geology and Geophysics, The University of Oklahoma

The Wichita Mountains of southwestern Oklahoma are locally spectacular topographic forms, rising as they do from the low relief, nearly planar, surrounding Permian redbeds. The relief of these mountains is up to about 1100 feet. This represents the second largest relief in Oklahoma (the largest being ~1500+' found in the Ouachita Mountains of the southeastern part of the state). The Wichitas are known for their paleotopography, which had been cut on both Lower Cambrian igneous rocks as well as on Cambro-Ordovician Reagan Sandstone and Arbuckle Group carbonates. The sedimentary rocks form the Slick Hills portion of the Wichitas. The topographic forms now being uncovered by erosion of the enveloping softer Lower Permian clastics were first eroded and carved in the Early Permian. The largest relief in the Wichitas themselves is formed on the Cambrian igneous rocks because these are the most erosionally resistant. The type of topography formed on the granitic rocks is known as "tor topography." A classic example of this tor form is well-displayed in the Wichita Mountains Wildlife Refuge and is known as Twin Rocks. This tor pedestal stands ~100 feet above its immediate surroundings. The pedestal has rounded sides and the big boulders sitting at the top of the pedestal are nearly completely rounded. This feature can be seen from the east-west Refuge road that links Oklahoma State 49 to the east and west sides of the Refuge. West of the Headquarters area, and just west of the turnoff to the Sunset picnic area, the highway climbs a hill and at the top, off to the southwest about 1-½ miles away, the Twin Rocks can be seen on the skyline **(Figure 1)**. Now how did this fascinating and visually interesting geomorphology form?

What may surprise you is that this tor formed beneath the groundwater table in the Early Permian. So there are two key ideas to be discussed here: rounding process and age of rounding. Let's first talk about how granitic boulders can get their rounded shape, whatever the age of the rounding turns out to be. One of the processes that can form such shapes in granitic rocks (here including granites, diorites, and gabbros) is called *spheroidal weathering*. This is chemical weathering where water reacts with feldspars to form clay minerals releasing to the environment some of the other rock minerals, particularly, in the case of granites, quartz grains. What is needed, and seems almost always to be present near the Earth's surface where granitic rocks are exposed, is *fractured* bedrock. The fracturing needs to be, and commonly is, in three dimensions as in two different vertical directions and one subhorizontal direction, forming "blocks" of rock very slightly separated from each other. These fractured blocks allow rain water to ooze down along the fractures until the water reaches the groundwater table for that area. Fractures die out as one progresses ever deeper into the Earth, until one reaches essentially pristine unweathered rock.

Figure 1

Twin Rocks. The view is looking south from an upper part of the pedestal base. One can hike to and climb to the top of the pedestal and stand between the double-rock tor and the single-rock tor. The lower rock of the 2-rock tor is about 5 feet high for scale.

What is happening in this environment? Well, beneath the groundwater table the water is in constant contact with the granitic rock along the fractures. The feldspars of the granite and the water are slowly reacting to make the new mineral assemblages that are

clay-rich, so as to be in thermodynamic equilibrium with the Earth's surface conditions. This is the weathering process. Erosion rates in such an environment can be very slow so that weathering rates can be faster than erosion rates. We don't want erosion rates to be fast because then weathering can't get the feldspar broken down. If erosional rates are fast, the result is very angular blocks of granite dislodged and transported by the surface stream system. Now the erosional process certainly rounds rocks, as we all know, but only have significant amount of transport in the stream. Such a process doesn't make tors! What spheroidal weathering does is make round rocks directly in the weathering environment before erosion (transport) takes place.

On the following page are two photos from the Wichitas illustrating spheroidal weathering. **Figure 2** shows the typical weathering shells in a granitic rock where feldspars have been broken down and transformed to clays and quartz is in the process of being released. Note the fractures around this block control the shape of the spheroidal weathering. The weathering process starts on the outside of the block where the groundwater is in direct contact with the granite, and proceeds inward toward the center of the block. The most altered parts of the granite in the block are the shells fartherest out from the block center, on the edges of the block. In **Figure 2**, one of the nearly vertical fractures is where the plants are growing on the far side of the shells, and a parallel one is not so visible on the near side of the picture. Cross vertical fractures outline the block at each end although they are not too visible. The subhorizontal fracture outlining the bottom of the block is approximately at the depth estimated from the width of the weathered shells.

Now let's look at **Figure 3**. Here we can see the fresh rock center of a spheroidally weathered block of granite, called the *corestone*, protruding up where the weathered rock's shells have been stripped away. Note how sharp the contact is between the weathered shells and the unweathered fresh rock of the corestone. If conditions change so that erosion now proceeds at a faster rate than weathering, as this picture is beginning to show, the weathered granite will be disassembled, resulting in a sediment of mixed grain sizes. The really large corestones will be left behind, with some on pedestals as is the case for the Twin Rocks. Some of the other bigger ones will only be moved a short distance and have accumulated in such features as displayed on the road up Mount Scott known as the "River of Rocks." This "river" can be thought of as "toppled tors." Somewhat smaller corestones, as in the cobble-size range, will be alluvially transported a short distance and, when lithified, will form conglomerates. This is the origin of the Post Oak Conglomerate that encircles and surrounds much of the eastern part of the Wichitas. Very good examples of this unit can be found along the highways traversing the Wichita Mountains Wildlife Refuge. Erosive processes, particularly streams, do the sorting so characteristic of clastic sedimentary units. Gravel-size materials, and individual mineral grains released during the spheroidal weathering cycle, especially quartz, will be transported farther away from the source. When lithified, sandstones result. Finally, much farther out from the source, the finest grains including the clay minerals, will be transported and deposited yielding siltstones and shales. The Post Oak Conglomerate interfingers with the Hennessey Shale which is the main Permian unit surrounding the eastern Wichitas.

Thus in the Early Permian, parts of the Wichitas, including the igneous rock center, had been worn down to a low-relief surface not far above sea level. The system was quite stable for a while and it was in this environment that weathering rates dominated over erosion rates. Then in the fractured granite substrate underlying part of this low-relief surface, which was below the groundwater table, spheroidal weathering became dominant. This actually was extremely important in forming the topography we see in the granitic part of the Wichita Mountains. All the huge rounded boulders scattered around on the mountain tops and slopes were being formed at this time. These boulders and rounded rock topographic forms were not created "in the air" as you see them today, but were formed underground and under the groundwater table. Of course, this stable spheroidal weathering cycle eventually gave way to renewed uplift (or climate change) resulting in active erosion which stripped off the shells of spheroidally weathered material and released corestones. This late erosional cycle carried away the weathered rock exposing the more pristine and much less weathered deeper granite. The igneous topography that one can see in the Wichitas today is essentially what that Permian erosional event uncovered.

However, the story is not complete without asking how this topography has been preserved for ~270 million years. Clearly, it can't have lasted exposed all this time since formation. What is almost equally fascinating, although this is to the mind's eye not to the physically active eye, is how this preservation came to be. This Permian topography, not long after it was formed as described above, was buried in Early Permian sediments. The regional highlands of the southern Midcontinent during the Permian were in the east, especially in the Ouachitas and in the Ozark area. The streams in Oklahoma were all flowing from east to west toward shallow marine seas of western Oklahoma, west Texas, and southeast New Mexico (i.e., down to the Permian Basin area). The center part of Oklahoma was a hugh mudflat, a vast delta plain, where west-flowing streams deposited fine erosional debris into shallow evaporitic seas. We know some of these units as the Hennessey Shale, Marlow and Rush Springs

Formations, and to the north, the Blaine Gypsum. Eventually this mudflat inundated the exposed Early Permian Wichita Mountains topography. By the end of the Permian none of the Wichita Mountain topography could be seen. It had been buried and preserved and was waiting to be re-eroded and uncovered for us to see. Fortunately, the rocks which covered the Permian mountains were siltstone and mudstone. These rocks can be easily eroded, and in today's erosional cycle, the Permian is rather easily stripped off the harder and more resistant igneous rocks (as well as the carbonates of the Slick Hills part of the Wichitas). This uncovering has been going on now for ~20 million years and we can begin to see what existed in the Permian. Interestingly, only about half the paleo-topography is exposed. There is still about 1,500 feet of topography buried in Permian unit waiting to be eroded away. The Wichitas, if fully exposed, would have relief of over 3,000 feet: a grander sight even than we see today.

Figure 2: *Top of a partially spheroidally weathered block displaying the shells of altered granitic material. This block is in the Mount Sheridan Gabbro. The geologic hammer is for scale.*

Figure 3: *Corestone partially exposed from a spheroidally weathered block of Mount Sheridan Gabbro. The geologic hammer for sale.*

Modeling Anisotropic Mechanical Properties: Barnett Shale, a Case Study

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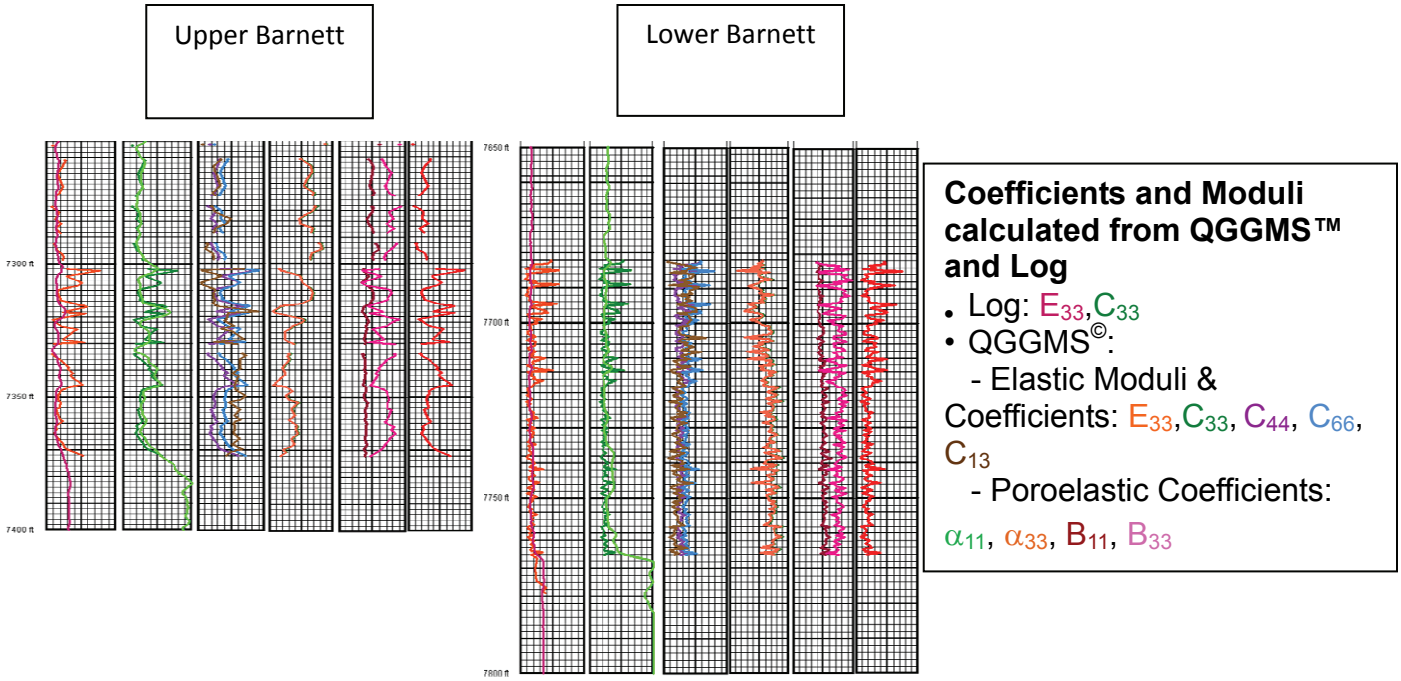
The University of Oklahoma, ConocoPhillips School of Geology and Geophysics

PhD Candidate in Geology

Shale is the most problematic lithology encountered in many operations ranging from seismic exploration to drilling, well-bore stability and production due to its unpredictable mechanical behavior. Because of its complex composition, the study of shale mechanical properties still remains an enigma. A comprehensive study at all scales, ranging from the macro scale with sonic log and Ultra Sonic Pulse velocity measurements down to the nano-scale of Atomic Force Microscope (AFM) or SEM, has been conducted on a number of shales with varying physical properties by the GeoGenome™ Consortium at University of Oklahoma to develop a GeoGenome™ model which allows up-scaling of macroscopic anisotropic shale mechanical properties from just a few intrinsic rock/shale properties such as mineralogy and porosity. This model was implemented into the Quantitative GeoGenome™ Mineralogy Simulator, QGGMS©, a software developed at the PoroMechanics Institute that is capable of predicting the full set of anisotropic elastic/poroelastic coefficients and parameters by directly importing data from logging tools. In this work, the full set of anisotropic stiffness coefficients, C_{ij}, were predicted using QGGMS© using available mineralogy and porosity data from a suite of log runs in a well drilled in the Barnett Formation, Fort Worth Basin, Texas. The comparison between P-wave velocity calculated from simulated C_{ij} with P-wave velocity from the wire-line measurements showed an excellent agreement with regards to any engineering applications.



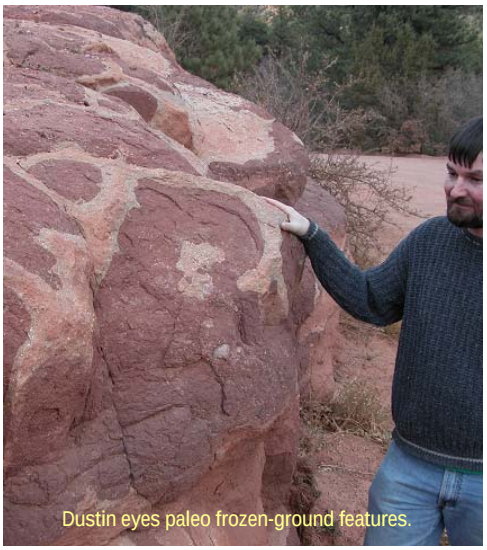
Continuing Results from Unaweep Canyon and Beyond: Records of Paleozoic Cold and Cenozoic Rivers

Unaweep Canyon in western Colorado

Dr. Lynn Soreghan continues to work with several students and colleagues to understand aspects of Paleozoic climate and Cenozoic geomorphology in parts of Colorado and beyond, but especially centering on some of the so-called Ancestral Rocky Mountains of western and central Colorado. Much of the work focuses on the Unaweep Canyon system of western Colorado, now hypothesized to be a late Paleozoic canyon only recently exhumed. Progress reports of this work appeared in previous issues of the *Earth Scientist*, but now published results are emerging. Much of the work on the Paleozoic story, for example, culminated in an August, 2008 paper published in *Geology* entitled "Anomalous Cold in the Pangaean Tropics" which was covered in several press releases and highlighted in *Science*, *Nature Geoscience*, the National Science Foundation News, Discovery Channel News, and other outlets. Many current and recent OU students have played significant roles in this overall research, and some of their results are highlighted in these pages. For example, Dustin Sweet, a PhD student, published (2008) on periglacial indicators in the tropical Fountain Formation of Colorado, Kate Moore (M.S. 2007) published on the structural character of the Paleozoic Cutler system at the mouth of ancestral Unaweep Canyon, Oswaldo Davogustto (B.S. 2005) conducted gravity work for his undergraduate thesis that contributed to the *Geology* paper, Yoscel Suarez (M.S. 2007) completed seismic imaging of the canyon, Sara Kaplan (M.S. 2006), discovered and mapped the Gunnison River gravels that linked the Cenozoic exhumation of Unaweep Canyon to the Gunnison River, and Kristen Marra (B.S. 2005, M.S. 2008) studied the partial re-burial of the canyon by Gunnison-sourced sediments. All of these students have contributed valuable field assistance to many aspects of this overall research project, and several are continuing to work toward journal publication of their thesis and dissertation results. Other OU faculty involved include Dr. Mike Soreghan and Dr. Roger Young.

Selected excerpts of these publications:

Sweet, D.E., *and Soreghan, G.S., 2008, Polygonal cracking in coarse clastics records cold temperatures in the equatorial Fountain Formation (Pennsylvanian–Permian, Colorado): Palaeogeography, Palaeoecology, Palaeoclimatology, doi 10.1016/j.palaeo.2008.03.046.*



Dustin eyes paleo frozen-ground features.

Sand- and granule-filled polygonal fractures are present on bedding surfaces within the equatorial Fountain Formation (Pennsylvanian–Permian, Colorado). The surfaces are areally extensive (>120,000 m^2) and occur within inferred braided-river deposits. The fractures penetrate downward into coarse sandstone to granule conglomerate and range from 3–55 cm to 13–220 cm in width and depth, respectively. At one locality (Manitou Springs), both fracture fill and polygon interiors display a grain-supported texture and contain 14% clay; additionally, the fracture fill is microbrecciated. At the other locality (Loveland), both the fracture fill and polygon interiors display a grain-supported texture and contain 3.5% clay. The polygonal fractures formed as frozen ground experienced thermal contraction induced by repeated cooling events. Owing to the equatorial location of the Fountain Formation, we suggest that diurnal, rather than seasonal, temperature variations provided the repeated cooling mechanism. Alternative causes of fracturing, such as desiccation of clay-rich sediments or thermal contraction of evaporite minerals, are untenable because the hosting strata contain minimal clay (14%) and are framework supported, indicating that there was insufficient space for either clay or evaporite minerals. A thermal contraction origin for these features implies that the equatorial Fountain Formation experienced at least two episodes of remarkably cold conditions. Furthermore, using maximum reasonable stream gradients (~0.02) between the polygonally fractured surfaces and the shoreline (gauged from shallow-marine deposits of the Denver basin), the fractures formed at relatively low elevation (≤1800 m).


Sara on the elusive Gunnison gravels

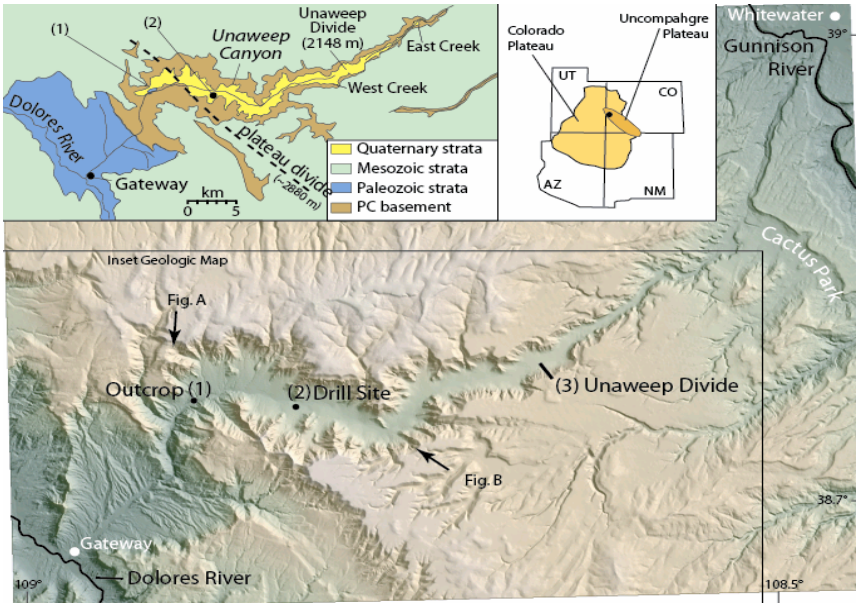
Kaplan, S.A., *Soreghan, G.S., Sweet, D.E., and Blum, M., in review, Late Cenozoic exhumation of Unaweep Canyon and implications for drainage development on the northeastern Colorado Plateau.*

Unaweep Canyon is a large gorge that bisects the Uncompahgre Plateau of the northeastern Colorado Plateau, but has no through-flowing axial stream, and instead is drained by two underfit creeks (East and West Creek) that head at a divide within the canyon. Recent work demonstrates the inner gorge originated in the late Paleozoic and contains a thick fill; the origin of the modern canyon, however, remains controversial. Analysis of gravels exposed near the western mouth of the canyon shed light on the late Cenozoic history of this enigmatic feature, and bear on the controversy of neotectonics on the Uncompahgre Plateau and drainage evolution of the greater Colorado Plateau. The oldest gravels, herein termed the Gateway gravels, occur atop bedrock straths cut into the Paleozoic Cutler Formation. These contain well-rounded clasts with an intermediate volcanic component and exhibit southwesterly paleocurrents, consistent with an ancestral Gunnison River flowing through Unaweep Canyon. A hillslope deposit termed the Palisade gravels overlie the Gateway gravels, contain angular clasts derived from Mesozoic and Precambrian units and form a heavily dissected but widespread unit recording slope retreat of cliffs at the canyon mouth. Within the canyon, deposits herein termed the Unaweep gravels form coalescing debris aprons that similarly record slope retreat. Calcisols and heavy vegetation atop both the Palisade and Unaweep gravels record recent surface stability. The West Creek gravels form fill terraces incised into older gravels and record recent aggradation by West Creek and its tributaries. Regional incision rates suggest the Gateway gravels are late Miocene to early Pleistocene in age, and that the ancestral Gunnison River occupied Unaweep Canyon during this time. Hence, exhumation of the canyon by the ancestral Gunnison River appears to coincide with the late Miocene drainage reorganization associated with the inception of southwesterly flow across the Colorado Plateau that has been documented largely from the southwestern Colorado Plateau and terminal reaches of the Colorado River. Our data thus provide a constraint from the far northeastern reaches of the Colorado Plateau that demonstrate southwesterly flow commencing in Miocene time. By early Pleistocene time, a blockage caused the ancestral Gunnison River to backfill and ultimately abandon the canyon, with the Gunnison River thereafter joining the Colorado River at Grand Junction. Following abandonment, slope retreat within Unaweep Canyon and at its western mouth buried the remnants of the ancestral Gunnison River, after which time East Creek and West Creek began to evolve by headward erosion. Hence, the enigmatic longitudinal profile through the modern canyon reflects recent evolution of East and West Creek, and bears no relation to the ancestral Gunnison River, nor presumed neotectonic deformation on the Uncompahgre Plateau.

Moore, K.D.*, Soreghan, G.S., and Sweet, D.E., 2008, Structural and stratigraphic relations in the proximal Cutler Formation of the Paradox basin: Implications for timing of movement on the Uncompahgre front: Mountain Geologist, v. 45, p. 49-68.*


Dustin, Kristen & Kate sit atop the Precambrian-Cutler contact.

In the proximal Paradox basin near Gateway, Colorado, previous mapping demonstrates that the Permo-Pennsylvanian Cutler Group depositionally onlaps Precambrian basement of the late Paleozoic Uncompahgre uplift. Nearby well and seismic data, however, suggest the presence of a large subsurface thrust; thus the deposition of >4 km of Cutler Group strata into the Paradox basin has traditionally been attributed to syndepositional thrusting during the late Paleozoic. Detailed facies and structural mapping of the Cutler strata within 2 km of the onlap contact confirm that the Precambrian-Cutler contact is a depositional onlap rather than a fault. Bedding orientations measured within the most proximal Cutler Formation here exhibit a semi-radial pattern of dip steepening in a small area adjacent to the nonconformity. This pattern, previously unrecognized, is here inferred to record primary depositional dips associated with a Gilbert-type delta system. This interpretation is consistent with (1) new work proposing a lacustrine setting for the proximal Cutler Formation and (2) the presence of an inferred subaqueous, syndepositional slide. The absence of syndepositional tectonic structures in the Cutler system exposed here implies that thrusting on the subsurface Uncompahgre fault had ceased before deposition of the youngest Cutler strata exposed at the surface. This cessation of movement signals the end of the Ancestral Rocky Mountain (ARM) orogeny in the proximal Paradox-Uncompahgre system.



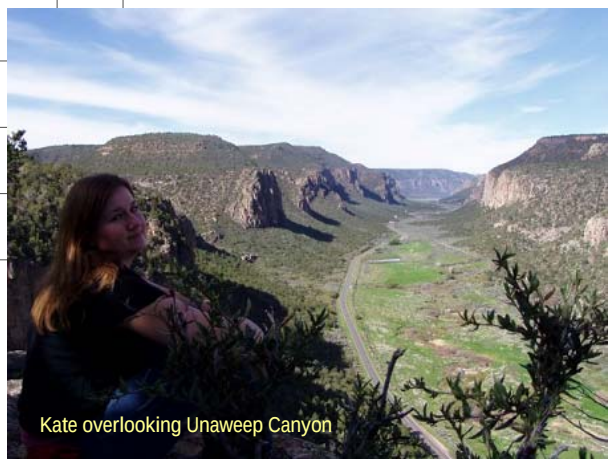
Kristen (top photo) puzzles over gravels found in Unaweep Canyon (see map bottom photo)

Marra, Kristen R.., *Soreghan, G.S., and Soreghan, M.J., New constraints on the Late Cenozoic fill history of Unaweep Canyon, Colorado.*

Unaweep Canyon represents a geomorphic oddity incised into the modern Uncompahgre Plateau. Canyon formation has been attributed to Cenozoic fluvial incision and/or Cenozoic (Pleistocene) glaciations and more recently to Paleozoic glaciations and Cenozoic exhumation. Work on cores collected from within the inner Precambrian gorge indicates a thick sediment fill (329 m) comprising three units: a lower Paleozoic-aged diamictite, unconformably overlain by a middle (150+) lacustrine interval, and an upper (160+) conglomerate unit. The base of the lacustrine section is dominated by organic-rich sediments, ranging from 1 to 7% TOC, and implies, along with an absence of fauna, anoxic conditions. Grain size studies of the middle lacustrine unit reveal an overall coarsening upward trend, consistent with the infilling of a lake, and the provenance indicates an ancestral Gunnison River source for the sediment. The lacustrine interval grades upward into an approximately 8 meter series of paleosols that alternate between argillisols and well developed calcisols, indicating multiple stabilization surfaces on the order of 10,000+ years. Paleosols are intercalated and overlain by stream deposits not likely derived from the Gunnison River. The stream deposits are overlain by conglomerates formed by mass wasting of canyon walls that may also reflect a change in climate. These data are consistent with the hypothesis that Unaweep Canyon was carved glacially in the Paleozoic and exhumed by the Gunnison River during the Cenozoic. The present work suggests that after almost complete exhumation, the Gunnison River became blocked, leading to aggradation of a lake system and ultimate abandonment of the canyon during the Plio-Pleistocene, as inferred from regional incision rates. Ongoing paleomagnetic analyses of the middle lacustrine unit and tephrochronology on two inferred ash deposits within the upper conglomerate will help constrain the age of the lacustrine fill and timing of Gunnison River abandonment.

Soreghan, G.S., Soreghan, M.J., Poulsen, C.J., Young, R.A., Eble, C.F., Sweet, D.E., and Davogustto, O.C., 2008, Anomalous cold in the Pangaean tropics: Geology, v. 36, p. 659-662.

The late Paleozoic archives the greatest glaciation of the Phanerozoic. Whereas high-latitude Gondwanan strata preserve widespread evidence for continental ice, the Permo-Carboniferous tropics have long been considered analogous to today's: warm and shielded from the high-latitude cold. Here, we report on glacial and periglacial indicators that record episodes of freezing continental temperatures in western equatorial Pangaea. An exhumed glacial valley and associated deposits record direct evidence for glaciation that extended to low paleoelevations in the Ancestral Rocky Mountains. Furthermore, the Permo-Carboniferous archives the only known occurrence of widespread tropical loess in Earth's history; the volume, chemistry and provenance of this loess(ite) is most consistent with glacial derivation. Together with emerging indicators for cold elsewhere in low-latitude Pangaea, these results suggest that tropical climate was not buffered from the high latitudes and may record glacial-interglacial climate shifts of very large magnitude. Coupled climate-ice sheet model simulations demonstrate that low atmospheric CO_2 and solar luminosity alone cannot account for such cold, and that other factors must be considered in attempting to explain this 'best-known' analogue to our present Earth.


Kate overlooking Unaweep Canyon

Soreghan, G.S., Sweet, D.E., Marra, K.R., Eble, C.F., Soreghan, M.J., Elmore, R.D., Kaplan, S.A., and Blum, M.D., 2007, An exhumed late Paleozoic canyon in the Rocky Mountains: Journal of Geology, v. 115, p. 473-481.

Landscapes are thought to be youthful, particularly those of active orogenic belts. Unaweep Canyon in the Colorado Rocky Mountains, a large gorge drained by two oppositely flowing creeks, is an exception. Its origin has long been enigmatic but new data indicate that it is an exhumed, late Paleozoic landform. Its survival within a region of profound late Paleozoic orogenesis demands a reassessment of tectonic models for the Ancestral Rocky Mountains and its form and genesis have significant implications for understanding late Paleozoic equatorial climate. This discovery highlights the utility of paleogeomorphology as a tectonic and climatic indicator.

Oil Sourced from Dust?

PhD student **Sohini Sur**, working with Drs. Lynn and Mike Soreghan, is nearing completion of her PhD investigating high-frequency glacial-interglacial climate change and the role that eolian input may have had on productivity and source rock genesis in the Pennsylvanian of the Midland basin. Sohini's work forms part of a larger project that involves colleagues from several universities to study atmospheric dust as an archive and agent of climate change, including its role in influencing the carbon cycle. Sohini presented her results at the 2008 AAPG meeting. Alice Stagner (M.S., 2008) also investigated eolian influx at the glacial-interglacial scale, in the Middle Pennsylvanian of Arrow Canyon, Nevada (reported in the 2007 *Earth Scientist*). Look for more results on this research in the near future.

***Sur, S.**, and Soreghan, G.S., 2008, Climatically driven shifts in eolian (dust) flux to Upper Pennsylvanian cycles of the Midland Basin, West Texas: American Association of Petroleum Geologists Annual Meeting Abstracts.*

Pyrite-rich sequence-bounding murock from Horseshoe Atoll

Horseshoe Atoll is a complex of phylloid-algal buildups that formed in the interior Midland basin (Texas), far from basin-margin depositional systems. We are studying detrital flux to Upper Pennsylvanian cycles within one buildup (Reinecke Field) to examine relationships between glacioeustasy and glacio-climatic shifts in this tropical site. We hypothesize that the location, far removed from fluvio-deltaic feeders, indicates that detrital material present within these dominantly carbonate cycles reflects eolian influx, which forms a proxy for atmospheric dustiness (aridity and eolian supply). The sequence boundaries are marked by subaerial exposure (calcrete) and studied cycles are symmetrical, with grainstones proximal to sequence boundaries and wackstones/packstones in mid-cycle position. We conducted high-resolution sampling (10 cm intervals from core) through one complete cycle and extracted the detrital residue fraction via a series of dissolution steps. Detrital fraction through carbonate facies ranges ~0.006 -- 3% with increased absolute amount and increased variability within ~5 m of sequence boundaries. Detrital fractions are highest (~65%) in the silty shale just above sequence boundaries. Furthermore, detrital fraction co-varies positively with pyrite content. Mid-cycle facies, recording greatest water depths, exhibit remarkably and uniformly low detrital flux. We suggest these data imply increased aridity during glacial to incipient interglacial phases. Reduced source distance during lowstands might have contributed to the high eolian flux near sequence boundaries. Stronger aridity during glacials and associated higher dust flux together could deliver more nutrients to the marine system and thus have influenced productivity and source-rock formation. The observed dust-pyrite relationship is consistent with this hypothesis.

OU Geophysics Team is Thinking Big

Dr. Eva-Maria Rumpfhuber, Catherine Cox, Jessica Pardo, and Dr. Randy Keller
ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

When someone in industry talks about regional or large-scale studies, they are usually referring to basin-scale structures that extend to depths of a few kilometers. When Randy Keller's students talk about their large-scale projects, they are thinking an order of magnitude bigger, and are focused on seismic lines 100's of km long and the deep crustal and upper mantle structure targeting depths of 50 km (30 mi) or greater. Dr. Keller's team at the University of Texas at El Paso led the development of the unique RefTek 130 series miniature seismic recorders that enable us to carry out this type of crustal-scale experiment. They are stand-alone instruments (no cables) and were also designed to carry out industry-scale 3-D surveys in areas of difficult terrain. These instruments are usually called "Texans", but we are lobbying to change the name to "Sooners."

One such large-scale refraction/wide-angle reflection survey was the "Continental Dynamics of the Rocky Mountains (CD-ROM)"

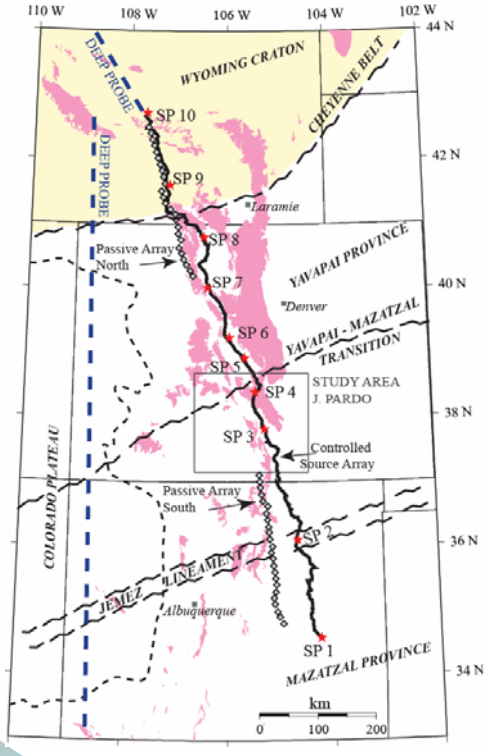


FIGURE 1

1999 experiment, which included a 1000 km seismic-refraction line extending from central Wyoming to central New Mexico **(Figure 1).** CD-ROM also featured two passive seismic deployments that recorded earthquakes for one year. Eva-Maria Rumpfhuber, one of Dr. Keller's PhD students, completed her dissertation on this project and worked on the integration of the various datasets. She focused on integrating data from the seismic refraction/wide-angle refraction profile with receiver functions, which are calculated from the passive source data. Only the integration and joint interpretation of the active and passive seismic results made it possible to better understand the crustal structure in the vicinity of the Cheyenne belt, which constitutes the suture between the 2.8-billion-year-old Archean Wyoming Craton to the north, and the 1-billion-year-younger Proterozoic terranes to the south **(Figure 1).** The results show that a strong crustal reflector underneath the Wyoming craton area terminates at depth about 100 km north of Cheyenne belt suture zone, which constitutes its surface expression. The results clearly show the distinct different nature of the crustal structure between the Wyoming craton and the Proterozoic terranes.

Jessica Pardo, a M.S. candidate, is using the same CD-ROM seismic dataset. However, she is having a detailed look at the area of the Wet Mountains in Colorado **(Figure 1).** She is working in particular on the integration of the seismic results with gravity and magnetic data (Pardo et al., 2007). The regional significance of this area emerged thanks to the geophysics exercise Randy Keller leads during the summer field camp that operates out of Canon City. With the help of the field camp students, gravity data have been gathered over an extensive area around the Gem Park

Eva Rumpfhuber
PhD in Geophysics

Catherine Cox
MS in Geophysics

Jessica Pardo
MS in Geophysics

FIGURE 1: Map of the Continental Dynamics Rocky Mountain (CD-ROM) experiment (modified from Snelson et al. [2005]). The controlled-source seismic line (black), its shotpoints (red), and the northern and southern passive arrays (gray diamonds) are shown. The tan region is the Archean-aged Wyoming craton, the remainder of the map is a region whose crust was formed in the Proterozoic. Outcrops of Precambrian basement are shown in pink. The Deep Probe seismic profile is shown in blue. The study area of Jessica Pardo is indicated by the gray box.

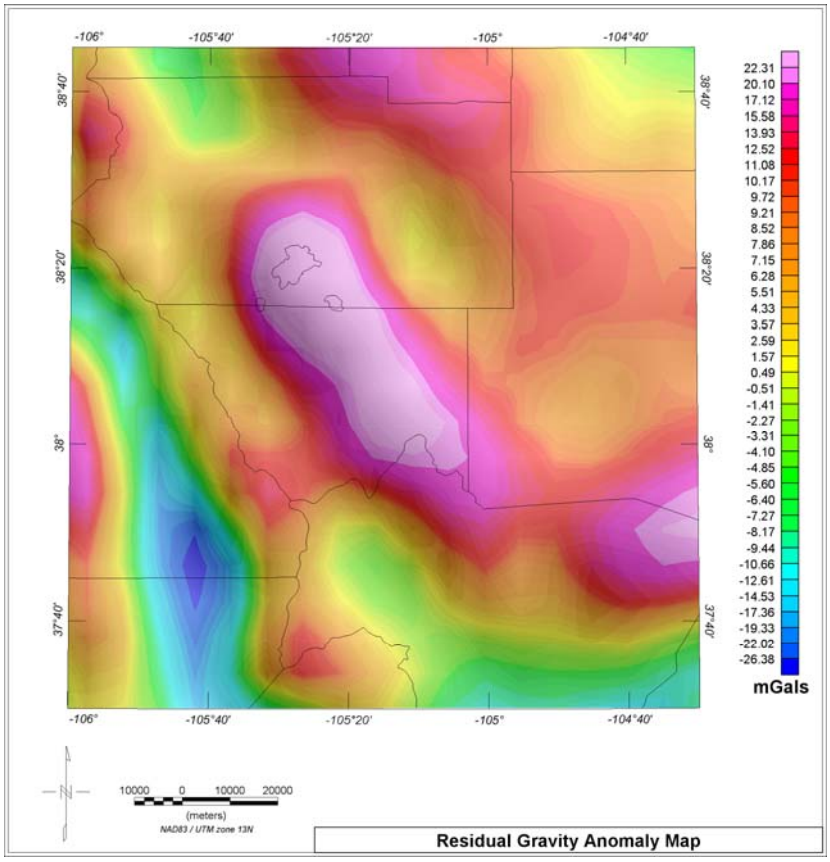


FIGURE 2: Residual gravity anomaly map produced by simply subtracting the grid of long-wavelength upward-continued (40 km) values from the grid of complete Bouguer anomaly values. We interpret the large NW-EW trending positive anomaly (red and pink) as representing a large mafic intrusion that underlies the entire Wet Mountains. The areas outlined in the northern Wet Mountains are outcrops of Cambrian mafic and ultramafic rocks.

and McClure Mountain mafic and ultramafic complexes in the Wet Mountains **(Figure 2).** Jessica's integrated geological and geophysical study of the Wet Mountains region is focused primarily on expanding our knowledge of the tectonic evolution of this area and the Southern Oklahoma Aulacogen in general. These results, when merged with regional gravity and magnetic data, indicate that a large (>1500 km^2) portion of the Wet Mountains is underlain by Cambrian mafic igneous rocks **(Figure 2)** in much the same way that the Wichita uplift is cored by rocks of similar age and composition. Furthermore, NW-SE trending regional anomalies align with known trends of the Southern Oklahoma Aulacogen (SOA) and suggest deep connection between the two features.

OU is leading a large seismic experiment this fall in eastern Oregon, and the data collected along the two main profiles will be the basis of an M.S. thesis for Catherine Cox. Part of Maxwell Okure's PhD dissertation is focused on this area and 10 other OU students are helping with the fieldwork. This project is part of the High Lava Plains (HLP) experiment, which is a large scale, multidisciplinary project geared towards understanding the intraplate volcanism extending from Newberry Crater to the Owyhee Plateau, Idaho **(Figure 3).** The HLP experiment is funded by the National Science Foundation, and in addition to Randy Keller, the project team consists of researchers from Carnegie Institution of Washington, MIT, Arizona State, University of Rhode Island, Miami University (Ohio), and Oregon State. In addition, Stanford University and the U. S. Geological Survey have organized experiments to "piggyback" on the main effort. The High Lava Plains **(Figure 3)** are bounded on the north by the accreted terrains in northeastern Oregon, on the east by the Precambrian craton in Idaho, on the south by the terminus of the Northern Basin and Range province, and on the west by the Cascade Range. However, the Cascade Range is the only clearly defined boundary. This area experienced Cenozoic volcanism resulting in the flood basalts seen at the surface with volcanism continuing to the present along the northwest-striking Brothers fault zone. This creates a unique geologic setting leaving many questions unanswered as to the mechanisms that are responsible for producing the intraplate volcanism. During the experiment in September 2008, the team will deploy 2500 "Texans" at 800m spacing along two 400km long seismic lines **(Figure 4)** and some shorter lines. A total of 17 shot points (one ton each) will be fired at intervals of 60 km along the two profiles. A combination of the data collected from the two active source lines, the ~90 passive source instruments the HLP team began deploying began in 2006, and the EarthScope Transportable Array (Bigfoot) will provide the first high-resolution images of the crust and upper mantle structures in the region. With the data collected this fall, Moho depth and crustal velocities across this region will be modeled. Eventually, these data will be coupled with receiver-function analysis of Moho depth and high-resolution broadband-array tomographic measurements of changes in lithospheric thickness across the boundaries of he High Lava Plains and Proterozoic North America. Our scientific goals are to answer questions such as:

1. Is a plume the only way to get large-volume aerially extensive intraplate volcanism?
2. Does flow of mantle around the edges of a retreating or "dying" subducting plate instigate focused volcanism in the overlying crust of the back arc?
3. Can the bottom topography of the lithospheric mantle influence flow in the underlying mantle to the point of localizing tectonomagmatism in the overlying crust?
4. Is crustal extension the cause or expression of continental magmatism?

G. Randy Keller
McCollough Chair Professor
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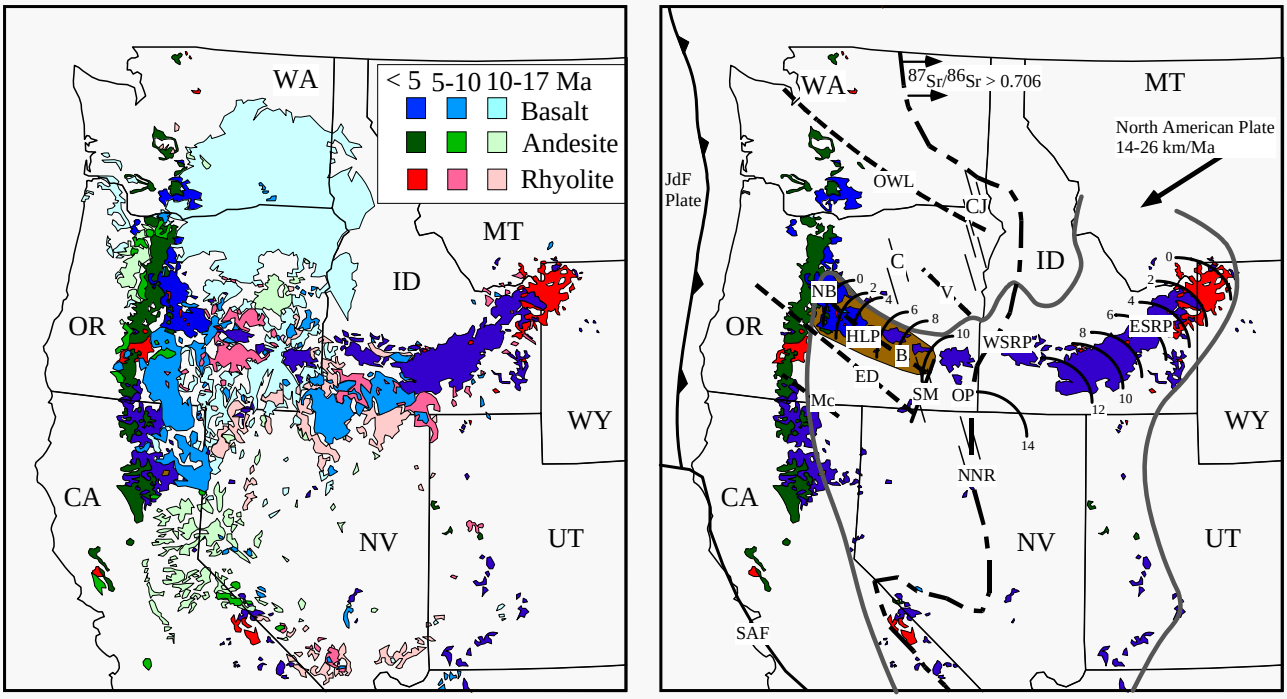


FIGURE 3: Volcanic and tectonic elements of the Pacific Northwest. Left panel shows post-17-Ma volcanic deposits to illustrate the tremendous volcanic activity east of the Cascades in the northern reaches of the Basin and Range (outlined by thick gray lines on right panel). The right panel shows only volcanic fields that are younger than 5 Ma to illustrate the continuing activity in the Cascades and along both the High Lava Plains (HLP – brown field) and the Eastern Snake River Plain (ESRP). Short curves along the ESRP and HLP are isochrons (ages in Ma) for the migrating silicic volcanism along each volcanic trace. Flood basalt activity was fed from dike systems in the Northern Nevada Rift (NNR), Steens Mtn. (SM), the Western Snake River Plain (WSRP) and the Chief Joseph (CJ) and Cornucopia (C) dike swarms of the Columbia River basalts. With the exception of the Cornucopia swarm, these dikes occur near the western border of Precambrian North America as defined by the large dot-dash line. Dotted lines show NW-trending fault systems: Olympic-Wallowa Lineament (OWL), Vale (V), Brothers (B), Eugene-Denio (ED) and McLoughlin (Mc). Additional features shown include Newberry Volcano (NB), the Owyhee Plateau (OP), Juan de Fuca Plate (JdFP), and San Andreas Fault (SAF)

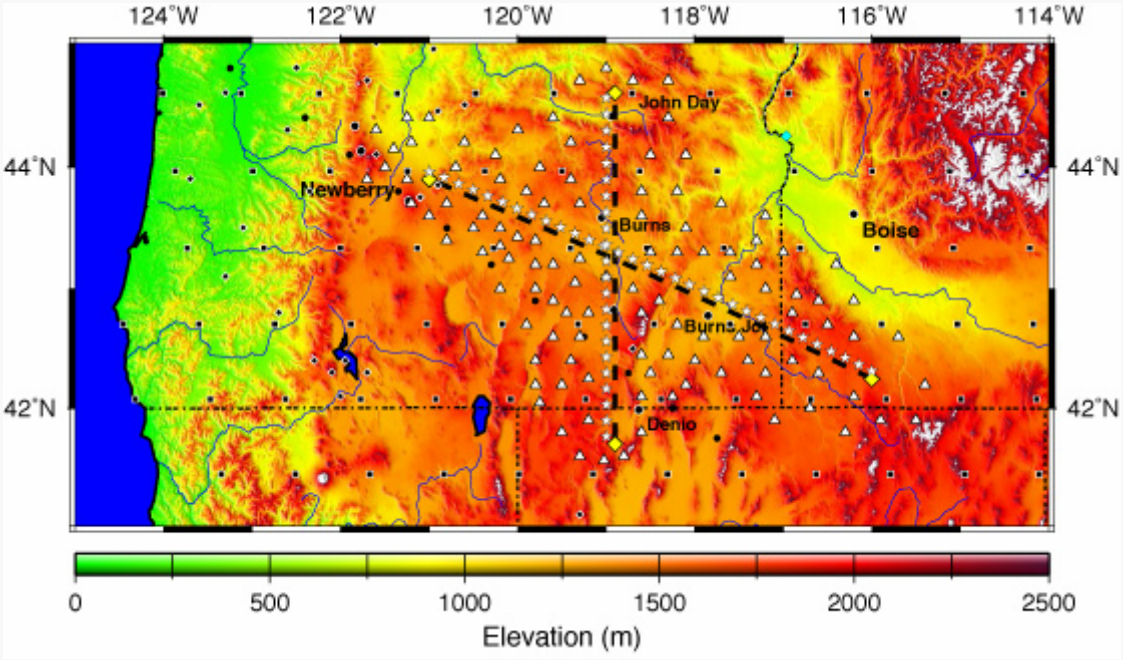


FIGURE 4: Map of the High Lava Plains (HLP) seismic experiment. The black lines represent the 2 active source lines to be collected in September 2008, the white stars and the white triangles represent the ~90 passive source instruments deployed in 2006-2009, and the little black squares are the EarthScope Transportable Array (Bigfoot) stations.

Borehole-image log for fine-scale stratigraphic analysis of the Barnett Shale

Nabanita Gupta, Julieta Vallejos, Prerna Singh, Dr. Roger M. Slatt
The University of Oklahoma, ConocoPhillips School of Geology and Geophysics

PhD Candidate in Geology

The upper Devonian-Mississippian Barnett Shale represents an important formation by being the source, reservoir and seal. Analysis of a high-resolution borehole-image log from one well is providing new insight into the fine-scale stratigraphy of the Barnett Shale, and offers the possibility of identifying fine-scale lithofacies stratification from an image log **(Figure 1).** An attempt to calibrate the high-resolution borehole-image log with a detailed core description **(Figure 2)** reveals some variation in the lithology which is not readily visible from the monotonous-appearing black shale core. The borehole image log also provides a tool for core-to-log depth correction with millimeter-scale correlation, which is essential when interpreting image logs in gas shales. Such fine-scale calibration is impossible with any other well log. Any mismatch in the core-to-log depth causes serious errors when the image log is used to predict lithofacies in an uncored well.

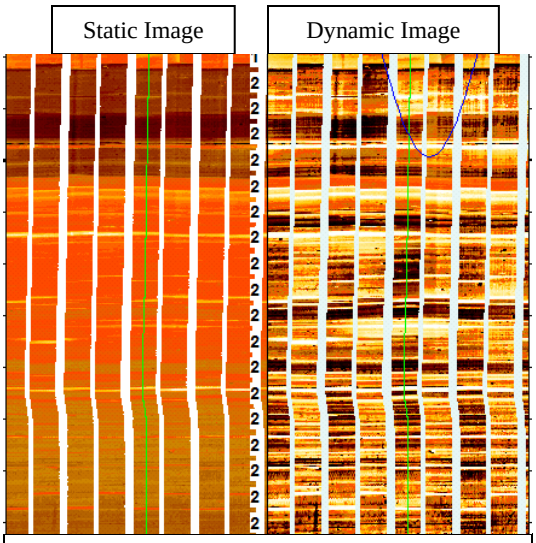
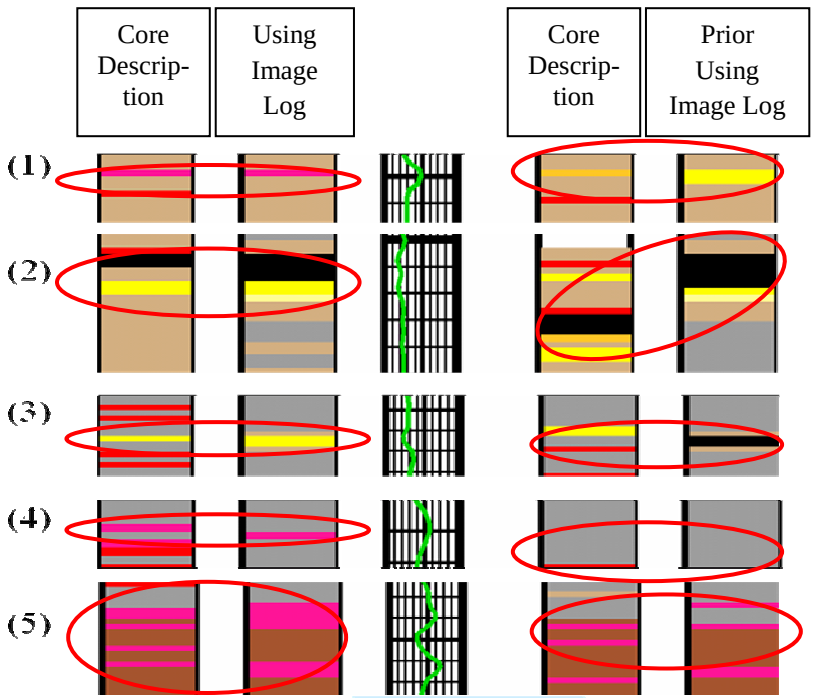


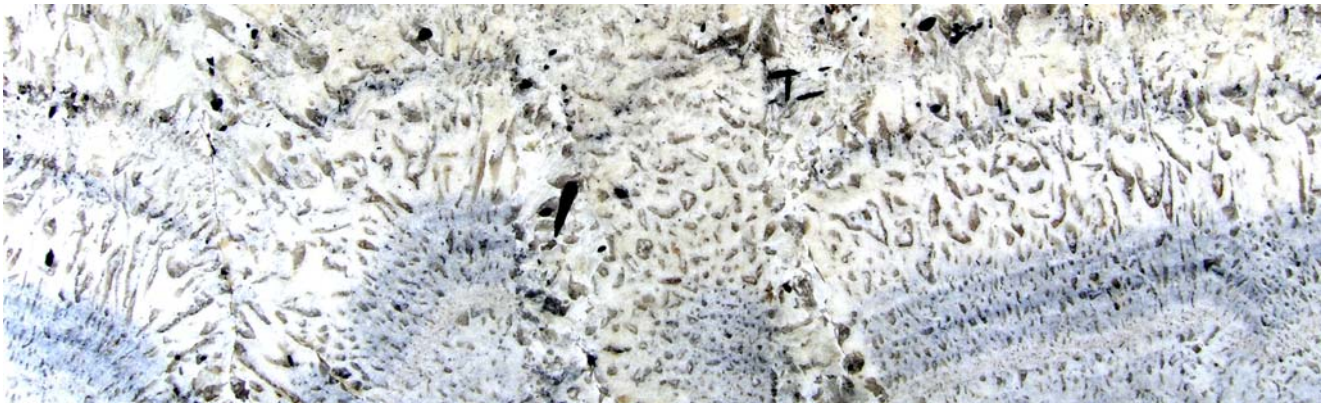
Figure 1: *As per the core description, calcareous mudstone with low calcite throughout this interval. Image log reveals finer variation which was not visible in the core.*



- Five snapshots showing the comparison between facies prediction with and without image log. Different colors represent different facies.
- Core description after the depth calibration using image log and facies prediction afterwards on the left panel.
- Core description prior using image log and facies prediction without using image log on the right panel.

Figure 2

Origins of Primary Textures within Granitic Pegmatites



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Many granitic pegmatites contain two textural domains. Anisotropic fabrics including unidirectional inward crystal growth (UST, or Unidirectional Solidification Texture), layered aplites, skeletal crystals and graphic quartz-feldspar intergrowths prevail in outer zones. Interior zones possess coarse-grained, blocky pegmatitic texture, wherein crystalline intergrowths evolve to segregated crystals with less anisotropy in the fabric.

Anisotropic fabrics arise when the rate of crystal nucleation in melts lags far behind the rate of cooling, such that crystallization commences from melt that is undercooled (supersaturated) by ~ 150°-250°C below its liquidus temperature. Pegmatite dikes probably experience rapid undercooling. Pegmatitic segregations in granites lie near the margins of their plutons where the cooling rate is fastest, but far slower than in distal dikes. Near pluton margins, slower cooling is matched by lower rates of crystal nucleation, which fall to zero as the granitic melt evolves chemically through fractional crystallization. Pegmatite segregations in granite eventually crystallize in the same undercooled state as dikes, though the granite-hosted pegmatites take longer to reach that condition.

Crystal growth from highly undercooled melt proceeds essentially in one dimension, linearly from the margins toward the center, with negligible lateral chemical diffusion (except alkalis) along the crystallization front. The high viscosity of melt (~ 10^8 Pa·s) impedes the lateral diffusion of Al and Si, and fine-grained textures including graphic quartz-feldspar intergrowths are the result. The transition from fine to very coarse crystals and from graphic intergrowths to large, separate crystals hinges upon rapid lateral diffusion of Al and Si across the crystal growth front, perpendicular to the inward direction of the solidification front.

The fluxes H_2O, B, P, and F facilitate the diffusion of Al and Si, and the corresponding result is that graphic intergrowths evolve to separate crystals of rock-forming minerals. The fluxes also inhibit the nucleation of new crystals through reactions with the melt that lower the activities of the essential components of the rock-forming minerals, quartz and feldspars. These effects are possible even in simple pegmatites because constitutional zone refining creates a flux-rich boundary layer of melt adjacent to the crystal growth front. In that boundary layer, lateral diffusion of components keeps pace with inward crystal growth, and consequently the size, homogeneity, and eventually clarity of crystals increase markedly. In analogue experiments, a flux-rich melt moves 10^7 times the mass of Si as aqueous vapor at 10^7 times the rate of diffusion in ordinary hydrous granitic melt at 800°C and 200 MPa. A hydrous flux-rich melt created via constitutional zone refining at crystal-melt interfaces provides the necessary mass transport to grow giant crystals in pegmatite-forming environments.

The development of pegmatite textures within dikes, therefore, has two primary controls. Initial crystallization is dominated by the effects of pronounced liquidus undercooling and results in anisotropic, inward-directed fabrics with skeletal and graphic crystal habits. Once a flux-rich boundary layer is established, rapid lateral diffusion of Al and Si facilitates two-dimensional crystal growth that generates the blocky interior zones.

GEOCHEMICAL STUDY OF THE PETRIFIED WOOD, MESA FORMATION (PLEISTOCENE), ANZOÁTEGUI STATE, VENEZUELA

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MS Candidate in Geology

Petrified wood found in the geological record can be analyzed to obtain information about the historical population of trees, some of them now extinct: prevailing climatic conditions during their growth period; sedimentary environmental conditions of the region being studied; specific chronological information, which may differ considerably from that obtained from contemporary trees and details of the petrifaction process (Nowak et al., 2005). Sigleo (1978, 1979) explained that petrifaction is not a molecule-by-molecule replacement of the organic content of the wood by mineral matter, but a void-filling mechanism of mineral solutions into the wood cavities and intracellular spaces, where the exposed surfaces act as a template for mineral deposition. Some of the petrifying agents comprise different varieties of silica (opal, chalcedony, and quartz), calcite, dolomite, pyrite, sphalerite, apatite, goethite and hematite, but with silica being the most important petrifying material. In general, during this process only one mineral is deposited in the woody tissue.

A set of six petrified wood samples **(Figure 1)** from the Mesa Formation were analyzed using a binocular, X-Ray Diffraction (XRD) and electron microprobe (EPMA) techniques. This allowed determination of the mineralogical composition and elemental distribution in the wood structures. The importance of this work lies in the contribution of information to Quaternary investigations, and serving as a starting point for research of these specimens in Venezuela.

Macroscopically, in all samples typical elements of wood such as vessels, vascular tissue and radial and axial parenchyma could be observed **(Figure 2)**. The XRD results showed that all samples were composed of quartz (SiO_2). The type of vessels, parenchyma pattern, pits, perforation plates and the presence of tyloses were determined by the EPMA technique **(Figures 3 and 4)**. These anatomical features identified in the samples permitted the conclusion to be made that the petrified wood from this geologic formation was related to *Maclura* Nutt. genus **(Figure 5)**. Additionally, the elemental associations determined were: Si and O forming quartz, chalcedony and/or opal forming different crystalline habits and aggregates **(Figure 6)**; and in lesser proportions Fe and O as iron oxy-hydroxides (goethite and/or hematite) **(Figure 7)** and O, Al, Si and K as clay minerals (illite) filling cavities and fractures **(Figure 8)**.

The results obtained indicate that the petrified wood from Mesa Formation is *silicified*, possibly generated from the infiltration of silicic acid, filling the splits of the wood and duplicating their structure, under anoxic and moderately acidic conditions and pressures and temperatures similar to those found on Earth´s surface.

Figure 1: Petrified Wood Sample from the Mesa Formation

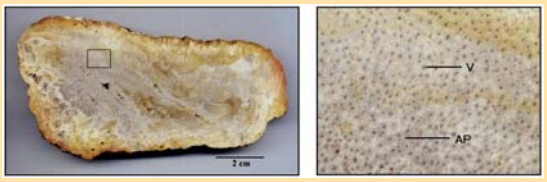


Figure 2: Transverse section analyzed through a magnifying glass showing the vessels (V) and the axial parenchyma (AP)

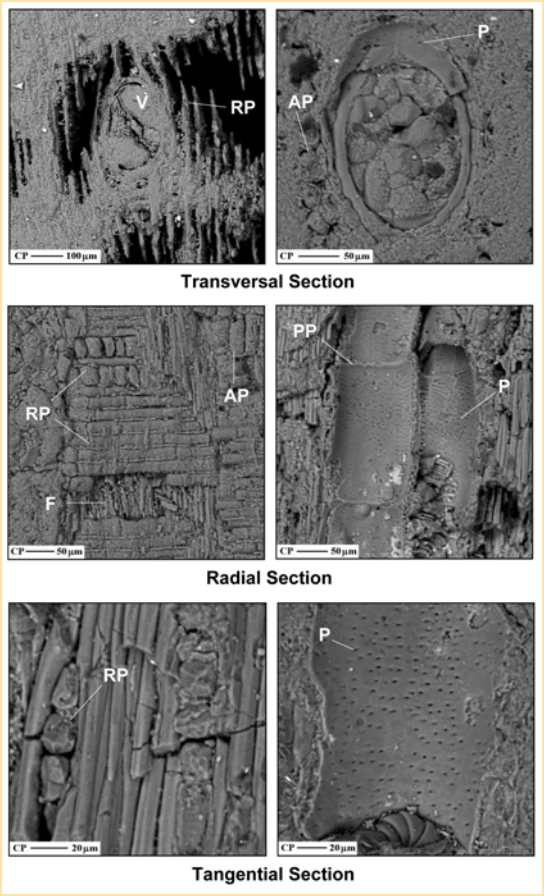
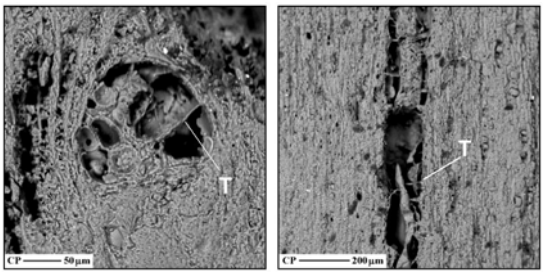


Figure 3: COMPO (CP) images showing diverse anatomical features of the petrified wood. (RP: Radial parenchyma, PP: perforation plates, P: Pits, F: Fibers)



Firgure 4: CP images showing the replicates of tyloses (T); transverse section

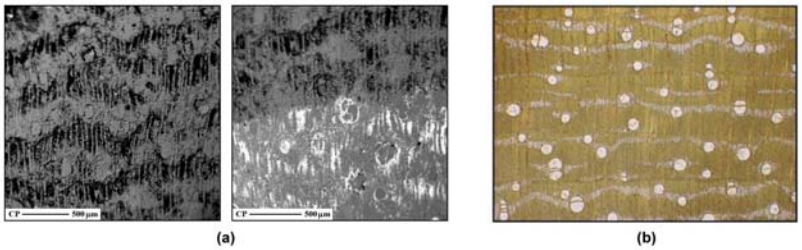


Figure 5: (a) CP images of two zones of a petrified wood sample in transverse section. (b) Photomicrograph of the M. tinctoria species in transverse section (from Richter and Dallwitz, 2006)

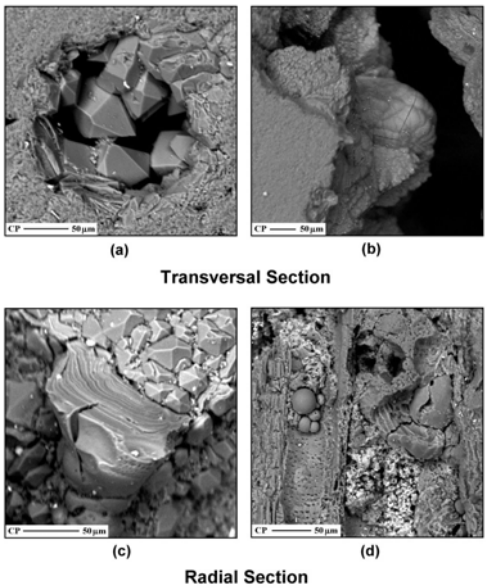


Figure 6: CP images showing (a) prismatic quartz crystals, (b) SiO_2 crystals with botryoidal habit, (c) vessel filled with agate, (d) vessel with microspheric aggregates of SiO_2

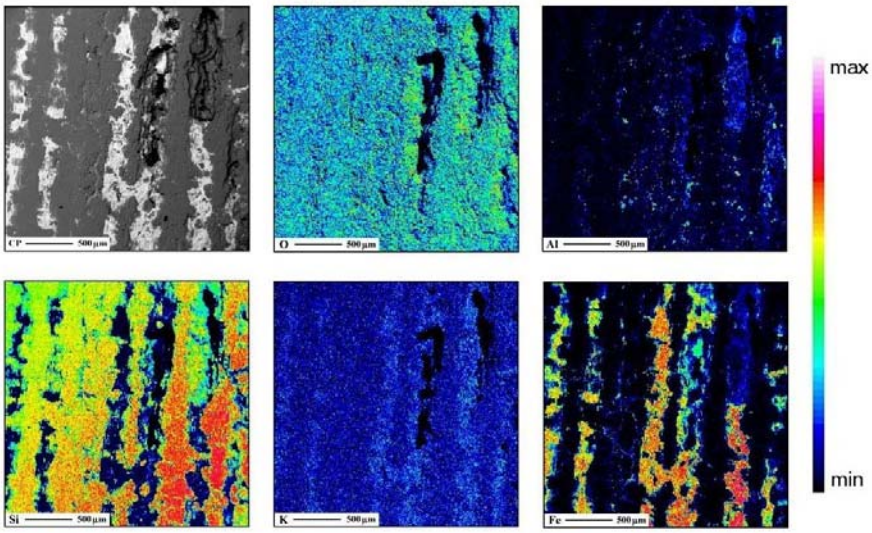


Figure 8: CP image and elemental maps of O, Al, Si, K and Fe; radial section

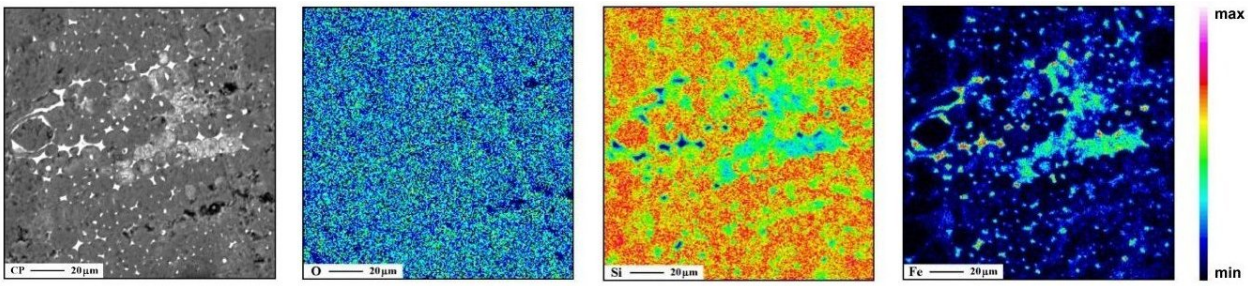


Figure 7: CP image and elemental maps of O, Si and Fe; transverse section

Attribute Expression of Mass Transport Deposits in an Intraslope Basin: A Case Study

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PhD in Geology

Summary

Mass transport deposits (MTDs) are common features that help us reconstruct the depositional environment in deepwater basins. Unlike turbidite sands that form in similar environments, MTDs only rarely form hydrocarbon reservoirs. Near the water bottom, recent MTDs can indicate the risk of future hazards to submarine platform legs, drill stems, pipelines, and communication cables. MTDs commonly exhibit an overall chaotic seismic pattern; several other associated features help to differentiate MTDs from other kinds of deposits in deepwater depositional environments. MTDs have similar characteristics in intraslope basins (also called salt minibasins) but vary as a function of restricted transport direction for sediment input, limited accommodation space, and syndepositional salt movement. By coupling principles of geomorphology with seismic attributes and a depositional model, we analyze the characteristics of an MTD within an offshore Gulf of Mexico study area to determine how it differs from other deepwater architectural elements.

Introduction

Weimer and Slatt (2006) consider mass transport deposits (MTDs) as one of the four main architectural elements of deepwater environments. Mass transport deposits generally form due to slope failure or slumping from the shelf-slope area when sea level falls rapidly, exposing the shelf-slope area and changing sediment pore pressure. For intraslope basins, MTDs often "develop from the failure of delta front or canyon walls, have extensive erosion at their base, and overlying sediment fill" (Weimer and Slatt, 2006).

Although mass transport deposits (also called mass transport complexes, or MTCs) are not prolific reservoirs, these deposits are still of great interest to industry, government safety departments, and academics. Shallow mass transport deposits are common drilling hazards due to their complex internal structure and the potential to contain local gas pockets. In some basins, including the Gulf of Mexico, individual depositional sequences may consist of more than 50% slides and/or deformed sediments (Weimer and Slatt, 2006). For this reason, MTDs are very important in setting up the sequence stratigraphic framework in a basin or minibasin. In most cases MTDs are deposited at the top of sequence boundary at early Lowstand System Tract (LST), sometimes eroding sediments at their base. In some instances, remobilized massive sands can form MTD reservoirs. Finally, the displaced water associated with the formation of MTDs is second only to undersea earthquakes in the initiation of destructive tsunamis.

Our study focuses on an MTD located within the tabular salt minibasin tectono-stratigraphic province which covers a large area of the continental slope along the northern Gulf of Mexico margin. Salt constrains the minibasin on the eastern, western and southern sides; the main sediment fairway is from the northern side. There is a broad variability in terms of the final geometric configuration of the minibasin, depending upon the interaction of the continuously deposited sediment load on top of the allochthonous salt, giving rise to temporally varying lateral changes in subsea topography. Due to the constrained sediment fairway and limited accommodation space, the geomorphology of deepwater deposits differ from those in open marine conditions.

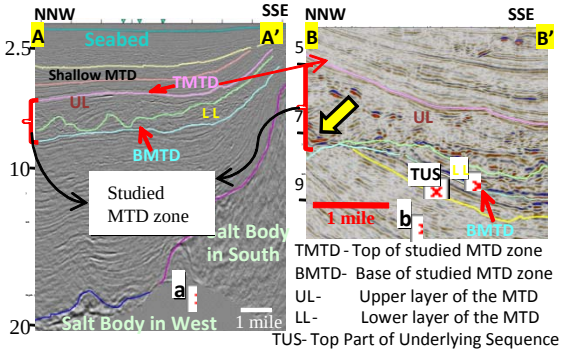

Figure 1: Seismic lines (a) AA' and (b) BB' show a mass transport deposit (MTD) imaged by our 3D seismic survey. The MTD unit is comprised of two discrete flow events forming two layers having different attribute characteristics. Note how the upper flow of the MTD cuts down through and erodes the lower flow unit. In Figure 1a, two salt bodies and another MTD situated in the shallower part are also indicated. In (b), the yellow arrow indicates the axis of the flow conduit of the upper flow. Data courtesy of Hess Inc.

Methodology

We focus on one prominent MTD within the 3D seismic volume (Figure 1- studied MTD zone). We used well logs and paleontological data to validate our time horizons and interpreted the bounding surfaces for the mass transport deposit. In addition to the migrated seismic amplitude we generate volumes of RMS amplitude, coherent energy (the square of the RMS amplitude of the coherent component of the data), eigenstructure coherence, generalized Sobel most-positive and most-negative curvature. Each attribute volume was then analyzed along stratal (proportional) slices between the two bounding horizons.

Each attribute was examined on each stratal slice. Although attributes such as RMS amplitude, coherence, and curvature are mathematically independent, they are often coupled through the underlying geology. For this reason, some the features can be identified on all the attributes while others were illuminated only by one or two attributes. Using this approach we set out to characterize our mass transport deposit. To put our MTD in the proper geological context, we also examined underlying and overlying sediments.

Results and Discussion

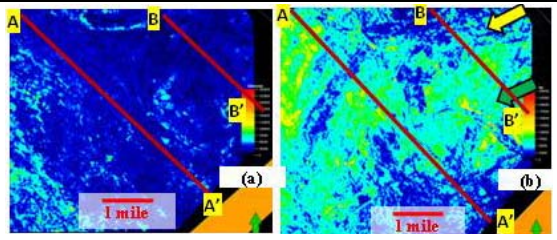

Figure 2: Stratal slice through the RMS amplitude volume (a) 400 ft below the base of the MTD and (b) at the base of the MTD. In (b), Green arrow indicates the lower flow while yellow arrow indicates the upper flow conduit of the MTD. AA' and BB' indicate the seismic lines shown in Figure 1.

We begin our analysis at the base of the mass transport deposit. In general, MTDs are formed during the early Lowstand System Tract (LST) when sea level falls, rapidly exposing the shelf and slope region, resulting in the collapse of shelfal sediments, slope failure and slumps. In deeper water the LST is expected to overlie the maximum flooding surface of a previous Transgressive Systems Tract (TST) or shale deposited during the previous highstand. In Figure 2 we display the Root Mean Square amplitude (RMS) computed in a 120 ft (40 m, or 5-sample) interval 400 ft below and at the base of the MTD.

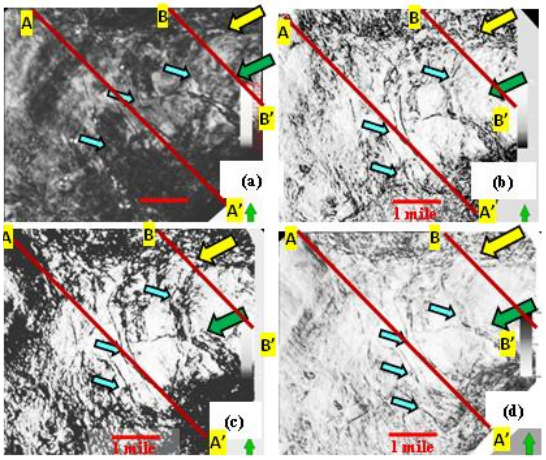

Figure 3: Stratal slices along the base of the MTD through the (a) coherent energy, (b) generalized Sobel filter, (c) eigenstructure coherence, and (d) variance volumes. Green arrows indicate the lower flow while yellow arrows indicate the upper flow which cuts down through the lower flow. Cyan arrows indicate arcuate compressional faults formed in the MTD.

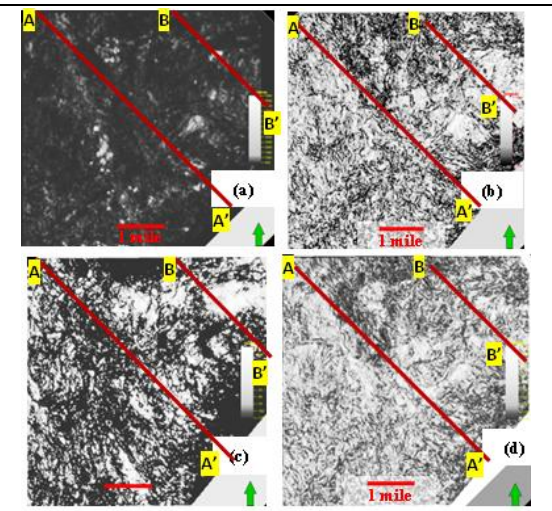

Figure 4: Stratal slices through (a) coherent energy, (b) generalized Sobel filter, (c) eigenstructure coherence, and (d) variance volumes through the upper flow of the MTD as it fills the minibasin. Note the more chaotic texture compared to slices through the base displayed in Figures 3 a-d.

The low amplitude deposits in Figure 2a may have been deposited during the previous TST. Maximum erosion occurs near the main conduit such that the MTD often overlies channel-overbank or sheet sands deposited during the previous lowstand.

Figures 1a and 1b indicate that the MTD is comprised of two different flows forming two distinct layers. The flow in the lower layer of the MTD is less erosive and relatively stratified, whereas the flow in the upper layer of MTD is highly erosive and more chaotic. Green arrows in Figure 3 indicate a broader

conduit for the lower flow from the northeastern side. The axis of the upper flow forms a canyon-like conduit seen in Figure 1b from the same (north-eastern) direction that erodes the lower flow (yellow arrows) as well as some part of the underlying sequence. We can see only part of the conduit in the available data set. The wings of the upper flow of the MTD are also erosive, but the flow energy is less. In Figure 3 we delineate the edges of these two layers of the MTD on stratal slices through the coherent energy, generalized Sobel filter, coherence, and variance volumes. In general, the lower layer is relatively smooth and continuous. In contrast, Figure 4 through the upper layer shows the more typical chaotic texture characteristic of MTDs. Indeed, the flow is so chaotic that the attributes cannot discriminate between internal discontinuities and the discontinuities associated with bounding faults. We interpret the difference seen in the two flows as the magnitude of the failure activity.

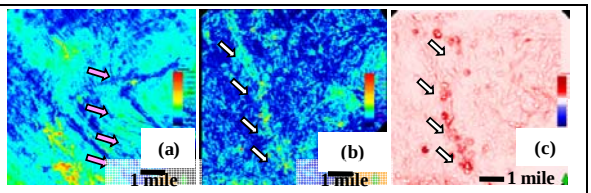

Figure 5: Stratal slices through RMS amplitude volumes (a) at the top and (b) within the MTD. (c) Stratal slice through most- positive curvature within the MTD. Lavender arrows in (a) indicate faults. White arrows in (b) and (c) indicate flow conduit from north or northwest.

In Figure 5a, we note increased reflector continuity towards the top of the upper flow in the MTD. We interpret this continuity as either deposition of suspended sediments after failure or as better-sorted deposits trailing the slump front. The RMS amplitude mostly shows a discontinuous nature especially in the upper flow of the MTD, but in some places some continuity in the amplitude pattern can be seen (Figure 5b). This pattern can be observed from the most positive curvature slice (Figure 5c) that indicates that in addition to the main flow from north-west to southeast, there are additional flow conduits

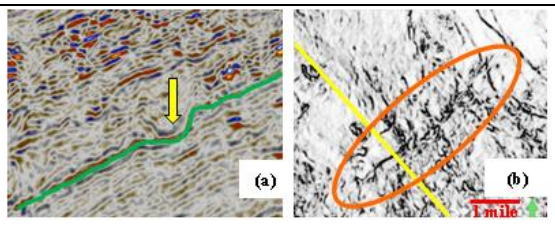

Figure 6: Striation or groove seen in (a) vertical seismic indicated by yellow arrow and (b) horizon slice through generalized Sobel filter volume, indicated by the red ellipse. Horizon slice corresponds to green pick in (a). Vertical slice corresponds to yellow line in (b).

from the northwest and north. This pattern continues above the mass transport deposit.

Although not common, we identify a groove or striation at the base of the MTD in Figure 6. The surface is almost perpendicular to the faults and may have been created due to dragging of some coarser material.

One of the most interesting features of the mass transport deposit is the presence of several high-amplitude blocks showing bright spots in the seismic (Figures 7a and b) that trend as a NNE- SSE arc (dashed cyan line in Figure 7e). These high-

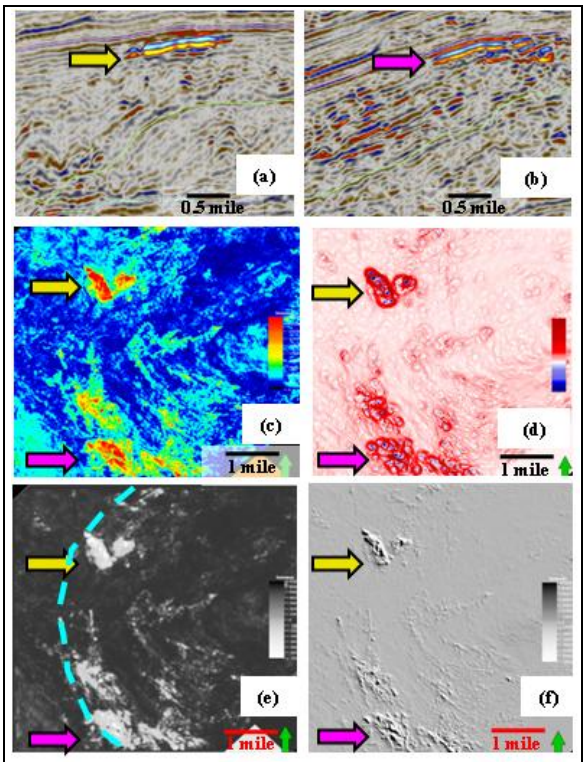

Figure 7: (a) and (b) Vertical slices through the seismic amplitude showing bright spots towards the top of the MTD. Horizon slices through (c) RMS amplitude (d) most-positive curvature, (e) coherent energy and (f) crossline amplitude gradient. Yellow and magenta arrows indicate the two bright spots shown in (a) and (b). Dashed cyan line in (e) indicates the trend of the high-energy features.

amplitude bodies are seen near the top of the mass transport deposit or top of the upper flow. The apparent flow direction indicated from coherent energy and most positive curvature does not follow the main mass transport direction. These features might be sand blocks deposited within the MTD from a sandy debris flow which came from the NNE direction. The strengths and confined character of these bright spots suggest that they are hydrocarbon charged sand bodies. Such bright spots are often observed in MTDs. If these bodies are sufficiently

large, they may be considered for commercial exploration, otherwise they should be considered to be a potential hazard.

A series of faults can be seen throughout the mass transport deposit. Horizon slices through eigenstructure coherence, variance and the generalized Sobel filter gives a very good picture of the faults (Figures 2b-d and 8). The faults are arcuate-shaped in profile and are formed due to toe-thrusts perpendicular to the direction of flow (e.g. Posamentier and Walker, 2006). The fault blocks are rotated (Figure 8) with the base of the mass transport deposit acting as the decollement surface. Our area of interest is confined by salt in all directions including the southwestern direction, such that the flow was not able to move a long distance and a thrust situation developed after entering the minibasin. Most of the faults in the studied zone were probably generated by the processes within the MTD. These faults were reactivated during the salt activity and consequently most of the faults have been extended beyond the MTD.

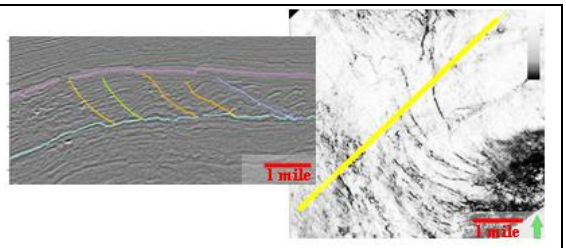

Figure 8: Stratal slice through generalized Sobel filter volume showing arcuate faults. Yellow line indicates the position of the seismic line where we have interpreted a suite of rotated faults that may be toe-thrusts.

In contrast to the MTD, the overlying deposits are characterized by continuous reflection events. RMS amplitude indicates a thick sheet deposit (Figure 9a). The feeder channels of the sheet can be observed at a shallower level (Figure 9b), and is characteristic of early LST after the deposition of a MTD. The fact that the feeders are above the sheet indicates they were open during sheet deposition and later backfilled during sea level rise. The internal texture contains a smaller network of channels of the sheet deposit and a sediment fairway from the NNE

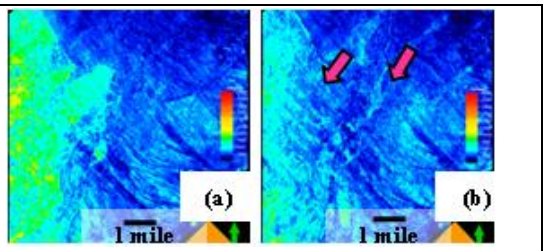

Figure 9: Stratal slices through RMS amplitude volume showing the sheet deposit overlying the MTD. Pink arrows indicate feeder channels from the north.

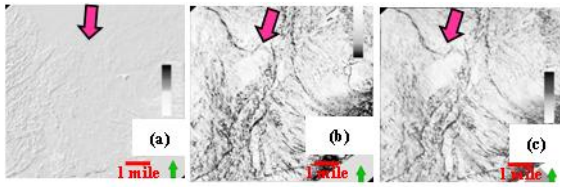

Figure 10: Attribute expression of the sheet sand deposit overlying the MTD: (a)inline amplitude gradient, (b) eigenstructure coherence an (c) generalized Sobel filter. Pink arrows indicate sediment fairway from the north.

(indicated by pink arrows), which can be observed from the inline amplitude gradient attribute (Figure 10a), eigenstructure coherence (Figure 10b) and generalized Sobel filter (Figure 10c).

Conclusions

By analyzing different seismic attributes in the MTD interval, we are able to identify characteristic features of mass transport deposits in intraslope basins. In addition to the well-known chaotic nature of mass transport deposits, we also identify more coherent stratification indicative of energy from different directions or completely decoupled flow events. We recognize fault patterns on coherence, variance and generalized Sobel filter slices that indicate upslope failure as well as terminal toe-thrusts. These attributes with coherent energy helped us to identify the sediment fairway and channel conduits. A grooved or striated trail may be identified at the base of the MTD which also helps to determine the flow direction. The most interesting features we identified were the internal sand blocks probably charged with hydrocarbons. They might have resulted from a sandy debris flow and came from a different direction than the main flow of MTD. The attribute characteristics of these features are completely different from the features of the overlying and underlying sediments. The sets of seismic attributes lead us to systematically characterize the complex deepwater deposits and, more importantly, help us to set up seismic-sequence-stratigraphic framework in the basin. We will continue this study with this dataset and also with more sets of attributes and datasets if available to find more characteristics improving the seismic geomorphological study.

Acknowledgements

We want to acknowledge Hess Inc., for the use of their deepwater GOM data volume for research and education and Schlumberger for providing the Petrel Software, in which the interpretation was done. We also want to acknowledge Ha Mai and Kui Zhang, ConocoPhillips School of Geology and Geophysics at the University of Oklahoma for helping extracting attributes and software expertise.

New Observations on the Extent of Cambrian Rifting in Colorado

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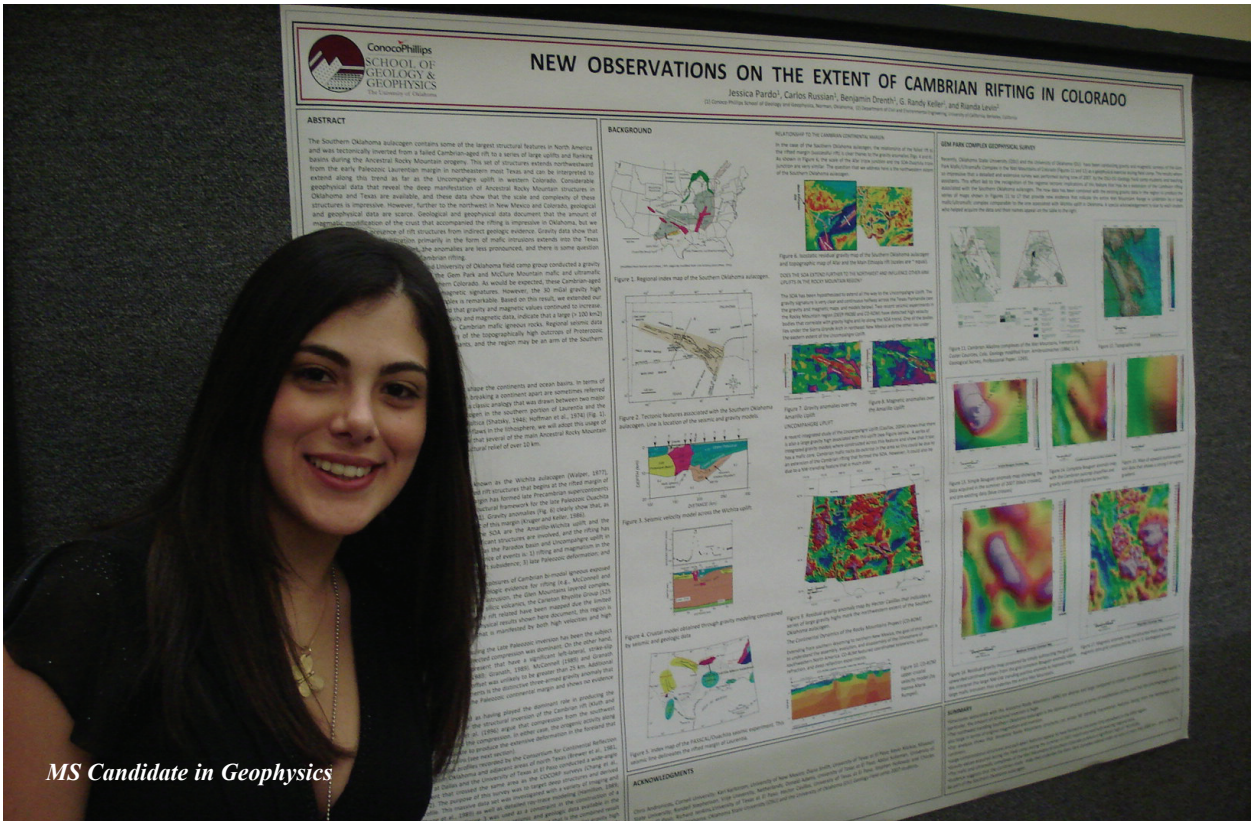

The Southern Oklahoma Aulacogen contains some of the largest structural features in North America and was tectonically inverted from a failed Cambrian-aged rift to a series of large uplifts and flanking basins during the Ancestral Rocky Mountains orogeny. This set of structures extends northwestward from the early Paleozoic Laurentian margin in northeasternmost Texas and can be interpreted to extend along this trend as far as the Uncompahgre uplift in western Colorado. Considerable geophysical data that reveal the deep manifestation of Ancestral Rocky Mountains structures in Oklahoma and Texas are available, and these data show that the scale and complexity of these structures are impressive. However, further to the northwest in New Mexico and Colorado, geological and geophysical data are scarce. Geological and geophysical data document that the amount of magmatic modification of the crust that accompanied the rifting is impressive in Oklahoma, but we can only infer the presence of rift structures from indirect geologic evidence. Gravity data show that extensive magmatic modification primarily in the form of mafic intrusions extends into the Texas Panhandle, but beyond that point, the anomalies are less pronounced, and there is some question about the nature and extent of the Cambrian rifting.

The joint Oklahoma State University and University of Oklahoma field camp group conducted a gravity and magnetic survey of the region of the Gem Park and McClure Mountain mafic and ultramafic complexes in the Wet Mountains of southern Colorado. As would be expected, these Cambrian-aged intrusives produced strong gravity and magnetic signatures. However, the 30 mGal gravity high observed in 3 km across the Gem Park complex is remarkable. Based on this result, we extended our survey towards McClure Mountain and found that gravity and magnetic values continued to increase. These results, when merged with regional gravity and magnetic data, indicate that a large (> 100 km^2) portion of the Wet Mountains is underlain by Cambrian mafic igneous rocks. Regional seismic data also indicate that this is the case. Thus, many of the topographically high outcrops of Proterozoic metamorphic rocks may actually be roof pendants, and the region may be an arm of the Southern Oklahoma Aulacogen.

Multiattribute Analysis of the Stratton Field, South Texas

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The University of Oklahoma

MS Candidates in Geophysics

The Stratton Field is located in south Texas in the Rio Grande embayment, basinward of the regionally extensive Vicksburg fault zone. The field is defined by structural rollover anticlines on the downthrown side of the Vicksburg fault zone. One of the major hydrocarbon producers in the Gulf Coast is the Oligocene middle Frio Formation. In the Stratton field, the middle Frio Formation consists of multiple vertically-stacked reservoir sequences. The present study has two primary objectives. The first is a structural analysis of the Stratton Field using seismic attributes that enhances fault features difficult to see with regular seismic data. In order to accomplish this, four attributes were applied to a 3D volume over the seismic data: Variance, Most Positive Curvature, Most Negative Curvature, and Ant tracking over Variance. Seismic attributes in the specified area contributed in the delineation of the two major faults (Agua Dulce Fault and Vicksburg Fault) and also in the interpretation of smaller but abundant synthetic and antithetic faults **(Figure 1)**. The second objective is a multiattribute seismic interpretation of the fluvial sandstone reservoirs F11 and F39, within the basal middle Frio (BMF). Fluvial deposits such as channels are the main objective to enhance. A variety of attributes such as Coherence, Variance, Energy Ratio, Peak Amplitude, Most positive and negative curvature, among others were used to accomplish the detection of those stratigraphic features difficult to visualize on the amplitude volume **(Figure 2)**.

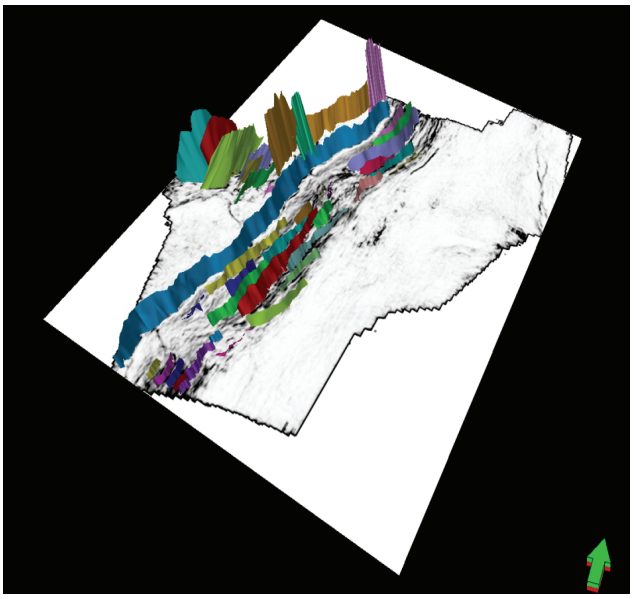


Figure 1: Picked faults in a 3D view over the variance volume.

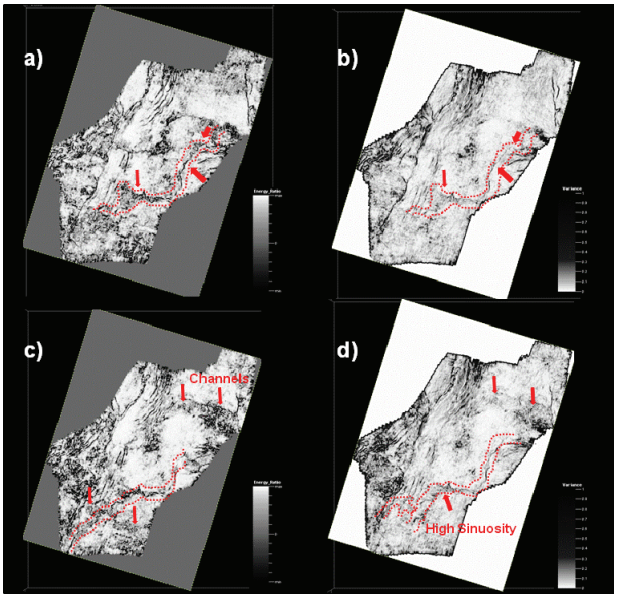


Figure 2: Example of attribute analysis. a) Phantom horizon slice 10 ms below the F11 horizon through the energy ratio volume. b) Phantom horizon slice 10 ms below the F11 horizon through the variance volume. c) Phantom horizon slice 46 ms above the F39 horizon through the energy ratio volume. d) Phantom horizon slice 46 ms above the F39 horizon through the variance volume.

Studying the Barnett Shale in the Negev, Israel

By Seth Busetti

Ph.D. Candidate in Geology

What do the hydrocarbon-rich rocks of the Barnett Shale, a twenty-six TCFG unconventional gas reserve in the Fort Worth Basin, have in common with Late Precambrian igneous rocks near the Dead Sea rift, southern Israel? Though the connection may seem elusive at first, both locations share some very similar and very useful mechanical processes. During spring break 2008 I had a chance to see evidence of some of these processes first-hand during a backpacking trip in the Negev. A few friends and I trekked the southern 150 miles of the Israel National Trail from Mitzpe Ramon to Eilat, passing through Timna, the site of sophisticated 13th Century BCE Egyptian and Midianite copper mines. To the non-geologists, the picturesque landscape at Timna **(Fig. 1)** was breathtaking, with stark contrasts between terraced sandstone cliffs and forebodingly dark and jagged olivine-gabbro, looming walls of speckled syenite, and haphazardly strewn piles of granite boulders **(Figure 2)**, over which we determinedly ascended. To the geologist, however, the terrain revealed even richer detail.

Exposed rocks in Timna, southern Israel, contain numerous dikes intruded into fractured basement. Dikes are nature's version of fluid-injected (hydraulic) fracturing, often well preserved, and exhibiting distinct geometries which reflect the stress state during dike emplacement and the preexisting fracture network. The three-dimensional orientations of dikes can be used to calculate the orientation and magnitude of tectonic stresses and the relative injection pressure at the time of the hydraulic-fracturing event. In previous studies at Timna (Baer et. al, 1994) and other areas injected by dikes, these calculations have helped in understanding the character of dike emplacement.

The process of dike injection is not unlike the hydraulic fracturing operations employed in the Barnett Shale. In nearly all Barnett wells, a slurry of fine sand proppant and water is injected at high pressures into perforations along the wellbore in order to stimulate and create a

network of hydraulic fractures in the formation – manmade dikes. In several Barnett wells I have integrated data from pressure-time curves and other in-situ stress measurements to calculate the values of the principal stresses and fluid driving pressure **(Figure 3)**. A range of orientations of hydraulic fractures that may be stimulated can be calculated for different zones along the wellbore to determine where preexisting fractures will undergo slip or dilation, and under what conditions fresh rock may be fractured. I am currently using these calculations to help Devon Energy develop more effective hydrofrac operations in their wells with the expectation to maximize fracture complexity and volume, as well as fracture-network connectivity. By incorporating real-time microseismic data we have qualitatively validated predictions of the expected fracture-network stimulation. In the upcoming months, the addition of more detailed microseismic data and computer simulations should prove invaluable to our study, and perhaps justify another trip to the Negev.

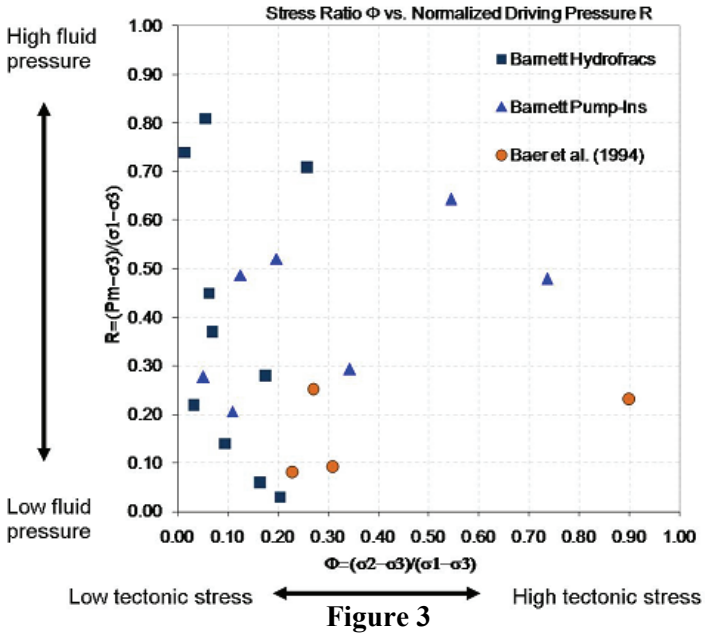


Figure 3

Figure 1

Figure 1: Numerous dike swarms (black streaks) cut through Late Precambrian host rock near Timna, southern Israel. The geometry and orientation of the dikes gives insight into the tectonic stress state and injection pressure at the time of dike emplacement.

Attribute Illumination of Basement Faults, Cuu Long Basin, Vietnam

Ha T. Mai and Kurt J. Marfurt, University of Oklahoma, Norman, USA*

PhD Candidate in Geophysics

Summary

Geometric attributes such as coherence and curvature have been very successful in delineating faults in sedimentary basins. While not a common exploration objective, fractured and faulted basement forms important reservoirs in Mexico, India, Yemen, and Vietnam. Because of the absence of stratified, coherent reflectors, illumination of basement faults is more problematic than illumination of faults within the sedimentary column. In order to address these limitations we make simple modifications to well-established vector attributes including structural dip and azimuth, amplitude gradients, and maximum and minimum curvature, to provide greater interpreter interaction. We apply these modifications to better characterize faults in the granite basement of the Cuu Long Basin, Vietnam, that form an unconventional, but very important oil reservoir.

Introduction

Faults play an important role in forming effective fracture porosity for hydrocarbon traps in the granite basement of the Cuu Long Basin, Vietnam. Mapping fault/fracture intensity and orientation can help delineate sweet spots and better aid horizontal drilling. In the Cuu Long Basin, faults and fractures tend to be planar and steeply dipping, such that we expect to see them more distinctly by viewing them perpendicular to their strike. Interactive shaded-relief maps of picked horizons are provided in nearly all 3D seismic interpretation software packages. Although most easily understood as sun-shading with locally higher relief features creating shadows that enhance the appearance of subtle dips, mathematically, shaded-relief maps comprise simple axis rotations and projection of the two orthogonal dip components of the surface with the direction of illumination.

Barnes (2003) showed how volumetric estimates of structural dip and azimuth can be used to generate shaded-relief volumes. We imitate this work and generate directional structural dip, amplitude gradient, and curvature volumes and evaluate the results in terms of basement fault illumination in the Cuu Long Basin.

Method

A planar surface such as dipping horizon or faults can be presented by its true dip azimuth θ and strike ψ. The true dip θ can be presented by apparent dips θ_x and θ_y along the x and y axes (Figure 1).

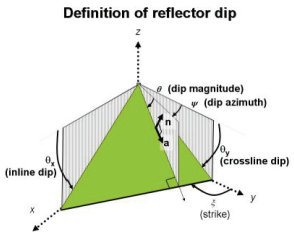


Figure 1: Mathematical, geologic, and seismic nomenclature used in defining reflector dip. By convention, **n** = unit vector normal to the reflector; **a** = unit vector dip along the reflector; θ = dip magnitude; ψ = dip azimuth; ξ = strike; θ_x = the apparent dip in the xz plane; and θ_y = the apparent dip in the yz plane. (after Chopra and Marfurt 2007)

For time-migrated seismic data, it's more convenient to measure apparent seismic time dips (p_x, p_y) components along inline and crossline directions in *s/ft* or *s/m*. For depth-migrated seismic data such as our Cuu Long survey, we simply compute θ_x and θ_y and display them either as components or as dip magnitude, θ, and dip azimuth, ψ, or alternatively as dimensionless (p_x, p_y) measured in ft/ft or m/m.

There are several popular means of computing volumetric dip components, including those based on weighted versions of the instantaneous frequency and wave-numbers (Barnes, 2002), on the gradient structure tensor (Randen et al., 2000) and on discrete semblance-based dip searches (Marfurt, 2006). The relationship between apparent seismic time/depth dips and apparent angle dips are:

$$p_x = 2 * \tan\theta_x \,/\, v, \quad (1a) \quad \text{and} \quad p_x = 2 * \tan\theta_y \,/\, v, \quad (1b)$$

where v is an average time to depth conversion velocity.

We can compute apparent dip at any angle ψ from north through a simple trigonometric rotation:

$$p_\psi = p_x \cos(\psi - \phi) + p_y \sin(\psi - \phi), \quad (2)$$

where ϕ is the angle of the inline seismic axis from north.

Marfurt (2006) also describes an amplitude gradient vector attribute that has inline and crossline components (g_x,g_y). We can therefore compute an amplitude gradient at any angle, ψ, from north:

$$g_\psi = g_x \cos(\psi - \phi) + g_y \sin(\psi - \phi). \quad (3)$$

To compute the apparent curvature at an angle, δ, from the azimuth of minimum curvature, χ, we slightly modify Roberts' (2001) description of Euler's formula:

$$k_\delta = k_{\max} \sin^2\delta + k_{\min} \cos^2\delta, \quad (4)$$

where k_{min} and k_{max} are the minimum and maximum curvatures. To compute the apparent curvature at an angle ψ, from north we write:

$$k_\psi = k_{\max} \sin^2(\psi - \chi) + k_{\min} \cos^2(\psi - \chi). \quad (5)$$

Using equations 2, 3, and 5, we are able to animate through a suite of apparent dip, amplitude gradient, and curvature images at increments of 15^0 to see which perspective best illuminates structural features of interest.

Application

We compute apparent dip, energy-weighted amplitude-gradient methods, and curvature for our 3D post-stack depth-migrated seismic dataset from the Cuu Long Basin,Vietnam.

The structure of Pre-Cenozoic basement of the Cuu Long Basin is very complex, and is mainly composed of magmatic rocks. Under the influence of tectonic activity, the basement was broken into a suite of fault systems. This faulting provided favorable conditions for hydrocarbons from a laterally deeper Oligocene-Miocene formation to migrate and accumulate in the basement high.

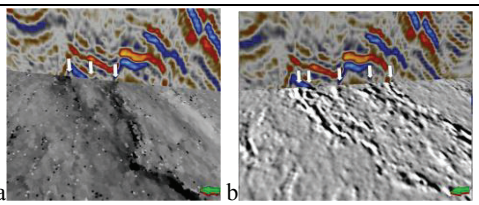


Figure 2: Seismic section on (a) apparent dip depth slice and (b) amplitude gradient. The white arrows show location where the attributes help interpreting fault features.

Since the nature of this basement is magmatic rocks, the seismic signal is very weak and noisy. Applying different methods to enhance the faults' signatures will aid our seismic interpretation, with the ultimate goal of estimating fracture location, density, and orientation.

The top of basement was highly compressed, forming a high-angle push-up to about 2500 m (Figure 3). The top of this basement high dips to the east and west at about 60°. Faults were formed along all four sides and cut deep into the basement (Figure 2).

In Figure 3 we display depth slices at 2750 m through the apparent dip volume, p_ψ, as a function of azimuth. We used equation 2 to compute images at ψ = 0°, 30°, 60°, 90°, 120°, and 150°.. White arrows indicate the major NE-SW-trending main faults, while yellow arrows indicate more subtle faults cutting across them.

In Figure 4 we display depth slices at 2750 m through the apparent amplitude gradient volume, g_ψ, as a function of azimuth. We used equation 3 to compute images at ψ = 0°, 30°, 60°, 90°, 120°, and 150°. White arrows indicate lineaments that we interpret to be indicative of subtle faults and fractures. Close to the north azimuth we see a suite of NE-SW-dipping features, which include faults and top basement boundary. The basement edge is dipping rapidly at an angle of about 70° or more at this location. There are many faults running along this edge that propagate into the shallower sedimentary column. In Figures 4d and 4e, nearly perpendicular to inline direction, we recognize many NW-SE-trending features, which are believed to be faults cutting across the basement. These features did not appear in the apparent gradient images parallel to the features.

Apparent curvature is computed from the maximum, minimum curvatures and the azimuth of minimum curvature shown in Figure 5.

Conclusions

Several modern attributes, including volumetric computation of structural dip and azimuth, structural curvature, amplitude gradients, and amplitude curvature, are multi-component in nature and are thus amenable to visualization from different user-controlled perspectives. Precomputing every desired azimuthal view results in consumption of significant disk storage. However, through the use of 'fast-batch' spreadsheet-like attribute calculators available in several 3D interpretation software packages, such manipulation can now be put under user control. Eventually, we envision generating truly interactive azimuthal visualization software, thereby enabling the interpreter to extract as much information from the data as possible.

Acknowledgments

We thank PetroVietnam and Cuu Long JOC for permission to publish the seismic data used in this paper. The rotation of the images was achieved through the use of Schlumberger's Petrel 'Attribute Calculator'.

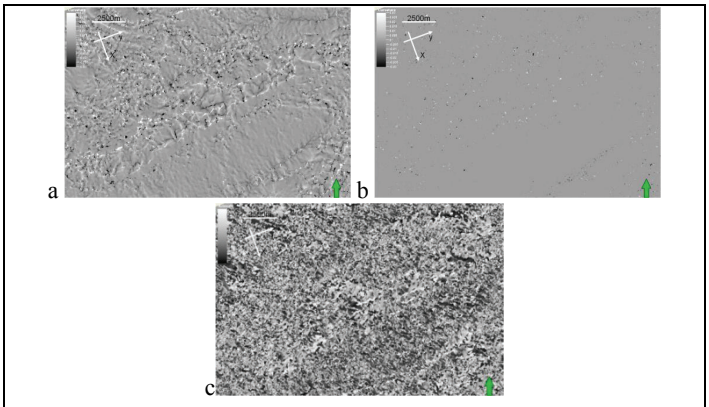


Figure 5: Depth slices at z=2750 m through (a) maximum curvature (b) minimum curvature and (c) azimuth of minimum curvature

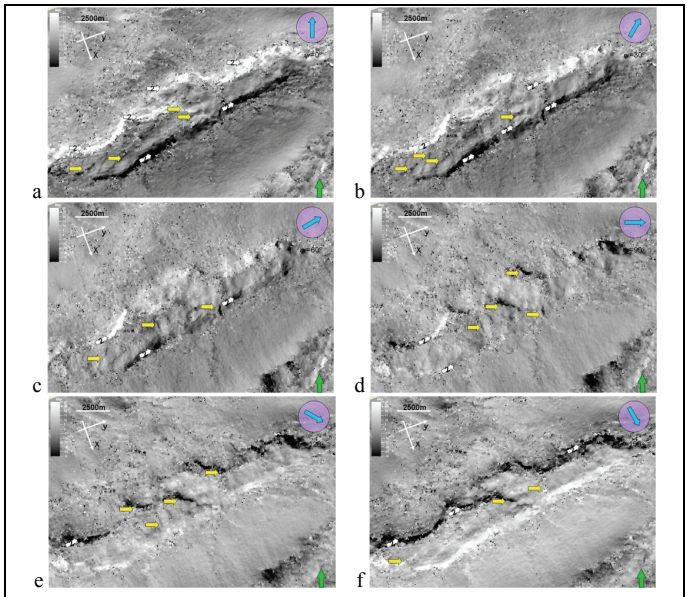


Figure 3: Depth slices at z=2750 m through apparent dip, p_ψ, computed at ψ=0°, 30°, 60°, 90°, 120°, and 150° from north. Block white arrows indicate lineaments that we interpret to be associated with faults and fractures. Several meandering channel segments can be seen in the sedimentary section to the SE.

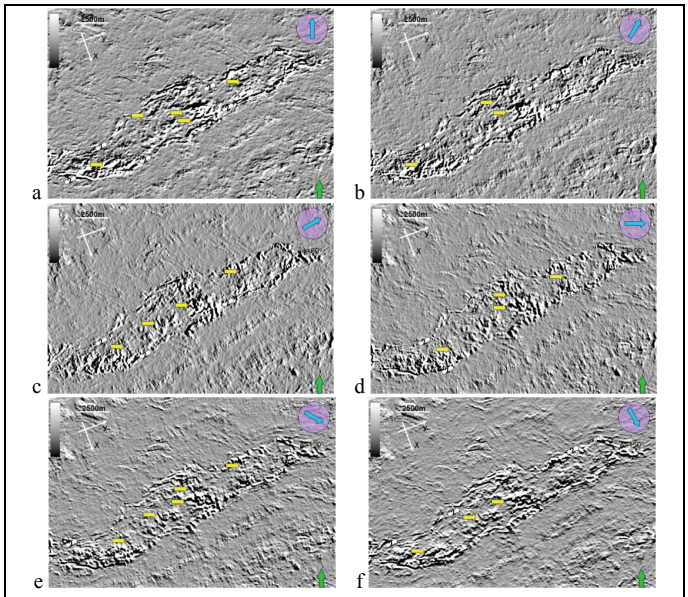


Figure 4: Depth slices at z=2750 m through apparent amplitude gradients, g_ψ, computed at ψ=0°, 30°, 60°, 90°, 120°, and 150° from North. Block white arrows indicate lineaments that we interpret to be associated with faults and fractures. Several meandering channel segments can be seen in the sedimentary section to the SE.

New structural mapping of basement features in the Fort Worth basin, Texas, using high-resolution aeromagnetic derivatives and Euler depth estimates

Olubunmi O. Elebiju*, *G. Randy Keller and Kurt J. Marfurt, ConocoPhillips School of Geology and Geophysics, The University of Oklahoma*

PhD Candidate in Geophysics

A new integrated basement study of the Fort Worth basin (FWB) that includes a high-resolution aeromagnetic data (HRAM), its derivatives, 3-D seismic data and well data reveals a highly segmented and complex basement. The preliminary new result of the structural mapping of the basement using HRAM derivatives reveals correlations with features seen on seismic attribute images. This correlation enables us to establish a relationship between basement lineaments and intra-sedimentary faults. Also, new depth estimates from Euler deconvolution provide a basis for comparison with depth-converted seismic data.

Introduction

The Fort Worth basin in Texas is one of the major late Paleozoic foreland basins associated with the Ouachita orogenic belt (OOB) that is located along the southern margin of North America (Figure 1). This asymmetric basin is at the edge of the advancing OOB that consists of continental shelf sedimentary rock underlain by lower Paleozoic shelf carbonates (Walper, 1982). The structural grain of the basement that underlies the FWB is shown by the regional total magnetic intensity (TMI) (Figure 1).

Our hypothesis is that by calibrating derivatives images and depth estimates from HRAM data with scattered 3-D seismic surveys will provide a means of accurately mapping basement features in the FWB where seismic data is unavailable. In spite of the fact that the basin has extensively been explored for hydrocarbons, adequate knowledge and understanding of the basement and its influences on collapse, dolomitization, karst and natural fracture is lacking. The ability to map basement features is very important to exploration within this basin, because some of the naturally induced fractures thought to be related to basement structures have been found to reduce well performance (Montgomery et al., 2005).

For HRAM data, derivative maps that are designed to enhance edges of magnetic sources can provide better pre-drilling understanding of the basement control on intra-sedimentary features.

This paper presents the results of using HRAM derivative maps to delineate basement structures with the goal of understanding how basement controls intra-sedimentary features. In addition, Euler deconvolution methods were used to estimate depth and source type as well as to map boundaries of basement structures (Reid et al., 1990).

Data filtering and enhancement

We employed data processing techniques designed to separate out weak-magnitude, short wavelength magnetic anomalies associated with weakly magnetized sedimentary layers from strong magnitude, long wavelength anomalies that are often associated with strongly magnetized basement rocks. These procedures involved calculating several types of derivatives and gradients.

Horizontal gradient magnitude

The horizontal gradient magnitude (HMG) map derived from the HRAM data (Figure 2) reflects abrupt lateral changes in magnetization. According to Blakely (1995), the computed gradient maxima are located directly on or near a vertical edge/boundary of an isolated potential field source. The resulting

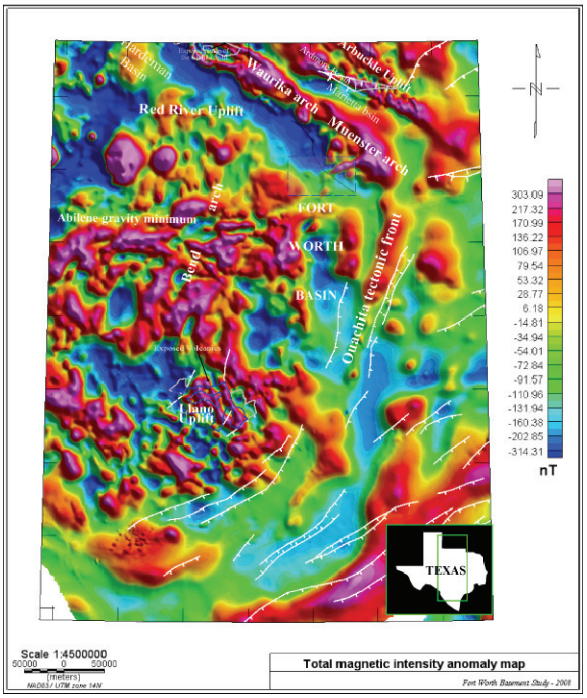


Figure 1) *Regional total magnetic intensity (TMI) map of central Texas, showing the Fort Worth basin and its adjacent features.*

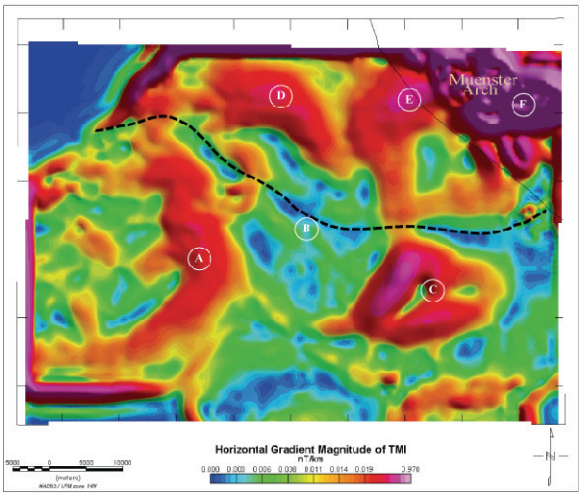


Figure 2) *Horizontal gradient magnitude of the TMI map shown in Figure 1.*

HGM map shows a NW-SE/NE-SW trending curvilinear feature labeled A and B in Figure 2. Within 25 km east these features, a predominantly NE-SW trending edge is noted. This is consistent with the result of Hoskins (1982) who delineated a predominantly NE-SW and NW-SE trends of joint and fracture from outcrop study close to our study area.

NW-SE features labeled D and E, which occur north of the NE-SW features, are juxtaposed next to the maxima associated with the Muenster Arch, F. This trend of orientation is very common throughout Fort Worth basin.

Tilt derivative

The tilt derivative (TD) map of the HRAM data can serve as an alternative for high pass filter or first vertical derivative map. TD helps map or enhance the continuity of a magnetic source body structure. On the TD map, the edge of the NE-SW trending features, B and D, are suggested to define the Abilene

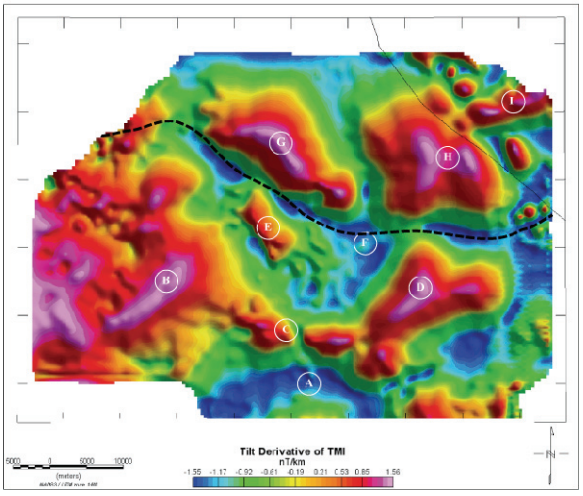


Figure 3) *Tilt derivative of the TMI map*

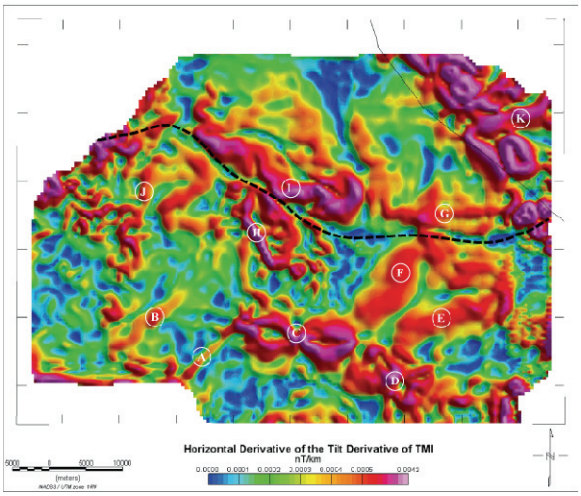


Figure 4) *Horizontal gradient magnitude of the TDR map*

minimum edge. Another NE-SW trending feature labeled I, is shown within the southern Muenster Arch (Figure 3). This might be related to the elongated mafic intrusion alluded to be within the SOA by Kruger and Keller (1986).

Total horizontal derivative of the tilt derivative

The total horizontal derivative of the tilt derivative map (HD_TDR) enhances prominent edges of a magnetic source. Verduzco et al. (2004) have used such maps to enhance edges of an induced or remanent magnetization body. Well-defined edges of features reflecting the complexity of the basement rock in this area are seen in Figure 4. Anomalies trending NE-SW, NW-SE and E-W are on the map.

Euler depth estimates

Euler Deconvolution depth estimates can provide depth estimates to shallowest possible magnetic sources as well as help delineate source boundary trends and type (Reid et al., 1990).

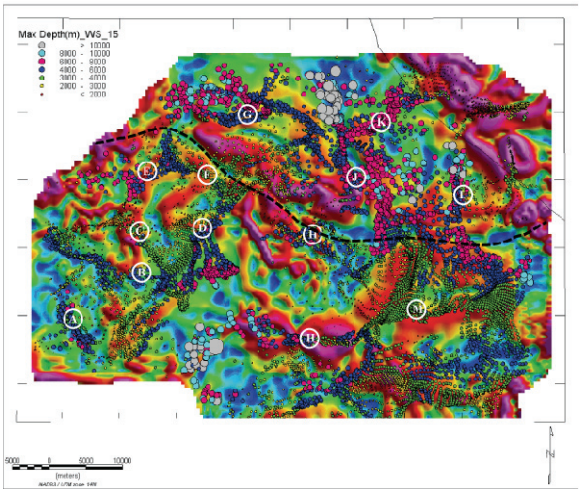


Figure 5) *Euler depth estimated (S.I = 1) on HD TDR map*

For the depth estimate computation, the HRAM grid has not been Reduced-to-the-pole (RTP), because an estimation of remanent magnetization was not made. However, a source geometry or degree of homogeneity was specified by the Structural Index (S.I) value. A structural index value of 0 represents 2-dimensional features such as a linear fault or a high throw contact. A S.I value of 1 on the other hand, represents a 3-dimensional feature such as isolated sheet edges or sill edges, with limited throw respectively (Reid et al., 1990; Goussev et al., 1998).

We adapted an effective method of plotting depth estimates as a circle clusters with depth proportionality representing circle diameter as suggested by Reid et al. (1990), to delineating magnetic source boundary trends. The higher S.I index map in this case S.I of 1, the more precise the depth estimates is (Reid et. al., 1990). Figure 5 displays the best clustering of NW-SE boundary trends.

Interpretation of the depth map estimated a gradient of 2-3 km SW of the Muenster Arch boundary (Figure 5). This gradient is shown by the juxtaposition of a 1.5 km clusters against a 3-4 km clusters. SW of this observation, another NW-SE linear trend was estimated of 4 - 6 km. On the SE corner of the map in Figure 6, an E-W clustering bounding the triangular shaped cluster has an overestimated depth of about 3 km. The boundary trends discussed above is an overestimated magnetic source depth. Source depth of about 3-4 km is suggested for the deepest magnetic source using a S.I value of 1. However, adjacent to the Muenster Arch, an overestimated source depth of as much 6-7 km is noticed.

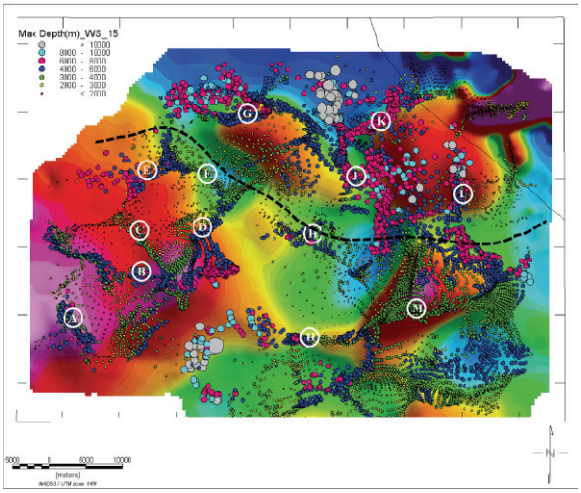


Figure 6) *Euler depth estimated (S.I = 1) on TMI map*

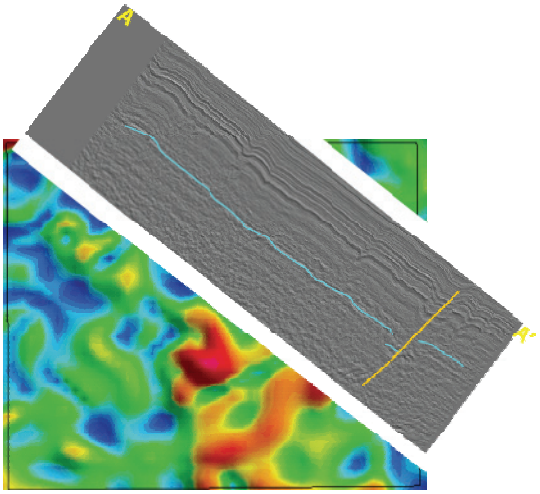


Figure 7) *Seismic section showing the correlation of feature seen on seismic data with lineament seen on HD_TDR derivative map.*

We attempted source type speculation with the Euler deconvolution technique. An irregular NE-SW trending magnetic source with segmented low-throw edge is suggested for the structure on the western part of the depth map (Figure 6). On the other hand, the triangular shaped clustering is suggested to be a massive body with low-contact edges similar to a pluton.

3D seismic attribute correlation with HRAM data, its derivative and Euler depth estimates

Seismic data and its attributes have revealed a NE-SW basement feature which is suggested to be the intra-sedimentary Mineral Wells fault. This NE-SW basement feature also correlates with linear NE-SW basement feature seen on the HD_TDR map (Figure 7). Other features seen on the HD_TDR that are not visible seismic attribute data reveals how helpful potential field data can be in mapping basement lineament. This mapping can be extended further to area where seismic data is currently unavailable. This can have implications to exploration within the basin.

Preliminary Results

The integrated results presented here reveal that a complex segmented basement underlies the study area of FWB. The fault and magnetic source pattern interpreted from the derivative maps and Euler depth maps highlight the structural grain of the area. Clearly, there is significant basement control on intra-sedimentary features, which has an impact on hydrocarbon exploration. Thus, the basement features can be mapped effectively with the aid of a HRAM and gravity data that is correlated with seismic data.

Acknowledgments

Thanks to Mike Ammerman and Devon Energy for providing us with the high-resolution aeromagnetic data and 3D seismic surveys used in this study.

2008 Enrichment Field Trip

M. Charles Gilbert, *Professor Emeritus*
ConocoPhillips School of Geology and Geophysics, University of Oklahoma

Saturday, May 10, 2008, at 7:30AM, OU vans pulled out of the Sarkeys Energy Center carrying 13 geologists and geologists-to-be. We were headed to the west to give some of our beginning G&G majors a special experience. The School wants to get its majors started off on their academic careers with a strong boost. It wants them to experience the fun and thrill of "doing geology" and of being able to see the concepts and ideas of their Physical Geology and Earth History courses come alive. So, since the early 1990's, and to continue even after he had retired, the School had prevailed upon Professor David Stearns to lead a one-week trip to some of the classic geologic sites in the western US---at least those sites accessible to us in a reasonable week's time. Other faculty, Tom Dewers and Charles Gilbert, had joined in to help. At different years, we had gone as far west as Las Vegas, NV, as far south as Big Bend National Park and to Chihuahua, Mexico, and as far north as Grand Junction, CO and Moab, UT. Some years we had concentrated mostly on sites in New Mexico. So until 2005, for at least 12 years, these trips had been run immediately after Spring semester finals. They were essentially a gift from the School to its new majors.

This year, after a 2-year hiatus, Director Doug Elmore decided to get them restarted and approached Stearns and me about running this sort of trip again. Well, surprisingly (or not) two old guys said yes. Fortunately, faculty member Barry Weaver also signed on this year, and more than that, will probably keep these trips going in the future. Former faculty member Dewers, who is now on the staff at Sandia National Laboratory, came out and participated with us when we were making our stops in Albuquerque.

This year we had 7 undergraduate majors, 2 graduate students, 1 staff (Gail Holloway), and 3 faculty: Stearns, Weaver, and myself. For several reasons, many of our new majors were not able to go this time around. Nevertheless, we plunged ahead. Stearns had mapped out an ambitious trip leaving on Saturday, May 10 and returning on Saturday, May 17. Our route included overnights at Santa Fe, NM; Durango and Grand Junction, CO; Moab, UT; Cortez, CO, Bernalillo and Tucumcari, NM. This allowed the students to see the Rio Grande Rift, Valles Caldera, San Juan Basin, San Juan Mountains, Uncompahgre Plateau at Colorado National Monument, Arches, Paradox Basin, and Mesa Verde. Mesozoic stratigraphy is beautifully displayed on this trip and we were able to follow some classic facies changes. Monoclines, ashflow tuffs, spatter cones, faults and fault-block mountains, and a host of other spectacular geologic features were seen, discussed and analyzed. Perhaps most importantly, geologic reasoning and thought processes were emphasized. How a professional geologist reads the history recorded in the rocks is the point of what we were doing. Having a week-long immersion in geology is a great stimulus for those just starting their geologic careers. The chance to bond early with one's classmates, while getting used to thinking "geologically", individually and as a team, is a wonderful opportunity.

We returned to the Sarkeys parking lot about 3PM on Saturday, May 17. From the comments the students made then and since, this trip, once again, was a success.

Most of the group at a stop as we crossed the San Juan Mountains in SW Colorado. From left to right: David Stearns, Rachel Barber (grad student), Gail Holloway (staff), and undergrads Brandon Guttery, Matt Kendall, Matt Miller, Justin Newman, Brittany Pritchett, Allison Stump, Cullen Hogan

ConocoPhillips 2008 Student Field seminar in the Laramide Rockies, WY

Supratik Sarkar, *ConocoPhillips School of Geology and Geophysics, The University of Oklahoma*

Ph.D. in Geology

ConocoPhillips organized a spectacular field trip from the 19-23rd of May in the Laramide Rockies, Wyoming. The title of the field trip was "Reservoirs and Structures of the Laramide Rockies Petroleum System." Nineteen geoscience students from the leading universities throughout the country attended this trip led by Peter Hennings, who heads the Reservoir Structure group at ConocoPhillips. Two of the students from CPSGG were invited - Seth Busetti and Supratik Sarkar.

The principle discussion themes of the field trip were evolution and structure of the Laramide Rockies, different geometries of compressional structures with relevance to the structural styles of the area, basement-involved structures and architecture of basement uplifts, characterization of fractured reservoirs and different petroleum systems of foreland basins. We also looked at fluvial, eolian and carbonate reservoirs at both undeformed and deformed stages.

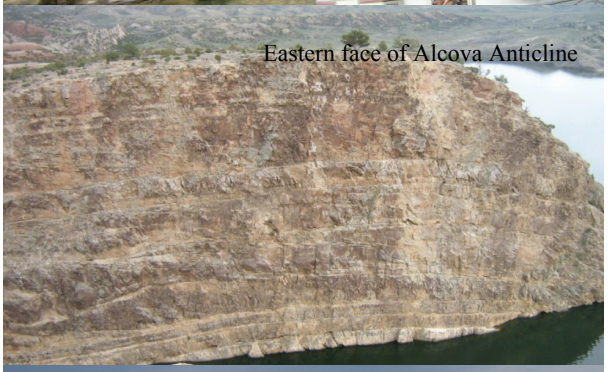
The trip started from Casper, Wyoming on the 19th of May with a comprehensive overview on the regional geology and introduction of the field trip. For the next three days we visited several outcrops at Oil Mountain Anticline, Casper Mountain, Alcova Reservoir, Wind River Basin, Owl Creek Mountains, Wind River Canyon, Western Bighorn Basin and there was a wholesome discussion on their stratigraphy and structural evolution along with the regional perspective. Interpreting seismic sections and regional cross sections of different structural settings of our area of interest was an integral part of this trip. We missed some outcrops at the last day of the field trip due to bad weather but instead, at the Buffalo Bill Historical Center in Cody; the students were hugely benefitted from the presentations by ConocoPhillips geologists regarding the structural geology of the area, fractured reservoirs and integrated reservoir modeling.

We sincerely thank Peter Hennings and Piers Cooke-Yarborough along with Thomas Neely, Tricia Allwardt and Kate Bower for the leadership and arrangements and giving us this great experience.

Reference: Field Guide Book

Photos courtesy of Piers Cooke-Yarborough, S. Sarkar

Alcova Reservoir



Eastern face of Alcova Anticline

Interpretation of data at a field stop

TWIN MOUNTAIN .....On the trail again!

The 2008 field camp students are dwarfed by the huge dipslopes of Fremont Dolomite looming on both sides of Twin Gulch. This was the beginning of the walk-through; later we divided the group into the "goats", who went to look at the base of the section; and the "sheep", who chased out the fault and watched it terminate into a fold.

Back to the Gap—Summer Field Camp 2008

By Neil Suneson

ConocoPhillips School of Geology and Geophysics

Oklahoma Geological Survey

OU geology seniors returned to "The Gap" again this year to measure, describe, and map 1.616 billion years worth of Colorado's Front Range geology. Former OU geology students will fondly remember tearing their pants on the Fremont Dolomite, trying to get a decent strike and dip in the Fountain Formation, measuring the Morrison, and looking for outcrops of Graneros Shale to map. This year Zac Cavner, Nathan Curtin, Greg Dean, Hannah Fay, Katie Gunderson, Jason Harms, Scott Kelley, Garrett Reasnor, Daniel Trumbo, Erich VonBargen, Garin Wente, and Katie Whitmarsh joined the usual large contingent of undergraduates from OSU, six students from the University of North Carolina – Chapel Hill, plus students from Arkansas Tech, TCU, TAMU - Corpus Christi, the University of Pittsburg, and the University of Vermont (!) at OSU's field camp near Cañon City. Clearly, the camp's reputation is extending farther and farther afield. The faculty this year included field camp director Jim Puckette (OSU), Neil Suneson (OU/OGS), Tom Stanley (OGS), George Bolling (CU – Colorado Springs), and for one week Randy Keller (OU/OGS Interim Director). We also had a strong group of TAs and assistants from OU – Quinn Floch had such a good time last year as a student that he asked to return this year to *really* work; and Jessica Pardo (her second year at camp) and Oswaldo Davogustto assisted with the geophysics week (Jessica's MS thesis is on the geophysics of the Wet Mountains region). In addition, Steve Holloway and Matt Cosett (Missouri State) attended for a few days to lay out survey lines and provide precise GPS coordinates. Annie Drewry and Tim Sickbert were the OSU TAs. All in all, an impressive faculty/TA crew to work with the 58 students at camp.

OU field camp alums would hardly recognize the old place. You may remember that shortly after the 2006 camp a flash flood in Eightmile Creek destroyed most of the buildings on the west side and several on the east side of the creek. A new women's/staff bathroom was ready in 2007, but this year the students were greeted by five new eight-person cabins (four rooms, two to a room) and a new men's bathroom. Many of the old cabins had been removed but apparently had been reconstructed near the caretaker's ranch. Some students (but none from OU) opted for staying in a couple of the old, still-standing, well-ventilated cabins (let's just call them "classic") with their detailed and highly descriptive missives authored by former students. At this point it's only appropriate to point out that most of the faculty and all the TAs stayed in old cabins, while Neil preferred to stay in his tent on the blessedly uninhabited west side of the creek.

The curriculum remains much the same as it was in 2007, with some notable exceptions. The camp ran from Monday, May 19 to Friday, June 20. Week one starts with an introductory field trip on the geology of the Cañon City area, including Gnat Hollow, Skyline Drive, and the Garden Park dinosaur fossil area. Skyline Drive is always a thrill and provides the students with a foretaste of Shelf

Road and the road up Blue Ridge. For many of the students, Tuesday was an introduction to field techniques (using a Brunton compass and Jacob's staff) **(Figure 1),** but for the OU students it was mostly a review of what they learned in Dr. Reches' field methods class. Wednesday was an introduction to mapping and orienteering at Red Canyon Park (and an introduction to the frustrations of wildly varying strikes and dips in the fluvial Fountain conglomerates). Thursday we went on a death march the length and breadth of the Grape Creek area but unfortunately did not get to the top of the Morrison hill at the southern end of the field area due to thunder. (In reality, there were only two claps of thunder and it never rained on us, but better to be safe, and we were late for dinner regardless.) Our first real field trip on Friday was up Shelf Road to the Cripple Creek – Victor gold mine where it snowed on us. Later, we went to the mostly old but partly new Molly Kathleen mine (where the group I was with sampled the chalcanthite encrusting the mine walls), and finally to eating in the town of Cripple Creek.

Week Two. Geophysics was moved up from week four this year but continued in the same area. As Randy told the students **(Figure 2),** their geophysics field work is real research and will help to determine whether the mafic intrusives in the Gem Park area represent an extension of the Southern Oklahoma Aulacogen. While half the students measured gravity and magnetics, the other half measured all the Paleozoic and most of the Mesozoic rocks they could find at Grape Creek **(Figure 3)** and then described facies changes in the Jurassic Ralston Creek Formation **(Figure 4).** This was a long week – six days – with a geophysics report, the Grape Creek measured section, and the Ralston Creek measured sections due at the end.

The third week started out with a field trip to the 1.1 billion-year-old Pikes Peak batholith. Despite the snow at the top, it was almost warm enough for short sleeves. After last year's adventure with the OU van Tom refused to drive it down the mountain, so a few daring OU students joined Neil for the trip down in a too-high-for-steep-mountain-roads low gear. Unlike last year we made it to the half-way station with good (i.e., non-smoking) brakes. After Pikes Peak, the camp visited Florissant Fossil Beds National Monument, discussed what happened there in the late Eocene, and looked some lahar deposits and the Wall Mountain welded tuff. On Tuesday the group made its annual pilgrimage to "Daddy's" critters trace fossil site in the Ordovician Harding Sandstone in the morning and spent the afternoon sketching an outcrop along Phantom Canyon Road. Wednesday saw our first day of real mapping at Grape Creek. Rain resulted in a chaotic Thursday and extended the mapping through Friday into Saturday (for many of the teams).

In the past we have spent very little time looking at or discussing the synorogenic sediments that filled the

Figure 1. *Garrett Reasnor and Rhonda Petry (Arkansas Tech) measuring the Pennsylvanian Fountain Formation. Rest assured, Garrett is not trying to measure the vertical beds by holding the Jacob's staff vertically.*

Figure 2*. The study hall was occupied with students drafting their Grape Creek measured sections, so the stone picnic table next to the fire ring became Randy's lecturn. Oswaldo (smiling – why?) is two people to Randy's right.*

Figure 3. *A well-deserved rest and photo-op at the top of the Glen Cairn Formation at Grape Creek. Left to right, Riter Berryman (OSU), Annie Drewry (OSU TA), Greg Dean (OU), Clayton Winkler (TCU), Zac Cavner (OU), Skuya Zephier (OSU), Cody Traywick (Ark. Tech), George Bolling (CU Faculty).*

Laramide basins throughout the Rocky Mountains. Part of the reason for this is that few (no) good field-trip guidebooks exist for that part of the section near Cañon City. On Monday, Dr. Ian Miller of the Denver Museum of Nature and Science graciously led us on a field trip starting at the top of Castle Rock (if you are driving along I-25 between Denver and Colorado Springs and have the time, a walk/climb to the top is well worth the effort) and ending at the KT boundary (West Bijou site) halfway between Denver and Limon. The KT boundary is less than impressive visually, but the dinosaur fossils below and plant fossils above were enough to excite even the most hardened of the students **(Figure 5).** Tuesday – the always fun project mapping the Precambrian pegmatites and isoclinally folded quartzites and schists along the road at Blue Ridge. Wednesday through Friday – the infamous Mixing Bowl. Saturday made this another six-day work week, with the annual trek to Leadville, including the National Mining Hall of Fame and Museum, the ever-popular rock shop downtown, the acid-mine drainage (pretty impressive what that water did to last year's aluminum can!), and collecting sulfide minerals on the old dumps.

And finally … TWIN MOUNTAIN. Yes, it's still there, and Nasty Knob is still unresolved and as controversial as ever. Monday was the walk-through on North Twin and Tuesday through Thursday was mapping, mapping, and more mapping. For the first time in several years, we had a mapping final exam in an effort to allow the students to individually "strut their stuff." No more teams – you're on your own to chase and map contacts. And in the evening, as a final goodbye, the students took a short multiple-choice (how easy can it get?) exam on the field trips. And then … home.

This year's program was better than last year's, and we continue to improve it. We eliminate some projects and field trips and add others, many due to students' suggestions. One of the real values of the OSU camp is our OU students getting to know and work with students from other universities and with diverse backgrounds. Also, the students are introduced to working in teams, sometimes with students whose work ethic differs from their own and something they will be doing throughout their professional careers.

Figure 4. *Erich VonBargen (why is he wearing an orange shirt?) carefully steps across a fault in an outcrop of the Jurassic Ralston Creek Formation below Skyline Drive. Lauren Keeling (OSU) takes notes on his style.*

Figure 5. *Garin Wente and Quinn Floch seem very pleased with the plant fossils that Garin collected just above the KT boundary. Katie Gunderson (over Garin's shoulder) carefully listens to the story the rocks are telling her.*

AND FINALLY .....some printable quotes from the campers:

"You tell us what your interpretation is, and we'll argue with you. Isn't that what geology is all about?"

"We have more descriptions than God!"

On measuring the Morrison Formation at Grape Creek:

"Why are those rocks so purple?"

Student answer: "Fossilized Barney"

Comment following Jim Puckette's suggestion to go laterally along a bed to find a better outcrop.....

"Will we find any rocks down there?"

On the KT boundary layer:

"It's just a dumb dark rock."

Student answer: "Yeah, the dumb dark rock of DEATH!"

2008 YEAR-IN-REVIEW

Social Events

EXCEEDING

Excellence

Convocation

Summer Camp

Field Trips

AWARDS

Student Recognition

Student Organizations

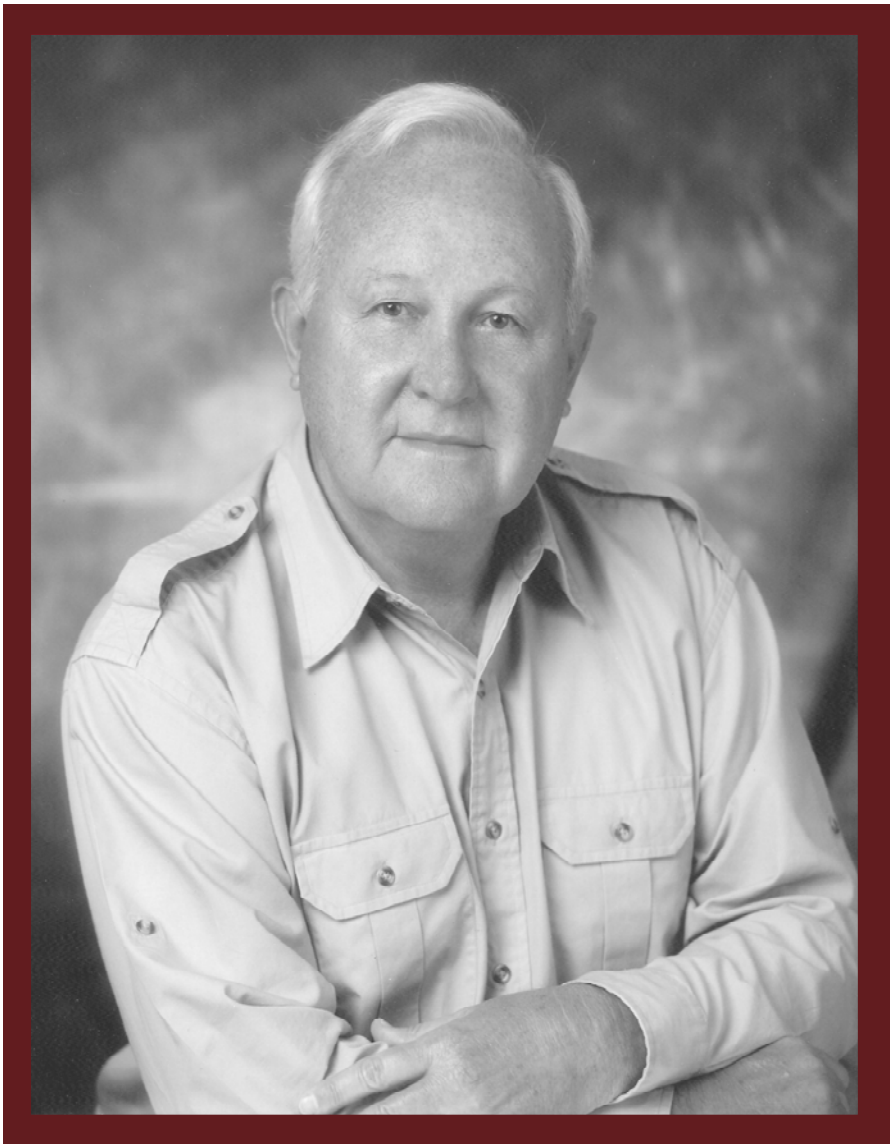
Student Expo

In recognition of his outstanding and long-time support of the University of Oklahoma and its programs in petroleum and geological engineering and his pioneering leadership in the field, which resulted in the creation of one of the most successful privately owned oil and gas producers in America, the newest college at OU has been named the Mewbourne College of Earth and Energy in honor of CURTIS MEWBOURNE of Tyler, Texas.

The announcement was made during a news conference November 2, 2007, on the OU Norman campus featuring remarks by OU President David L. Boren, College of Earth and Energy Dean Larry Grillot and Mewbourne, a 1958 OU petroleum engineering graduate who founded Mewbourne Oil Company in 1965. He continues to operate the company privately for the benefit of his employees and family.

When the College of Earth and Energy was formed on January 1, 2006, bringing together the School of Geology and Geophysics—later named the Conoco Phillips School of Geology and Geophysics—and the Mewbourne School of Petroleum and Geological Engineering, Mewbourne stepped up to be an alumni leader and generous supporter of the new college. In fall 2006, he made a gift to create two new endowed faculty positions in the newly formed college. And that November, he issued a challenge to alumni and supporters of the college to promote contributions to endowed undergraduate scholarships and graduate fellowships for students in petroleum engineering, geological engineering, geology and geophysics. He pledged to match all those gifts up to March 2008. Mewbourne Oil stands alone as the largest supporter of student scholarships and internships over the past 25 years.

In addition, the Oklahoma Trailblazer Award was presented to Mewbourne on November 2nd at a gala event held in the Molly Shi Ballroom on OU's campus. He was selected to receive this honor because of his professional achievements and lifetime commitment to the energy industry, especially for his support and mentoring of OU students.



College of Earth and Energy

Renamed in honor of

Curtis W. Mewbourne

2007 Oklahoma Trailblazer Award Recipient

State of the School

As presented to the Alumni Advisory Council, April 18, 2008 by Doug Elmore, Director

http://geology.ou.edu

Current Faculty Status:

- 11 Full-Time Tenured Faculty
- 2 Full-Time Tenure Track Assistant Professors
- 5 Tenured Faculty with Split Appointments
- 2 Ranked Renewable Term
- 1 Split Research Appointment

Vacancies

Structural Geology (Full Professor—offered to Z. Reches)

Others: One jr. level Geophysics faculty position—next year

FACULTY

Faculty taught 85 geology and geophysics courses in 2007. Courses included are:

- "Stratigraphy and Structural Geology"
- "Introduction to Petroleum Geology and Geophysics" for engineers
- "Petroleum Geology for Business Majors" taught by Stan Cunningham in Fall '07 and Spring '08

We also taught many general education courses for non-majors. Average teaching load for faculty was at least four courses/FTE per year, plus graduate student supervision.

This semester, we offered "Subsurface Methods" with the help of Oklahoma Geological Survey staff members Neil Suneson, Dan Boyd, and Rick Andrews.

We are also continuing to work to develop more cooperation with the Survey. There's a possible joint appointment for the new director and other staff. A search is under way for a new director.

STUDENT LIFE

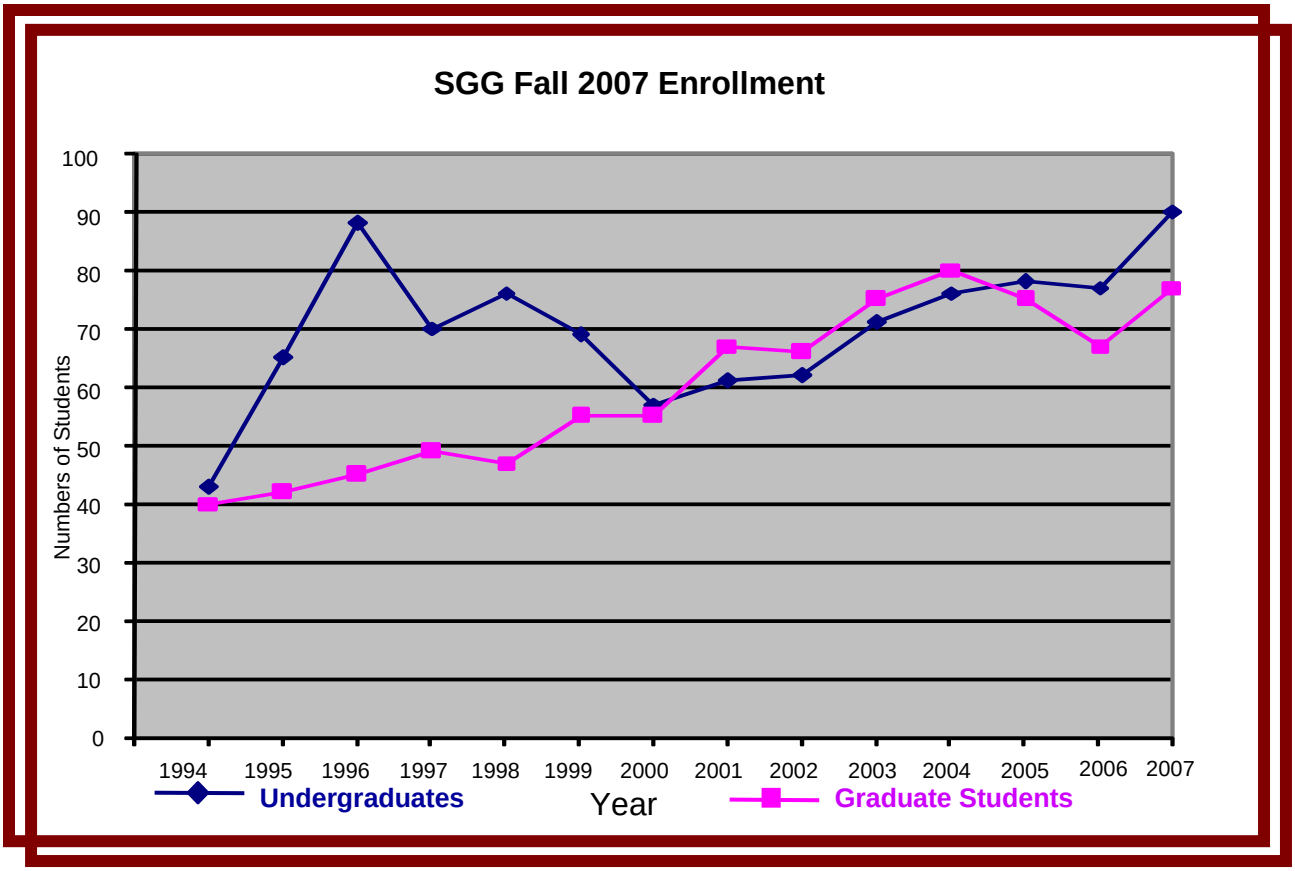
Student field trip experiences are important. Summer Field Camp 2008 was held again at the OSU locations in Canon City, Colorado. Attendees included 4 faculty members and 58 students, of which 12 were OU students. We are still hoping to acquire our own camp in the near future.

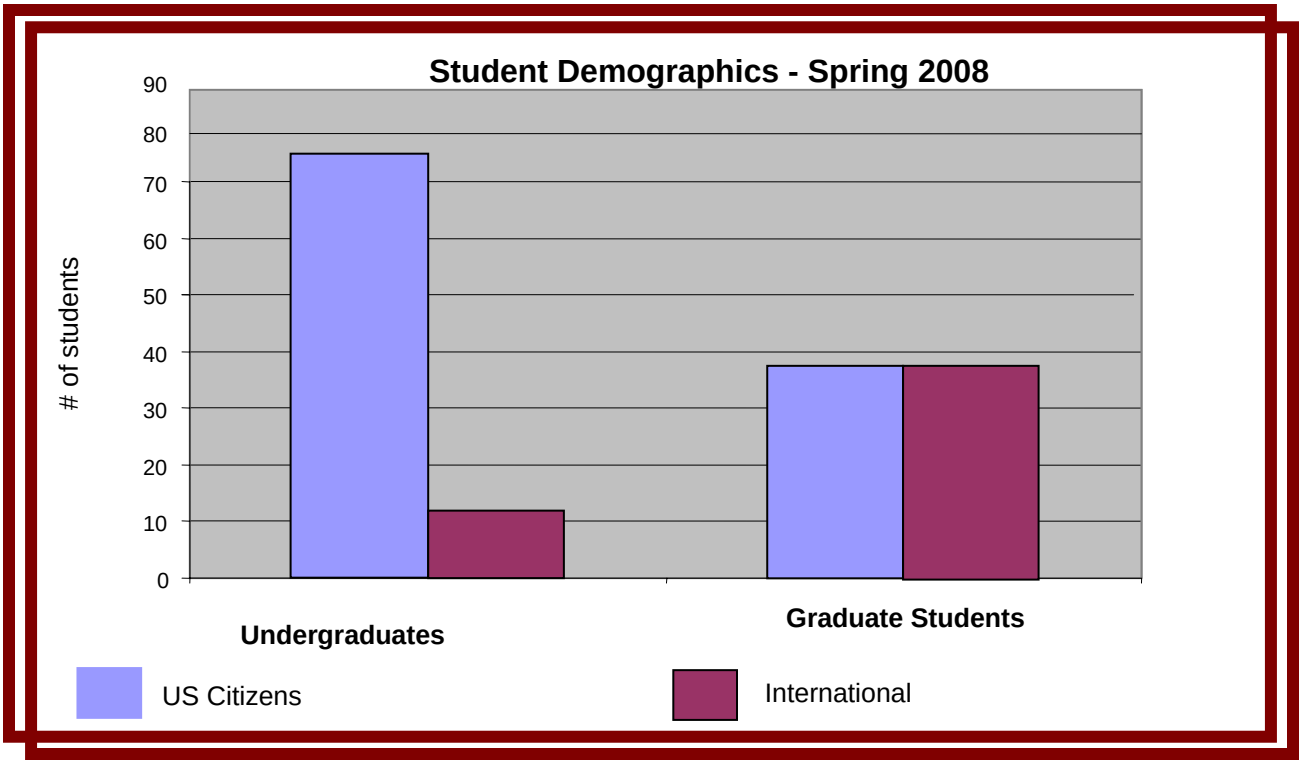
<u>Upgrades to school labs and equipment:</u>

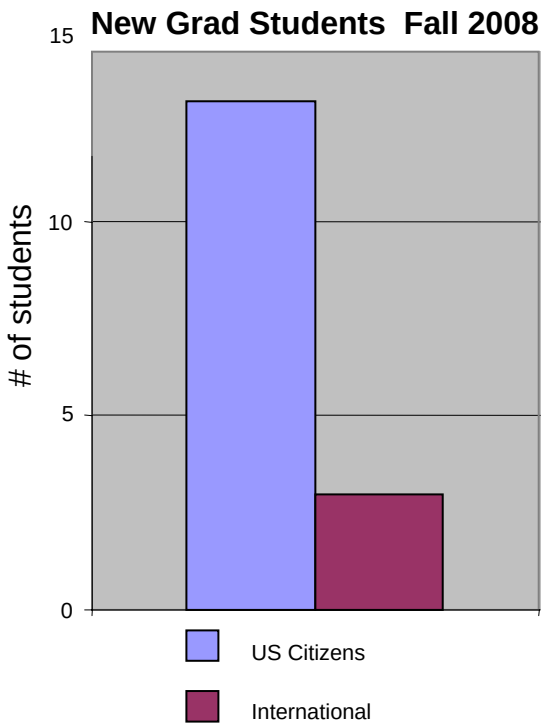
- Additional microscopes for mineralogy and petrology courses to address increased enrollments
- Teaching flume for Sedimentology courses
- Two new vans
- New Geophysics equipment—gravity meter for field camp and an upgrade to GPR

<u>Student Demographics:</u>

- Spring 2008—97 total undergraduate majors, up 10% from Fall 2007
- Spring 2008—supported 22 students with teaching assistantships


SGG Fall 2007 Enrollment
Numbers of Students
100
90
80
70
60
50
40
30
20
10
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
Undergraduates
Graduate Students


Student Demographics - Spring 2008
# of students
90
80
70
60
50
40
30
20
10
0
Undergraduates
Graduate Students
US Citizens
International



Successful Recruiting Season

New WEB site

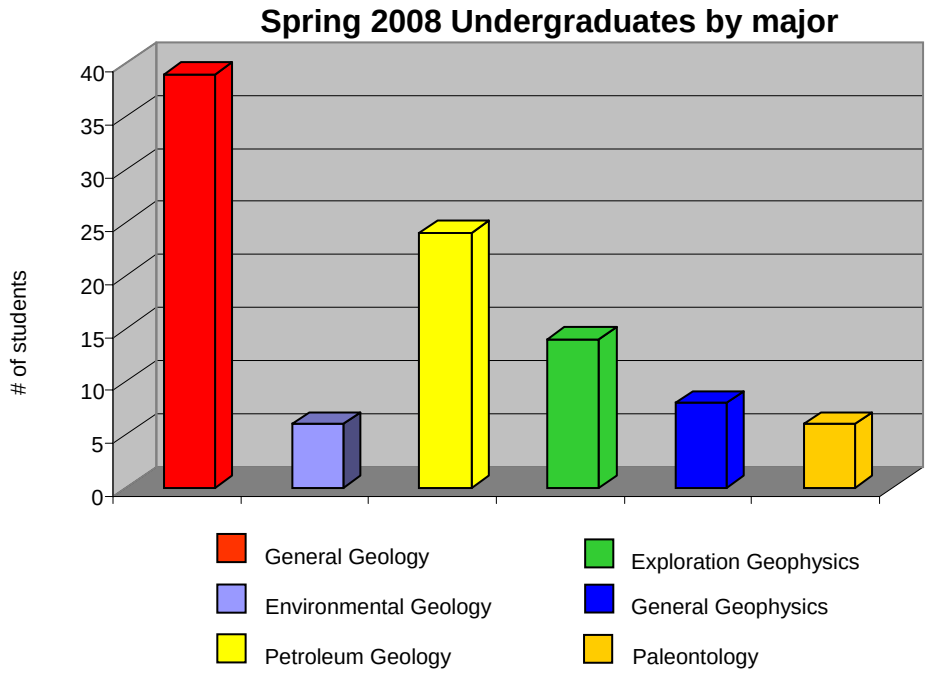
Recruiting booths at SEG, AAPG, GSA

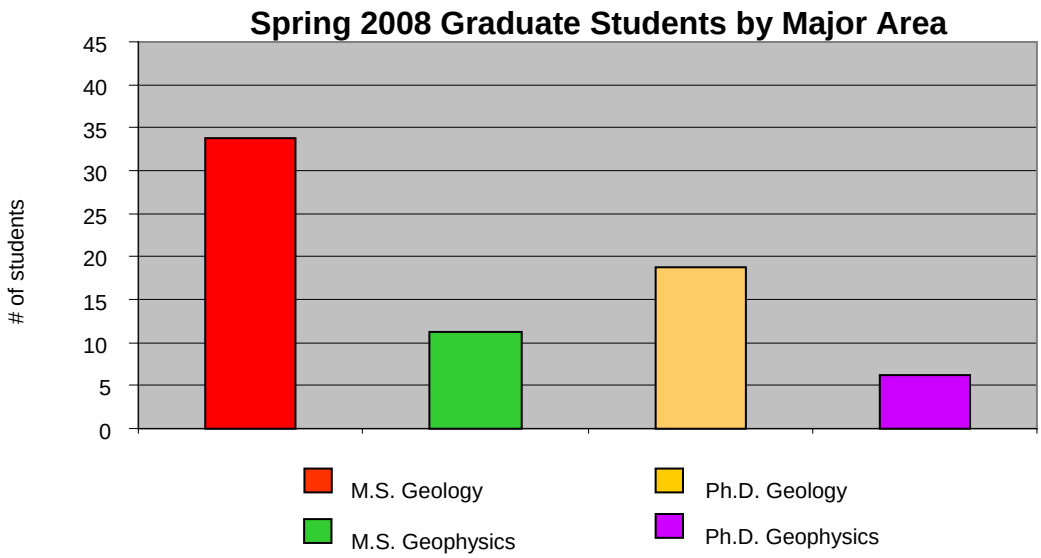
Faculty contact grad prospects

150% increase in applications

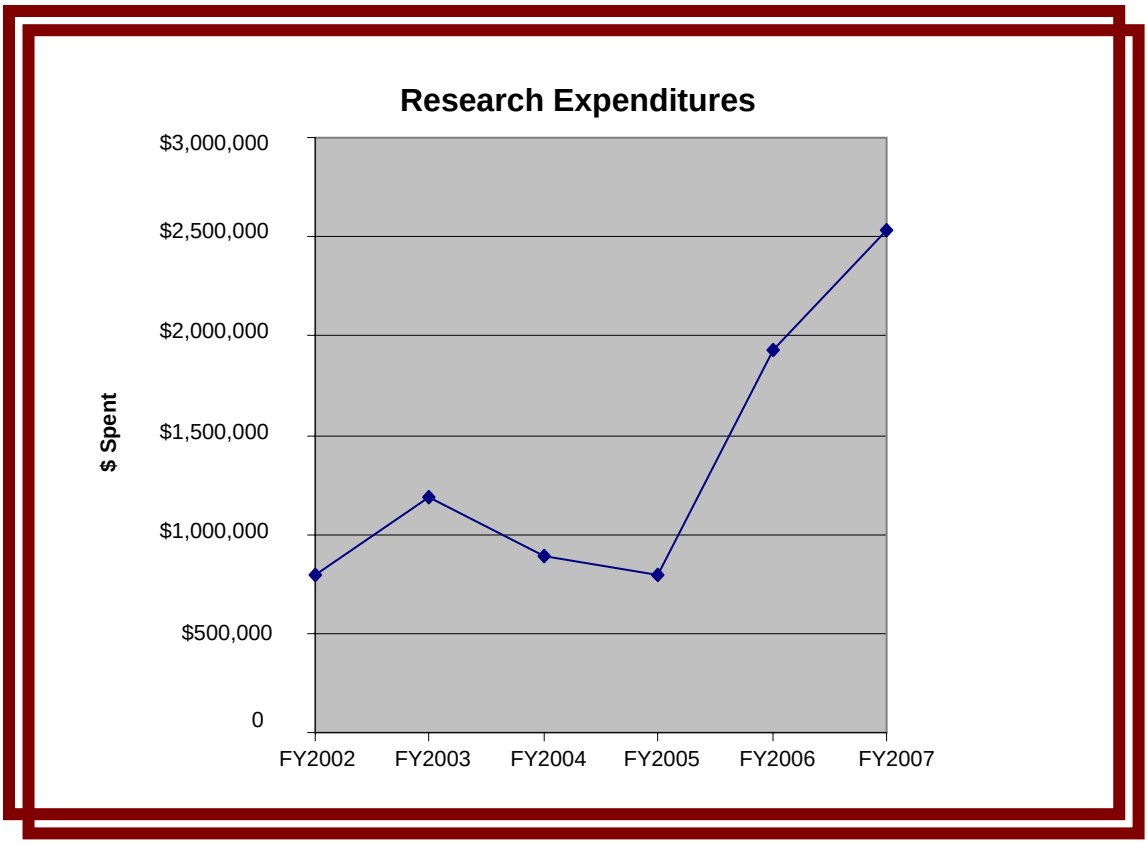
Significant quality increase

26 aid offers - 8 Enhanced offers





FINANCIAL INFORMATION



PROJECTS

- ***Attribute-Assisted Seismic Processing and Interpretation (Consortium) and Improving Geologic and Engineering Models of Midcontinent Fracture and Karst Modified Reservoirs Using 3-D Seismic Attributes (DOE)*** **(Marfurt)**

- ***Projects on the Barnett and Woodford funded by Devon*** **(Slatt, Philp)**

- **Natural Earthquake Laboratory in South African Mines (NELSAM) (Reches)**

- **GEON (the Geosciences Network)-NSF-funded collaborative project on need for 3-D and 4-D models of lithospheric structure (Keller)**

- **Dust as an archival agent in Late Paleozoic Pangea (L. Soreghan and M. Soreghan)**

- **Diversity in the Geosciences: Development of a Pipeline for Native American Students at OU (Joint project-CEE, CAGS, and A&S (Elmore PI)**

- **Poromechanics Consortiums (Abousleiman)**

- **Fourteen faculty have grants that contribute significantly to research expenditures.**

CONOCOPHILLIPS DONATION - $6 Million (Over Six Years)

2007 500K Visiting Chair in Petroleum Geology/Geophysics
500K Geology and Geophysics Graduate Fellowship

2008 500K Geology and Geophysics Undergraduate Scholars
500K Geology and Geophysics Graduate Fellowship

2009 500K Visiting Chair in Petroleum Geology/Geophysics
500K Geology and Geophysics Graduate Fellowship

2010 500K Geology and Geophysics Graduate Fellowship
250K Geology and Geophysics Undergraduate Scholarship
250K Renovation and Lab Upgrades

2011 500K Geology and Geophysics Graduate Fellowship
250K Geology and Geophysics Undergraduate Scholarship
250K Renovation and Lab Upgrades

2012 500K Renovation and Lab Upgrades
500K Lab Endowment

CPSGG 2008 CAMPAIGN STATUS

New Flume for Sedimentology

Total Donations = $ 8,322,682 (From MCEE report; does not include the $6 million from ConocoPhillips.)

Mr. Mewbourne match = $2,478,135

New Endowed Funds

William and Lillian Clopine Endowed Fellowship
Ben Hare Excellence in Geology and Geophysics Prize
Thomas Mairs Memorial Fund
Ben Hare Memorial Fund
T.D. and Marilyn Craighead Endowed Fund
Stanley L. Cunningham Endowed Teaching Award (reclassified to endowed)
Raymond Ben Shawn Endowed Scholarship for Marines
Bill K. and Doann Reed Fellowship Fund—Grad Fellowship
Sally Rahe Thomas Endowed Fund—Grad Fellowship
Al and Ann Basinger Endowed Fellowship Honoring Dr. Roger M. Slatt

New SCIF Lab

New Non-Endowed Funds

Paul and Natalie Buckthal Sedimentary Petrology Lab
ConocoPhillips Laboratory—Introductory Lab
Schlumberger donation of computers to the new SCIF Lab
Gene P. Morrell Memorial Fund
Philip Boyle Scholarship Fund
ConocoPhillips—$130,000
Chesapeake Energy Graduate Fellowship—$250,000 ($50,000/year for 5 years)
OERB Scholarships (undergraduate)—$35,000
Chevron—$30,000
BP—$32,000
Exxon—$6,000
Marathon Oil—$7,000
TOTAL USA Scholarship Fund—$3,000
Questar—$20,000
Shell Oil—$28,000

New East Atrium

Convocation May 2008

Spring 2007, Fall/Summer 2008

DOCTORATES AND MASTER'S DEGREES AWARDED

Subhotosh Banerjee, *Doctor of Philosophy in Geology*
Thesis title: "Structural Analysis of Basement-Involved Anticlines Along the Western Margin of the Bighorn Basin, WY"

Brooke Wilborn, *Doctor of Philosophy in Geology*
Thesis title: "Paleoecology and Stratigraphy of the Morrison and Cloverly Formations, Bighorn Basin, WY"

Dileep Kumar Tiwary, *Doctor of Philosophy in Geophysics*
Thesis title: "Mathematical Modeling and Ultrasonic Measurement of Shale Anisotropy and a Comparison of Upscaling Methods from Sonic to Seismic"

Kristen Marra, *Master of Science in Geology*
Thesis title: "The Late Cenozoic Geomorphic and Climatic Evolution of the Northeastern Colorado Plateau as Recorded by Plio-Pleistocene Sediment Fill in Unaweep Canyon, CO"

James Fargo Miller, *Master of Science in Geology*
Thesis title: " Analogue Modeling of Basement-Involved Compressive Structures"

William Jose Duran, *Master of Science in Geology*
Thesis title: "Outcrop-based Geologic Modeling of the Jackfork Group at the Baumgartner Quarry, Kirby, AR"

Non Prapasanobon, *Master of Science in Geology*
Thesis title: "3D Seismic Imaging of Fault Plane Geomorphology: Examples from Offshore Myanmar, Gulf of Thailand and Onshore Maracaibo Basin"

May, 2008

Convocation May 2008 ....*continued*

ACADEMIC DISTINCTION

The University is honored to recognize undergraduate students who excel academically. Their performance is recognized by the University and the College by graduating with Academic Distinction.

WD - With Distinction
WSD - With Special Distinction

HONORS DISTINCTION

This is the most prestigious undergraduate degree designation at the University. These students complete both the requirements within their chosen major and the requirements of the Honors College.

CL - Cum Laude (With Honors)
MCL - Magna Cum Laude (With High Honors)
SCL - Summa Cum Laude (With Highest Honors)

Outstanding Seniors Katie Gunderson, CPSGG and Bryce Ballard, MPGE

BACHELOR DEGREES AWARDED

Bachelor of Science in Geology

Zac Aaron Cavner
Nathan James Curtin
Gregory James Dean
Hannah Isabel Fay, *With Distinction*
John Robert Guess
Katie Gunderson, *Magna Cum Laude*
Jason Andrew Harms
Maxwell James Hollman
Michael Scott Kelley
Erich John Von Bargen
Garin Blaik Wente

Bachelor of Science in Geophysics

Rika Renee Burr, *Magna Cum Laude*
Juliana Katherine Gay, *With Special Distinction*
Jonathan Daniel Jarrett Green
Evan Matthew Hamilton, *With Distinction*
Nathan Andrew Johnson, *With Distinction*
Nicole McMahon, *With Special Distinction*
Victor David Pena
Justin Dale Simmons
Katelyn Whitmarsh, *With Special Distinction*

2008 CANDIDATES FOR DEGREES

Kajari Ghosh, *Doctor of Philosophy in Geology*
Jennifer Hargrave, *Doctor of Philosophy in Geology*
Sohini Sur, *Doctor of Philosophy in Geology*
Dustin Sweet, *Doctor of Philosophy in Geology*
Faiyaz Ali, *Master of Science in Geology*
Kelly Bischoff, *Master of Science in Geology*
Nicole Buckner, *Master of Science in Geology*
Angel Gonzalez Canro, *Master of Science in Geology*
Gustavo Diaz, *Master of Science in Geology*
John T. Hull, *Master of Science in Geology*
Breanne Kennedy, *Master of Science in Geophysics*
Francy "Natalia" Leon-Diaz, *Master of Science in Geology*
Veronica Liceras, *Master of Science in Geology*
Erin Miller, *Master of Science in Geology*
Victor Parra-Galvis, *Master of Science in Geology*
Kerry Paul, *Master of Science in Geology*
Roderick Perez, *Master of Science in Geology*
Romina Portas, *Master of Science in Geology*
Alice Stagner, *Master of Science in Geology*
Jarred Tarkington, *Master of Science in Geology*
Julieta Vallejo, *Master of Science in Geology*
Thomas Ward, *Master of Science in Geology*

CPSGG 2007—2008 SCHOOL EVENTS

Back-to-School Mixer

Thunderbird Lake, Clear Bay Cafe

September 7, 2007

To celebrate the beginning of a new year with students, faculty, and alumni

Fall Recruiting

Sarkeys Energy Center

September to November, 2007

To bring together oil company recruiters and job-seeking OU students for interviewing and networking opportunities: 27

Holiday Mixer

Sarkeys Energy Center

December 7, 2007

To celebrate the holiday season and to recognize the students, faculty, donors, alumni, and friends of CPSGG. There's always

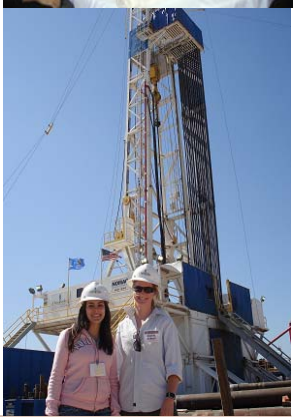
Spring Break Student Expo

Sarkeys Energy Center

March 13 through 15, 2008

To bring together oil company representatives and job-seeking students from all over the country for three days of networking and interviewing.

The 2008 Expo attracted 33 companies, 213 students from 52 universities, and 52 posters were entered in the scientific poster contest. The poster winners from OU were:
1st Place Geophysics—Jessica Pardo and Carlos Russian
3rd Place Geophysics—Carlos Russian and Jessica Pardo
1st Place Geology—Nabanita Gupta



The Expo was host to the 2nd Annual SEG Sooner Challenge Bowl and AAPG held the regional semi-finals for the Imperial Barrel Award competition. Also available for the students were 4 short courses, a field trip to the Wichita Mts., and a rig tour offered by Chesapeake Energy.

End-of-Year Picnic

Lions Park

May 3, 2008

To celebrate the end of the school year and to award students for outstanding and memorable accomplishments.

This year, the students formed two baseball teams and competed for bragging rights and Starbucks gift cards. The OU All Stars, led by Roderick Perez, pulled off a narrow victory over Carlos Russian's SGG Hall of Fame team.

Other sources of entertainment were volleyball, horseshoes, and a giant twister game.

CPSGG AWARDS AND RECOGNITION 2008

AAPG Imperial Barrel Award

OU's Barrel team won first place at the National Convention in San Antonio in April, 2008. Left to right: Roderick Perez, Elizabeth Baruch, Carlos Santacruz, Romina Portas, and Carlos Russian. The first place prize was $20,000 awarded to the School of Geology and Geophysics. Advisors for the team were Dr. Roger Slatt, Dr. Kurt Marfurt, Dr. Roger Young, and Dean Larry Grillot.

Norman Lions Club selected **Carlos Santacruz** of Colombia as International Student of the Month for March, 2008. He was the club's principal speaker at their meeting April 1st.

SEG Sooner Challenge Bowl

The OU team, **Inyene Awakessien** and **Matt Hamilton,** won 2nd place in the SEG Sooner Challenge Bowl, which was held in conjunction with the Spring Break Student Expo in March, 2008. They are pictured here with Peter Duncan, the MC from SEG (photo on the left). Inyene and Matt won the local student chapter Challenge Bowl preliminary to earn the honor to represent OU in the regional runoff.

Picnic Award Ceremony

At the End-of-Year Picnic Award Ceremony, the following students received recognition: (Not pictured is Nichole McMahon—David Stearns Award for Outstanding Geology Student.)

Rika Burr—Alan Witten Award for Outstanding Student in Geophysics

Kristen Marra—Stanley Cunningham Award for Excellence in Teaching

Juliana Gay—Estwing Hammer Award for Outstanding Senior

Matt Hamilton—Outstanding Senior Award

Katie Gunderson—Charles N. Gould Award for Outstanding Senior

Vincent Heesakkers—Student's Rock Award for Outstanding Volunteerism and Stewardship

Nancy Leonard—Jennifer L. Wise Award for Good Stewardship

Benjamin Drenth—Ben Hare Excellence in Geology and Geophysics

Nichole Buckner received the Robert D. Cowdery Award for Best Student Paper at the AAPG Mid-Continent Section meeting in Wichita. This came with a $5,000 cash prize.

Dr. Kurt Marfurt received an award for SEG's Best Poster Paper Presented at the annual meeting for 2007.

Matthew Zechmeister received the Alan Cox Award from the Geological Society of America in honor of a research proposal submitted.

CPSGG AWARDS AND RECOGNITION 2008

Francy "Natalia" Leon Diaz *(left)* was named as an "Outstanding International Student" and will appear in OU publications, on the OU home Web page and on the go2.ou.edu Web site. Natalia is a master's degree candidate in Geology from Colombia, South America.

Katie Gunderson *(right)* has been named a Gates Cambridge Scholar for 2008 — the first OU student to win this prestigious scholarship. Katie plans to pursue a doctoral degree in earth sciences and study nuclear waste products and atomic processes at Cambridge University in England. Last year, Katie was the first OU student to ever win both the Goldwater and Udall scholarships and one of only three nationwide. The Udall recognizes undergraduates who demonstrate a commitment to careers related to the environment, to Native American public policy, or health care. The Barry M. Goldwater Scholarship and Excellence in Education Foundation recognizes undergraduates who intend to pursue careers in science, math, or engineering.

Prerna Singh was selected by the Tulsa Geological Society as their 2008 TGS Student of the Year. This award came with two $500 checks, one for Prerna and one for the School. **Prerna** also was the recipient of the Thomas A. Hendricks Memorial Grant from the AAPG Grants-in-Aid Program. This Grant is awarded to a deserving graduate student for study of the Ouachitas, the Arkoma Basin, and/or the Marathon/Solitario areas.

Prof. David London presents undergraduate **Christopher D. Althoff** with a certificate of recognition as an Outstanding Student of Mineralogy by the American Mineralogist, the publication group of the Mineralogical Society of America. Among other rewards, Chris' name will be inscribed on a recognition plaque that hangs at the front of the mineralogy teaching lab at OU.

Other AAPG Grants-in-Aid Program Recipients

Matthew Zechmeister was selected for the R. E. McAdams Memorial Grant, which is awarded annually to a deserving graduate student through the American Association of Petroleum Geologists Grants-in-Aid Program and is endowed by the AAPG Foundation through generous contributions from friends and colleagues.

Gustavo Diaz was selected for the Garth W. Caylor Memorial Grant, which is awarded annually to a deserving graduate student through the American Association of Petroleum Geologists Grants-in-Aid Program. Funding for the Grant endowment came from a bequest that Mr. Caylor left to the AAPG Foundation.

Spring Break Student Expo Poster Winners

Jessica Pardo and **Carlos Russian** with Judge Dave Campbell. The pair won 1st and 3rd places in the Geophysics category.

Nabanita Gupta's poster took home 1st place in the Geology category, pictured here with Judge Dave Campbell.

On May 31st in El Reno, Roger Young participated in the Rt. 66 Sprint Triathlon. He not only completed the 500 meter lake swim, the 20 km (13 mi) bike ride and 5 km (3.1mi) run in 1:56:31, but he also left several other (younger) contestants in his dust. What a fantastic accomplishment!

Kudos to Professor Roger "Ray" Young

BARREL AWARD

Carlos Russian, MSc. Candidate
ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

For a second year in a row, the ConocoPhillips School of Geology and Geophysics formed a team of five M.S candidates: Romina Portas, Roderick Perez, Elizabeth Baruch, Carlos Santacruz, and Carlos Russian to participate in the challenging "Imperial Barrel Award" (IBA) competition organized by the AAPG. From its inaugural year in 2007, the competition has grown rapidly and has raised the attention of universities all around the world making it a world-wide known competition. This year 34 universities participated representing a variety of countries including: United States, Austria, Canada, Nigeria, Indonesia, England, Scotland, Russia, and France. It was our goal as a team representing the University of Oklahoma for the second year in such competition to keep up the excellent work presented by the previous 2007 OU Imperial Barrel Award team which obtained the 3rd place Stoneley Medal.

The dataset used was from South Australia (Cooper and Eromanga Basins) consisting of only three wells and three 3D seismic volumes. In addition to the complexity of the project we did a rigorous quality control on the data and encountered mismatches and errors that were immediately corrected to pursue the competition's goal: "to derive new possible prospect locations and future exploration areas." During a one-month period, the 2008 OU team prepared an integration of sequence stratigraphy, basin modeling, petrophysics, seismic interpretation, seismic attributes, volumetric calculation and risk analysis that resulted in a series of well proposals that included not only low-risk prospects but also high-risk prospects in our portfolio presented to a panel of industry experts.

This year the IBA competition was held in San Antonio, Texas during AAPG's Annual Meeting, where 12 teams competed in the semi-final round and only 6 teams advanced to the finals: West Virginia University, Imperial College London, University of Oklahoma, University of Louisiana, Lafayette, Texas Christian University, and University of Alberta. The 2008 OU Barrel team under the advice of Dr. Roger Slatt led the list of winners by obtaining **1st Place**.

We proudly represented The University of Oklahoma; but in particular, the School of Geology and Geophysics' students, faculty and staff that supported us from the very beginning of the competition. On behalf of the team, I would like to acknowledge Dr. Kurt Marfurt, Dr. Roger Young, Dr. Larry Grillot, and Dr. Tim Kwiatkaowski of OU, as well as John Hooper, Mike Burnett, Jan Dodson, Eva Peza, and Henry Pettingill for their invaluable advice and support. It was a lot of time and hard work that resulted in obtaining 1st Place in the Annual Imperial Barrel Award competition. The prize was a well deserved $20,000 check that will go into the coffers of the AAPG and SEG Student Chapters in support of all their activities. GO SOONERS!!

From left to right: Romina Portas, Carlos Russian, Dr. Roger Slatt (faculty advisor), Elizabeth Baruch, Roderick Perez, and Carlos Santacruz

(Photograph provided by Bob Taylor, OU photographer)

As Advisor Dr. Slatt said, "The team was absolutely flawless in their science, application, and presentation, which included a statistical analysis and ranking of seven drilling prospects they developed on the basis of sound geologic concepts".

Left to right: Roderick Perez, Elizabeth Baruch, Carlos Russian, Roger Slatt, Romina Portas, and Carlos Santacruz

OU's ConocoPhillips School of Geology and Geophysics Students Win International Competition

NORMAN, OKLA. – A University of Oklahoma student team from the Mewbourne College of Earth and Energy won first place in the international Imperial Barrel Competition sponsored by the American Association of Petroleum Geologists.

The team from OU's ConocoPhillips School of Geology and Geophysics – composed of Elizabeth Baruch, Roderick Perez, Romina Portas, Carlos Russian and Carlos Santacruz, all first-year master's students – competed against 34 university teams representing the United States, Austria, Canada, France, Russia, Scotland, England, Indonesia and Nigeria to win the first-place honor and a $20,000 award designated for student support.

The program was initiated to encourage students from universities worldwide to compete in a petroleum exploration program similar to that which they will experience when working in a petroleum company. Participating teams were provided with a complete data set from an area (Australia's Cooper and Eromonga basins, in OU's case), including seismic and well logs. Within a six- to eight-week period, the teams are required to analyze the data, develop a portfolio of exploration drilling prospects and present their findings in a formal presentation judged by industry exploration experts.

"The team was absolutely flawless in their science, application and presentation, which included a statistical analysis and ranking of seven drilling prospects they developed on the basis of sound geologic principles," said the team's adviser, Roger Slatt, OU professor of geology and geophysics and holder of the Lew and Myra Ward Chair.

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Article written by Roger M. Slatt, Ward Chair Professor and Director, Institute of Reservoir Characterization

PICK AND HAMMER STUDENT CHAPTER

ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

2007—2008 OFFICERS

Matt Hamilton, President
Brian Harms, Vice President
Paul Bowen, Secretary
Dr. David London, Faculty Advisor

Year-End Report

The Pick and Hammer Club was one of the first student organizations at the University of Oklahoma and continues to be the oldest geosciences club on campus, having just celebrated its 105th anniversary. Our goal is to encourage students to become more involved in all aspects of geology and to enable students and faculty to become better acquainted with one another in a fun and open environment. The club is open to anyone with an interest in geology. **Membership is free.**

Despite hosting a bonfire at Lake Thunderbird in October and several faculty luncheons throughout the year, student participation was lacking compared to previous years. However, we ended '07-08 with a large gathering at New York Pizza, and over 60 people from the department showed up. We hope this is a sign of a better year in '08-09.

In an effort to renew interest in the club and in geology in general, the Pick and Hammer Club is planning a variety of events throughout the 2008-2009 school year. Starting at the beginning of the fall semester, we will host an ice cream social to help introduce new students to the department and to help current students become better acquainted with faculty and staff. In addition, the club will be offering mentoring for new geology and geophysics majors throughout the year.

105th Anniversary Picture of the Pick and Hammer Club

Several fossil collecting trips are also in the works and will be headed by paleontologists in the department. The club will continue its tradition of going to Lake Thunderbird in the fall and will also continue to sponsor faculty luncheons throughout the year. Finally, the club will host an alumni mineral auction to raise funds to support even more activities.

If you would like to become a member of the Pick and Hammer Club, feel free to come to our meetings, which will be held after Thursday colloquia and announced via email. Also, feel free to contact us at oupickandhammer@gmail.com.

Report prepared by: Paul Bowen
Brian Harms
Matt Hamilton

Photo courtesy of Brian Harms

AWG STUDENT CHAPTER

ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

2008—2009 OFFICERS

Rika Burr, President
Stacey Evans, Vice President
Sara Fadaiepour, Secretary
Alisan Templet, Treasurer
Dr. Megan Elwood Madden, Faculty Advisor

Year-End Report

Prepared by Megan Elwood Madden

AWG members visited Crater of Diamonds State Park in Arkansas in May, 2008, and sluiced for diamonds. While diamonds may be a girl's best friend, the group discovered they are definitely hard to find!

The Sooner Chapter of the Association for Women Geoscientists was reinvigorated in 2008 with field trips and a visit from an AWG Distinguished Lecturer. Members of the Sooner Chapter of the Association for Women Geoscientists (AWG) recently organized two field trips and hosted Marjorie Chan, an AWG Distinguished Lecturer and Chair of the Department of Geology and Geophysics at the University of Utah.

The Sooner Chapter is a student-driven organization that supports AWG's overarching goals to enhance the quality and level of participation of women in the geosciences and introduce young women to geosciences careers. The group is diverse, composed of men and women interested in supporting women in the Geosciences (Geology, Geophysics, Petroleum Engineering, Meteorology, and Geography) and all levels of the university from undergraduates to faculty and staff.

At the conclusion of the spring semester 2008, AWG headed out for a road trip to Crater of Diamonds State Park in Arkansas. The group explored the park, then got out their shovels and sieves and started digging through the regolith of the weathered kimberlite in search of diamonds. After several hours of hunting, the "mother lode" remained elusive.

In September, AWG again ventured into the field, accompanied by Stan Paxton and Carol Becker (USGS-OKC office), Neil Suneson and Julie Chan (OGS), and AWG Distinguished Lecturer Marjorie Chan. Instead of diamonds, they were in search of "blueberries"— spherical iron-rich concretions similar to those observed by the Opportunity Rover at Meridiani Planum, Mars. Dr. Chan has been studying the formation of iron concretions in the Navajo Sandstone for more than 15 years and uses her expertise to propose diagenetic pathways for the formation of the "blueberry" concretions on Mars. Stan Paxton led the group to three outcrops in NW Oklahoma City and near Lake Arcadia where iron mobility is evident in the distinct yellow, red, and orange staining of the Garber Sandstone, as well as iron concretions, sheets, and pipes similar to those observed in Utah and on Mars.

In addition to visiting the local outcrops of red rocks, Dr. Chan led a discussion on the current climate for women in the geosciences with undergraduate and graduate students and presented the weekly CPSGG seminar on "Red Rocks and Blueberries on Earth and Mars".

The Chapter continues to plan activities that encourage women to begin and continue a career in the Geosciences. In the next year, they look forward to meeting with more female colloquium speakers, planning social and field trip outings, and volunteering in the community.

(Top) Julie Chan (OGS) and Marjorie Chan, (DL Lecturer) examine a Garber Sandstone outcrop with students Stacey Evans and Rika Burr; and (bottom) Marjorie Chan discusses concretions with Neil Suneson (OGS) and student Stacey Evans.

SEG STUDENT CHAPTER

ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

2007—2008 OFFICERS

Xavier Refunjol, President
Victor Pena, Vice President
Julieta Vallejo, Secretary
Romina Portas, Treasurer
Dr. Roger Young, Faculty Advisor

Year-End Report

Prepared by Xavier Refunjol

The academic year 2007-2008 was another great success for the University of Oklahoma's Society of Exploration Geophysicists Student Chapter. In this year's agenda, successful annual events and brand new activities maintained the long tradition of educating members and integrating them with the energy industry.

Once again, the University of Oklahoma's diverse and driven students left a footprint in the **77th SEG Annual Meeting in San Antonio**. Students seized the opportunity to attend short courses, technical talks, the student reception, and network with industry recruiters, fellow students, and spread the good name of our school. In the Challenge Bowl Competition our Student Chapter was represented by PhD students Prerna Singh and Dileep Tiwary, who obtained second place and brought back a generous check.

In mid-October, the SEG Student Chapter, along with the AAPG Student Chapter, represented the College of Earth and Energy marching in the **OU Homecoming Parade**. Wearing our CEE t-shirts and (gently) throwing candy at the crowd, we proudly marched in front of Dean Grillot's car carrying the CEE banner. Members also shared some time together outside the classrooms during the chapter's **Movie Night Series** featuring Jules Verne's Journey to the Center of the Earth. This now annual activity lured students with the promise of collectively poking fun at hilarious 1950's Hollywood interpretations of the Earth's interior. In an attempt to show our infinite gratitude to all the College of Earth and Energy's Faculty and Staff members for the great support and guidance, the SEG Chapter held its **Annual Christmas Banquet**. Over 25 people attended and shared a meal among friends before the hectic finals week.

The SEG and AAPG Student Chapters united forces once again for the annual **AAPG/SEG Spring Break Student Expo**. Students prepared and presented posters, attended courses, and interviewed with companies from the 13th to the 15th of March, proving that Spring Break can also be celebrated in suit and tie on campus. Graduate students Jessica Pardo and Carlos Russian won first and second place in the Geophysics portion of the poster contest.

Also during the AAPG/SEG Spring Break Student Expo former SEG President Peter Duncan held the second **Sooner SEG Challenge Bowl**. Participants were challenged to prove their breadth and depth of knowledge in the field of geoscience competing with their peers in fast question/answer rounds. If ego-boosting competition with fellow colleagues was not enticing enough, the winning team would win an expenses-paid trip to the upcoming Annual Meeting in Las Vegas. In order to better prepare our participants, the first **Challenge Bowl Selection Rounds** were held in a similar format as the Challenge Bowl. To make things interesting, faculty members donated a great portion of the questions. We thank Dr. Roger Young, Dr. Kurt

SEG Annual Meeting 2007 Booth: Roderick Perez, Victor Pena, Roger Slatt, Niki Chapin, Jessica Pardo, Prerna Singh, Bumni Elebiju, Mai Thanh Ha, Carlos Russian

SEG Meeting - Chapter members enjoying a night on the town in San Antonio

Marfurt, and Dr. Roger Slatt for the great questions. This was a great opportunity for members to get to know each other and share free food and refreshments. Gift cards and checks for $50, $25, and $15 were given as prizes for first, second, and third places to Inyene Awakessien, Matt Hamilton, and Carlos Russian respectively. Nevertheless, we are very convinced students participated out of their sheer passion and excitement for geoscience. During the following Sooner SEG Challenge Bowl, our Awakessien-Hamilton team finished in second place.

TOP: *Challenge Bowl Selection Rounds—Students prepare to buzz in their answers. BOTTOM: (left to right—president, Xavier Refunjol; Selection Round winners Matt Hamilton, Inyene Awakessien, Roderick Perez, and Carlos Russian.*

The **Seismic Acquisition Field Trip** is a great activity that was lost a few years back. Thanks to the great people at Dawson and Chesapeake, the chapter was able to make this happen once again. In the vicinity of Ardmore, Oklahoma, over 20 students were given a presentation on the what, why, and where of a 3D seismic survey. Lunch, safety vests, glasses, and hard hats were provided. In the field everyone had the opportunity to observe and go inside an operating vibroseis truck, a receiver truck, an airboat, a helicopter for geophone drop-off, and witness the drilling and detonation of dynamite sources. The chapter would like to thank Russell Lyons of Chesapeake and everyone involved for their dedication. Mr. Lyons himself said that this was "one of the most detailed and interactive field trips of the past five or six years with the University of Oklahoma."

Seismic Field Trip *- (top) Dr Young and Victor Pena look at a map of the acquisition area; (bottom) Maxwell Okure in an airboat.*

The Chapter also continued to attend the monthly Geophysical Society of Oklahoma City meetings, where distinguished members of the industry and academia, like Distinguished Lecturer Biondo Biondi, discussed topics such as refraction statics, depth migration, and amplitude and phase in processing and inversion. The chapter would like to thank Star Geophysics for taking care of our member's GSOC membership fee and giving our students the opportunity to be up to date on the industry's current developments and dine with some of its most accomplished members. The SEG Student Chapter worked alongside other student organizations as a bridge between the College of Earth and Energy and its students through the Dean's Advisory Council. This brainchild of Dean Larry Grillot consists of a monthly interaction between a panel of student organization leaders and himself, aiming to listen to concerns and needs of the student body.

The Chapter would like to acknowledge all the faculty and staff that helped make such a successful year for the student chapter. We would like to thank Dr. Roger Young, our Faculty Advisor for all his advice and constant assistance; Niki Chapin, our Staff Advisor for always helping us in any situation imaginable, Dean Larry Grillot and Director Dr. Doug Elmore for the support provided with all our events; Jenny Cole and Candice Chinsethagid at SEG for all their help from headquarters. We would also like to thank our sponsors, Paradigm and CGGVeritas for the Student Membership Corporate Sponsorship Program that allows our student memberships to be free of cost; BP, Devon, ConocoPhillips, UOSA and the College of Earth and Energy, for their fund allocations and generous donations without which our activities would be severely limited. Without a doubt we would like to thank each member. The Chapter is its members, and without them and their hard work, nothing would be achieved.

AAPG STUDENT CHAPTER

ConocoPhillips School of Geology and Geophysics
The University of Oklahoma

2007—2008 OFFICERS

Gustavo Diaz, President
Prerna Singh, Vice President
Gloria Romero, Secretary
Diana Parada, Treasurer
Dr. John Pigott, Faculty Advisor

Year-End Report

Prepared by Prerna Singh

The American Association of Petroleum Geologists (AAPG) Student Chapter is a registered student organization at the University of Oklahoma. The Chapter is strong with about 75 members and also one of the largest student registered clubs of ConocoPhillips School of Geology and Geophysics. Our purpose is to encourage students to explore and expand their interest in Geoscience, to provide a platform for interested members to explore about enhancing their skills for a professional career in the oil industry and to promote interaction among the members of the geosciences community at OU. The Chapter is managed and chaired by the elected officers including the president, vice president, treasurer and secretary. They are backed by the constant guidance of the Student Chapter faculty advisor.

This year, the Chapter officer's hard work paid off as we were successful in drawing the interest of new students towards AAPG membership, thus expanding the chapter from about 50 member student body to a whopping 75 member student body chapter. Creating awareness amongst the students about the purpose of this organization and the immense benefits of AAPG membership were the key to achieving this overwhelming size of the chapter.

AAPG Chapter table at Mewbourne College of Earth and Energy BBQ lunch event set up to promote the Student Chapter. Students signing up for membership includes not only Geology and Geophysics students but also Petroleum Engineering students.

The officers make every effort to promote participation among the members towards the various events organized by AAPG on national level including the annual convention, regional meetings and other educational programs.

Academic year 2007—2008 was an eventful one for the AAPG Student Chapter. It actively organized events throughout the year. To name a few:

Interviewing: Playing the game and winning – an in-house event was organized early in the Fall prior to the recruitment weeks wherein students attend the talk "Interviewing: Playing the Game and Winning" given by OU-AAPG Student Chapter Faulty Advisor, Dr. John Pigott and enjoy a lunch and learn kind of event.

The Geology of the Wines of Gondwanaland – an event organized every year, by the chapter, was a short seminar wherein OU-AAPG Student Chapter Faulty Advisor, Dr. John Pigott talked on a holistic approach to enjoying wine through the perspective of a geoscientist. At this event, we featured and tasted wines from the former Gondwana terrains including wines from Chile, Argentina, Brazil, New Zealand, Australia, South Africa.

Risk Analysis for Exploration Evaluation Course - This course was taught by Henry S. Pettingill, Director of Exploration Portfolio at **Noble Energy** on February 29th to March 1st. This course had an attendance of 25 students. The very practical and interactive course focused on risk and uncertainty analysis applied to the exploration of oil and gas.

Miscellaneous: Chapter members actively volunteered in making the *AAPG/SEG Spring Break Student Expo* at Norman a success and worked closely with Niki Chapin, co-ordinator of the Expo. The chapter president, Gustavo Diaz worked diligently to arrange and add to the list of short courses at Expo. With his help, two new short courses: "**3D Seismic Stratigraphy and Seismic Geomorphology – Predicting Lithologies Ahead of the Drill Bit 21st Century Style"** by Henry Posamentier and **"Carbonate Stratigraphy in Petroleum Exploration and Field Development"** by Jean Hsieh and Gareth Jones were organized this year, all this thanks to **Chevron**. Both the courses were heavily attended by students from several universities and employees from several companies.

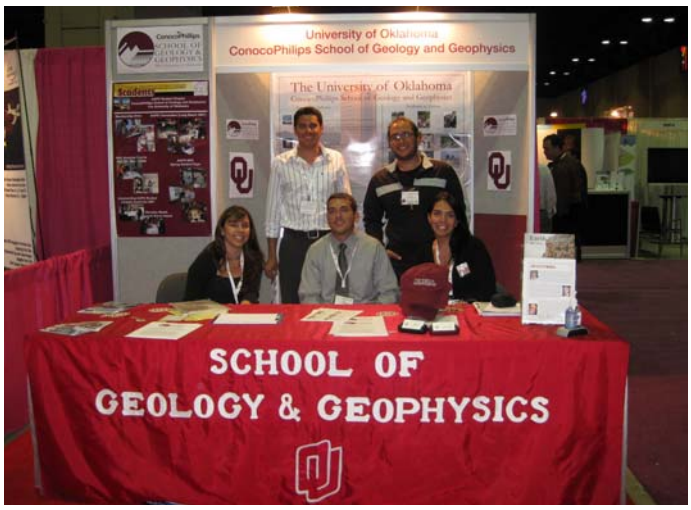
Once again this year, the Chapter did a wonderful job in making sure that OU has an outstanding participation at **2008 AAPG Annual Convention**. A total of 20 students attended the convention at San Antonio. The Chapter officers put every

Chapter Event: 'Risk Analysis for Exploration Evaluation' *one-day course. Students enjoyed the interactive, open style of the course, which was backed by plenty of exercises. Henry Pettingill, the instructor, is seen on the extreme left of the top photo.*

effort required to arrange for the transportation, lodging, etc. all provided by the **CPSGG;** and thanks to the generous donation from **Shell,** the Chapter was able to cover the registration fees and part of food expenses for the attending students. The Chapter assisted in exhibiting the school booth which intends to inform the AAPG attendees about the great facility and research at our school, to promote awareness about the admission processes, etc. to prospective students. This year, the students of University of Oklahoma certainly made their presence well felt at the convention by contributing to the technical session with a total of ***7 participating student presenters*** and by becoming the ***1st Prize Award winning team of Imperial Barrel.***

Finally, the Chapter has set the bars high enough for the incoming officers to proudly carry the legacy and the good work of the AAPG Student Chapter at OU!!!

Chapter Event: *Academic year-end meeting and election for the incoming officers*



2008 AAPG Annual Convention and Exhibition, San Antonio Texas

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SEG

Society of Exploration Geophysicists
The international society of applied geophysics

Student Membership dues are generously sponsored by corporate supporters of SEG.

American Association of Petroleum Geologists

Since our founding in 1917, AAPG has been a pillar of the world-wide scientific community. The original purpose of AAPG, to foster scientific research, to advance the science of geology, to promote technology and to inspire high professional conduct, still guides us today.

For our 30,000 members we provide world-class scientific publications, conferences and educational opportunities to geoscientists, and disseminate the most current geological information available to the general public.

Included in our world-wide membership are geologists, geophysicists, engineers, CEOs, managers, consultants, students and academicians in more than 120 countries.

AAPG dues are structured in such a way that no one in the geoscience community should be unable to participate based upon economic factors. Unlike other organizations whose dues are linked to the World Bank's GNP rating, AAPG dues are based upon the individual member's ability to pay, i.e. their annual *Personal Gross Income*. Although publication options vary for each level, all other member benefits are available and accessible, including voting privileges for Active members.

Level	Annual Income (USD)	Annual AAPG Dues (USD)
1	Greater than $50,000	$80
2	$25,000 to $50,000	$40
3	Less than $25,000	$20

For complete details of our Graduated Dues and online applications, please visit our website: www.aapg.org/join

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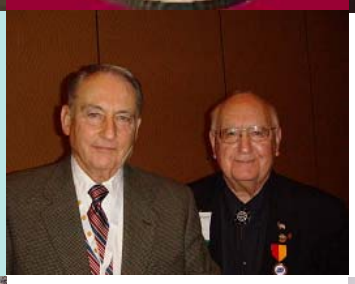
2008 ALUMNI NEWS

Visit the new Web site at www.ougeoalumni.com

Spring AAC Meeting

Mentoring

Fall AAC Meeting



New AAC Committees

New AAC Officers

Alumni Recognition

Nostalgia

Reprint of the 1920 *The Oklahoma Daily*

Alumni Advisory Council

Know Your Council Members

(Executive Council highlighted in red)

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Tommy H. Atkins
Tyrrell "Terry" Axtmann
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A.E. "Al" Basinger, Jr.
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John A. Taylor
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ALUMNUS PROFILE

"THIS MAN REALLY CAN MOVE MOUNTAINS"

A Tribute to Bob Allen

Introduction by Suzanne "Mom" Malm

According to my son's science project, the Ouachita Mountain range in Oklahoma dips underground and comes up again in Virginia as the Appalachian Mountains, Geologically speaking. Personally speaking, the two mountain ranges have moved a whole lot closer together in the last five years. It was at that time that our family, from the beautiful Virginia Valley near the foot of those Mountains in Virginia, visited my mom, now of 91 years, in Ardmore, Oklahoma. The mountains between the two states began to move closer, thanks to a very special person, fondly known by our three boys as 'the fossil guru', and known to the rest of the world as **Bob Allen**.

Just before leaving for vacation our family visited a small gem mine in Morefield, Virginia. Three boys and three buckets headed off to dig for buried treasure, hoping to find the crown jewels, or at the very least, a rival to the Hope Diamond, to present to grandma on our visit. To help us confirm our pirate's ransom, grandma helped us look up a gemologist or a geologist when we arrived in Oklahoma. Out with the yellow pages, and we came across the intriguing name "Kabodi" geologists, and the rest is history…literally and figuratively!!

We will never forget the gracious smile and genuine enthusiasm for our find, as three small happy faced strangers, poured their little nest of gems onto Bob Allen's desk that warm summer morning. "Well, what do we have here?", he grinned, giving each of our three excited little boys the attention of a personal friend, though he had never met them before. The boys could barely concentrate on their finds, for Bob's office, adorned with fossils, maps and microscopes, looked like the mountains themselves pouring out of the walls. And so it began, the fascination of the past, the friendship of the present, and the anticipation of the future, which has become filled with many adventures.

In the Mind of a Young Boy, as he reflects—Jeremy Malm

Thanks to my inquisitive nature as a youngster back in Virginia, Bob Allen and my family were able to cross paths before it was too late. When I was a little guy I was naive and had no idea what a fossil was. I thought it was some animal that died yesterday and in a week when all the local vultures had finally finished scraping the meat off of the grotesque victim and leaving just the bones, then it was a true fossil. Since there were no real fossils lying around my yard except some quartz and a driveway full of rocks from our hometown quarry, I became hooked on rocks. As I grew up I finally managed to get a rock collection from my parents as a birthday present, and it skyrocketed from there. I was studying the names of all of the common rocks around the world, visiting the local rock store to buy shiny rocks, fat striped rocks and many others, but the kicker was that I would be able to travel to a gem mine in southern Virginia to dig for the rocks that I was

The true Jeremy..... sweating with grass on his face after either a soccer match or a race.

When asked what he liked about learning Geology from Bob, Brother Bradley said, "It feels cool to find something that's been in the ground for millions of years ....and you're the first one to find it!"

Random doodles by Jeremy (take particular notice of "Fossil Man"!)

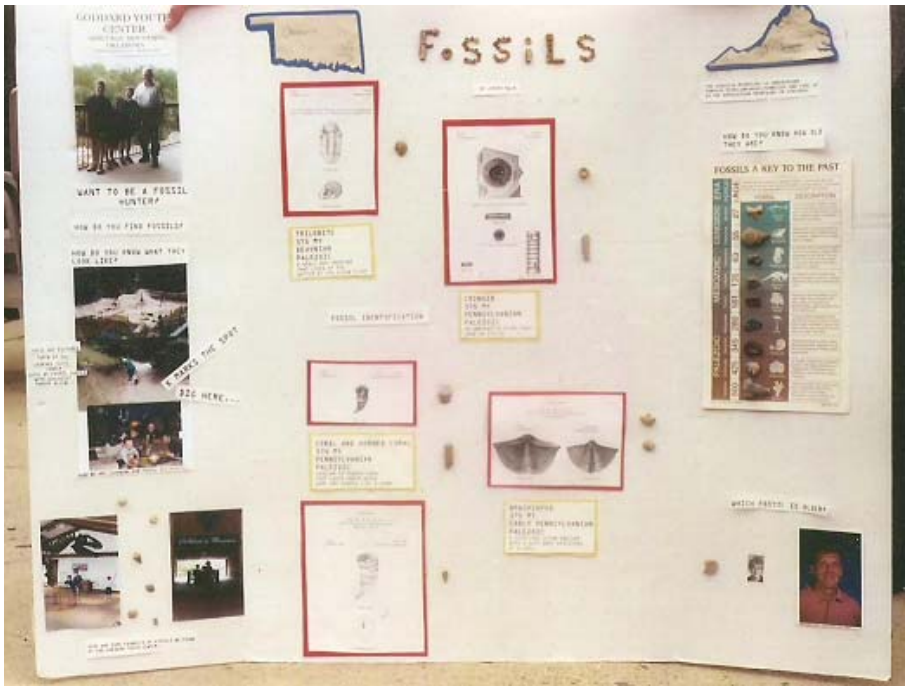
learning about in my books. (I bet Mr. Allen hates not meeting me earlier so I wouldn't have been exposed to so much rock business and would be just a diehard fossil hunter.) That same summer I went to the Morefield Gem Mine in Virginia.

It's a stifling 100 degrees outside in midday Oklahoma heat. Most kids are confined to their quarters playing boring videogames, but I'm itching for some adventure in my life. Since I only visit this world renowned geological site once every year with my family and chocolate lab Maverick from my home town of Charlottesville, Virginia, I couldn't help but beg my mom to take my brothers and I fossil hunting early in the morning. Hopefully, we could be back in the evening from our adventure so we could stop by and see the world famous geologist, Bob Allen. This time of day was the best of all because it was the moment of truth as I found out if my specimens were rare, their scientific name, and if they had any value. Every second I was in his office I cherished the memories as my family and I hung out with the oldies of fossils and rocks. His workspace is like the Smithsonian wrapped up in a gift shop. It's amazing as I scan his vast wealth of geological treasures, such as his stash of trilobites, his array of stones that look like he has a rock from every country. Mr. Allen's majestic maps give weary fossil hunters like myself a library full of information in one poster that's just dizzying, his famous microscopes detect the smallest but most important aspects of his geological finds, and Bob Allen himself is always wearing a wholehearted smile for young fossil enthusiasts like me to continue the exhilarating search for the unsuspecting fossil.

A few years later when we were assigned a science project for the annual science fair at my elementary school in the fifth grade, I knew what to do before my teacher had finished telling us when the project was due. That's how much Kabodi inc., a.k.a. Bob Allen taught me - that a curious trip to his office for a simple question turned into a passion and sincere love for geology. Also, that many people have committed their lives to teach the next generation what the land we walk on is actually made of so we can put an end to pollution, global warming and get others to become addicted to inform others of the dire consequences that can take place if we don't take time to teach each other and protect land and its natural resources before the world becomes one big city.

Bob Allen is amazing. I don't know how I will ever be able to repay him for all of the kind and caring work he has done for me while he has taught me geology in a nutshell and mostly the geology that lies in and around Ardmore, OK. Mr. Allen is the farthest thing from an ordinary geologist, as he goes the extra nine yards to make sure I understand what the point he is trying to get across. He is the best fossil lover ever. It is remarkable. The first year we met Bob, I was 9, my brother Josh was 7, and my youngest brother Bradley was 5. Since we were so young, we thought that a geologist wouldn't have any time for a family from Virginia that had a question about rocks found in Virginia when we were in Oklahoma. To our surprise he took us under his wing and he began a journey teaching us all about fossils through unbelievable field trips. The Goddard Youth center was a learning center where you can learn about fossils in a museum and search for your own fossils right outside the building. He has shown us areas that anyone can go and search for fossils (luckily, we're one of only a few that know about the lost treasure). He has guided us in the back of his pick-up on the Lazy S Ranch to learn about the dip and strike of the rocks where fossils are located in relationship to Era, the names of fossils and rocks, where to look where other fossil hunters haven't, what the fossils main niche was when they were alive, and much more. Thanks to Mr. Allen, I now know where to search for the best fossils in the world and spend time with a dear friend.

I wish I never had to leave Oklahoma. It was hard enough to say bye to my grandma that we are only able to see once a year; but since we met Bob, it is extremely hard because we have to leave more good friends behind. Bob is such a genuine person by working hard to complete a task and always caring for others. He is an inspiration for anyone and especially for us because he keeps on coming back year after year to teach us about fossils, knowing that our

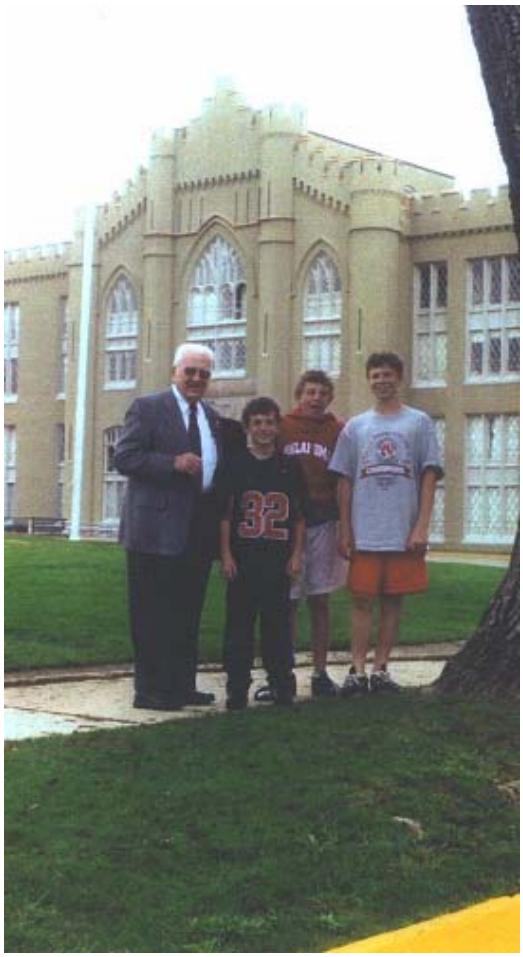


Jeremy's 5th grade science fair project, inspired by Bob. The poster is now displayed in a glass showcase in Sarkeys Energy Center at The University of Oklahoma as a legacy to Bob's passion and dedication to the field of geology and sharing his vast knowledge with young up and coming geoscientists. (Did you know that the Ouachita Mountains in Oklahoma run underground through Texas, Arkansas, Tennessee and come up as the Appalachian Mountains in Virginia???)

family will gladly go on the adventure. Throughout the years, Mr. Allen and my family have enjoyed church services together, hardy meals after a day in the field and is nice just like us. It seems as though he is part of the family. It is such a pleasure and was a sign from God that day while we were searching through the yellow pages and found a whole page of geologists, that Bob's professional name set him apart from the rest of his field, leading us to five years of fun-filled fossil adventures. Without Bob we would have never known how a family from Virginia, an amazing geologist from Oklahoma, and fossils could work together – the old, the young, and the really, really old!!!

~~Jeremy Malm

Bob with the Malm family and the precious poster. Thank you, Jeremy, for sharing your heart-felt story about Bob.



Bob at Virginia Military Institute with the boys, left to right: Bradley, Jeremy, Josh. (Notice that Jeremy is already wearing OU duds.)

Jon R. Withrow Receives Honors

OU Regents' Alumni Award

Presented by the OU Board of Regents and OU Alumni Association, the Regents' Alumni Award is a testament to the important roles OU alumni and supporters play in the life of the university. A committee formed by the Alumni Association selects the award recipients from nominations made by alumni, friends, and OU faculty and staff. The names of each year's recipients are engraved on a permanent plaque in Oklahoma Memorial Union on campus.

JON R. WITHROW received the Regents' Alumni Award for his dedication and service to the university in a May 9, 2008, ceremony on the Norman campus.

Jon believes financial hardship should not prevent students from pursuing their goals and attending college. With this in mind, he has endowed many scholarships to assist financially challenged students. He and his wife, Cathryn, recently established a new scholarship for students interested in studying autism. In addition to his financial support of the university, Withrow is a member of the College of Arts and Sciences Board of Visitors and is a past chairman and lifetime member of the Geology and Geophysics Alumni Advisory Council. He is also the recipient of the OU College of Arts and Sciences' Distinguished Service Award.

Petroleum Engineering BS 1954
Geological Engineering MS 1963

Seed Sower Society Award

The University of Oklahoma Seed Sower Society honors donors whose gifts to the university total $1 million or more. The Seed Sower name was selected for this society because, like first president David Ross Boyd, these donors have played an extraordinary role in planting seeds of excellence at the university. All Seed Sower members receive a specially made sculpture of the Seed Sower statue created by OU sculptor-in-residence, Paul Moore.

An award ceremony was held at the Withrow home with family and friends, where Jon was presented with his Seed Sower statue.

WELCOME, DEDICATION VISITORS,—THE UNIVERSITY'S LATCHSTRING IS OUTSIDE

THE OKLAHOMA DAILY

VOL. XIV. UNIVERSITY OF OKLAHOMA, NORMAN, OKLAHOMA, TUESDAY, MARCH 9, 1920. NUMBER 109.

Robertson To Speak At Dedication Service This Morning

120 SOONERS GET INTO GAME OF OIL

Scores of Visitors Here Today For Dedication To Include Former Students.

More than 120 geology students who received practically all their preliminary training in the University of Oklahoma are now holding responsible positions with various oil companies of North and South America, according to a roster complied Monday by the geology department.

Many of these alumni and former students are expected here today to participate in the dedication of the new geology building.

They are:

Andrews, Sylvan, Amarada Oil Co., 142 Kennedy Bldg., Tulsa, Okla., Armstrong, J. M., Roxana Petroleum Co., Tulsa, Okla., Arnett, William, Emerald Oil Co., Winfield, Kan., Aurin, F. L., Marland Refining Co., Ponca City, Okla.,

Bassett, Orval N., Marland Refining Co., Ponca City, Okla., Belt, Ben C., Gulf Production Co., Fort Worth Tex., Blanchard, Wm. G., Marland Refining Co., Ponca City, Okla., Bowen, James, Marland Refining Co., Ponca City, Okla., Boylan, Ebert E., Gulf Production Co., Barranguia, Colombia, S. A., Boyle, J. Philip, 411 Colcord Bldg., Oklahoma, Okla., Brillhart, Norman, Kaufman, Tex.; Brown, Wilbur N., 129 West 9th, Oklahoma, Okla.; Brown, Harry, Anadarko, Okla.; Burnett, Jerry, Emerald Oil Co., Winfield, Kan.; Burress, W. A., Amarada Oil Co., 142 Kennedy Bldg., Tulsa, Okla.; Burress, Walter, Empire Gas & Feul Co., Bartlesville, Okla.; Burress, G. H., care of Story & Burress, 8th floor Colcord Bldg., Oklahoma, Okla.; Buttram, Frank, 601 West 14th Oklahoma, Okla.; Buttram, William, 601 West 14th, Oklahoma, Okla.; Carpenter, Everett, Chief Geologist, Emerald Oil Co., Winfield, Kan.; Cary, John Ira, 1112 East 6th, Okmulgee, Okla.; Castile, Andie, Roxana Petroleum Co., Duncan, Okla.; Clark, Carl H., Amarada Oil Co., 65 Broadway, New York; Clark, Chester C., Drawer S, Bartlesville, Okla.; Clark, Glenn, Marland Refining Co., Ponca City, Okla.; Clark, William L., Marland Refining Co., Ponca City, Okla.; Clinkscale, Albert, Norman, Okla.; Conkling, Richard C., Roxana Petroleum Co., Tulsa, Okla.; Crabtree, J. Russell, 302 South Holyoke St., Wichita, Kan.; Cullen, John, (Consulting), Ft. Worth, Tex.; Dawson, R. L., 5 W. Grand Ave., Oklahoma, Okla.; DeGolyer, Everett L., 65 Broadway, New York; Donnenburg, Richard, Marland Refining Co., Ponca City, Okla.;

Donovan, Wilbur, Okmulgee, Oklahoma; Dorchester, C. M., Gulf Refining Co., Shreveport, La.; Douglas, A. J., Atlantic Petroleum Co., 311 A. E. N. B. Bldg., Dallas, Tex.; Eckes, Charles R., The Texas Company, Houston, Tex.; English, Leon E., Emerald Oil Co., Winfield, Kan.,(Now in Norman); Ford, Carl S., Champlin Oil Co., Enid, Okla.;

Frates, Earl, 735 E. Walnut St., Springfield, Mo.;Fuqua, H. B., Atlantic Petroleum Co., 311 A. E. N. B. Bldg., Dallas, Tex.; Galbraith, Thomas J., J. Ansel White Oil Co., Clovis, N. M.; Garrett, Dan, care of Hager and Rabitaille, 1317 A. E. N. B., Dallas, Tex.; Garrett, Robert E., Apartado 241 Tampico, Tamps., Mexico; Gentry, J. Malcolm, Enid, Okla.; Geyer, F. Park, Marland Refining Co., Ponca City, Okla.; Goodrich, H. B., 214 New Wright Bldg., Tulsa, Okla.; Goodrich, Robert D., 214 New Wright Bldg., Tulsa, Okla.

Graham, Will, Okemah, Okla.; Green, G. L., 208 First Ave., N. E., Mineral Wells, Tex.; Green, Linda, Roxana Petroleum Co., Tulsa, Okla.; Hall, Roy,

(Continued on Page 4)

Oklahoma Meteorite Is Relic In Museum

Natural Curiosity From Beaver County May Indicate Several Such Occurrences.

A meteorite found near Knowles, Beaver county, is on display in the Memorial Hall of the American Museum of Natural History, New York City, according to C. W. Shannon, director of the Oklahoma Geological Survey. No record of the collector or the date it was found is available.

The meteorite is about 10 inches by 12 inches by 24 inches and is composed chiefly of iron, with almost 10 per cent nickel and a very small percentage of cobalt. It weighs 355 pounds.

Meteorites are durable, Shannor says, and this fact is said to have led to the adoption of an alloy of nickel and iron in making armor plate for battleship.

Several occurances of meteorites have been reported from Oklahoma some material from northern McCurtain county indicating that it was once a part of a meteorite.

EASTERN SCHOOLS FAVOR OKLAHOMA

Geology Majors Tell Sigma Gamma Epsilon Members That University Is In High Regard.

Eastern universities have a high regard for University of Oklahoma, according to geology majors from various schools in the East who spoke at the smoker given by Sigma Gamma Epsilon, honorary geological fraternity Wednesday.

A large percentage of the 172 geology majors were present at the Phi Gamma Delta house, where the smoker was held. These included men from Texas, Kansas, New Mexico, Illinois, Arkansas, Missouri, Washington, D. C., and other parts of the United States, and all gave as their reason for coming to Oklahoma the reputation which this university is gaining for its course in oil geology.

GEOLOGY ENROLLMENT BIGGEST IN COUNTRY

Growth in Subject Since 1901 Shows Phenomenal Interest in State; History Traced.

Growth in the department of geology since it was established in 1901 has more than kept pace with the rise of the oil industry in the middle west, according to facts given out by the registry office Monday.

In 1901 the total enrollment of the university was only 400. Now almost 800 are enrolled in the department of geology alone; 172 men and women are taking major work in the subject. The University of Oklahoma department of geology now is the largest in the United States.

Dr. C. N. Gould was the only teacher in the department when it was established. As the first member of the faculty, and later as geologist and director of the geological survey, he stimulated interest here in his usbject in the early days of the school.

Mineralogy Introduced.

In 1904 E. G. Woodruff became instructor in mineralogy and was succeeded by Frank F. Grout in 1906. In 1908, Dr. D. W. Ohern became head of the department and only teacher and Gould was appointed director of the geological survey, still remaining the nominal head of the department.

In 1911 Dr. Ohern was appointed director of the survey, and C. H. Taylor became head of the department with Dr. Irving Perrine as assistant.

Since that time the faculty has increased to ten, and has had the following directors: Dr. M. G. Mehl. A. J. Williams, Dr. W. T. Lee, and Dr. J. B. Umpleby.

The present faculty, much bigger than in previous years, consists of Dr. Joseph B. Umpleby, head, Dr. C. E. Decker, V. E. Monnet, A. J. Williams, E. P. Rothrock, S. Weidman, Adele Franklin, and two graduate students acting as assistants. They are W. F. Absher and W. P. Lively.

Will Spry Young Geologists Ever Hear The Riot Act Read By Coed Partner In Office?

Will the geologist of the future stay in town only long enough to accept orders from his office geologist, who at one time was only a Sooner co-ed?

And will it come about that fond hubby will be sent out to locate oil wells while wifey patiently works out the underground structure in the same area?

And again, cries the anguished geology major, will it ever ever come to pass that while the valiant male is pushing a drawing-pen in the office, the weaker sex is out holding a rod on a persistent limestone?

All these things and more seem probable if one is to judge from the deadly seriousness of the rockhoundpose of many of the men taking geology.

Fail With Overconfidence?

It is a law of life that the overconfident fall in the race. In the age of the brachiopods and the pterodactyls-and everything-the species which became too sure of themselves and sacrificed their usful parts in order to "sport" strange and useless appenages were annihilated. The Romans thought nothing hould beat them, and degenerated.

Will male geologists now step aside, as steeplejacks and aviators have already, and let the conquering female sweep everything before him?

Or will they have any choice in the matter, with one woman on the faculty, five student assistantesses, six geological surveyessess, and seven girls now majoring in geology; and, last but not least, two employed by real honest-to-goodness oil companies at the present writing?

Will they?

Don't ask us.

Adele Franklin, graduate of Columbia University and with much graduate work to her credit, is the first woman faculty member in the school of geology here. She teaches paleontology and the elementary geology courses.

Co-eds Fortify.

Grace Jennings, B. A., '18, is our first woman graduate to take up oil work. She was employed by the Oklahoma Geological Survey while attending school, and left upon graduation to work in the subsurface department of the Marland Refining Company, Ponca City.

Linda Green, B. A. '19, is also doing subsurface work with the Roxana Petroleum company, Mineral Wells, Tex.

The seven majoring in geology are Jessie Kelsey, Chickasha, graduate student, Dollie Radler, Bristow, senior, Vita Lee Waters, Fredrika Fitch, and Bess U. Mills, juniors, and Milred Bobeck and Dorine Guthrie sophomores.

172 ROCK HOUNDS WILL TAKE OATH AS CELEBRATION OPEN

Faculty And Students Will Form Procession At 10 This Morning As First Geology Day Service Begin.

Scores of Alumni Are Guests Today

THE PROGRAM TODAY

10:00	*Pick and Hammer Club—Celebration and Oath.*
10:15	*Processional ---------- Geology Building*
10:20	*Dedication Exercises ---------- Auditorium*
12:30	*Pick and Hammer Club Luncheon to out-of-town guests ---------- Teepee House*
4:00	*Inspection of Geology Building and Informal Reception.*
7:30	*Geological Survey Smoker ---------- Geology Building*
7:30	*Chi Upsilon reception for visiting women, 318 College Ave.*

Chi Upsilon Is First Woman's Geology Order

Local Coed Rock Hound Fraternity May Take Steps Soon To Become National.

Chi Upsilon, only women's honorary geological fraternity, was established at the University of Oklahoma by girl geology majors recently.

Charter members are Jesse Kelsey graduate student, Dollie Radler, senior, Vita Lee Waters, Bess U. Mills, and Frederika Fitch, juniors, and Dorine Guthrie and Mildred Bobeck, sophomores.

Efforts will be made to introduce the fraternity into other schools offering geology and nationalize it.

GEOLOGY SOCIETY IS BINDING LINK

Alumni Are Held In Touch With University By Sigma Gamma Epsilon, Belief.

That Sigma Gamma Epsilon, honorary geologic fraternity, serves as a connecting link between faculty, students and alumni of the university, as well as a means of bringing together men of the profession, was the opinion expressed Monday by Dr. C. E. Decker, a faculty member of the fraternity.

Sigma Gamma Epsilon was founded in the University of Kansas in 1915 and since that time chapters have been established in the Universities of Pittsburg, Oklahoma, Nebraska, and Missouri.

W. Casper Kite, Oklahoma City, was largely responsible for bringing the fraternity to Oklahoma, according to Decker. Since that time the chapter has reached a membership of 75 out of a total of 275 in the five chapters in the United States. It has sent men out to Mexico and South America.

To Unite College Men.

The purpose of the fraternity is to unite college men specializing in geology, metallurgy, and mining.

The chapter here forms a convenient organization for handling social affairs of the geology department and securing prominent men as speakers, Dr. Decker said.

Members in Norman now are: faculty, C. E. Decker; C. W. Shannon; V. E. Monnett; A. J. Williams; students: W. F. Abshier; Milo Orr; Wallace Thompson; I. J. Vernon; Leon E. English; Rolfe Engleman; Sam Dendy; John Galloway; Carl Horne; Herbert Williams; Dwight Ross; Willis Storm; John E. Van Dall; Glenn Laskey, and Guard Marvin.

Reservations Made in Auditorium For Hundreds of Geology Students At Governor's Address.

Dedication exercises officially opening the geology building will begin at 10 o'clock this morning and celebrations are expected to last late tonight.

Gov. J. B. A. Robertson will arrive early this morning to be present when the Pick and Hammer club administers the Rock Hound oath in front of the geology building at 10 o'clock to scores of geology majors.

The faculty, in full academic robes, will be present when the oaths are given. Following these exercises, the faculty, preceded by university band in full unifor, will march to the auditorium. All geology students will also participate in the exercise.

Faculty members will be seated on the stage. The entire lower floor seating 910 persons has been reserved for all geology students and for visitors Upper floors will be for the general student body.

Governor In Address.

Governor Robertson will deliver the address of the day. J. W. Kayser, for the State Board of Public Affairs, S. W. Hayes, for the Board of Regents, and Pres. Stratton D. Brooks, for the university, will speak at the presentation of the keys of the building.

Prof. J. B. Umpleby, head of the department of geology, will respond C. W. Shannon, director of the geological survey, will deliver a congratulatory address. This will be followed by the governor's address.

Charles N. Gould, first head of the geology department, Irving Perrine, formerly of the Oklahoma Geological Survey and formerly on the faculty, Dr. J. A. Udden, head of the Texas Geological survey, J. W. Beede, of the Texas survey, and Fritz Aurin, former member of the Oklahoma Survey, are prominent geologists who expect to be at the university today.

Governor Robertson will be the guest of honor of Pick and Hammer club at its luncheon this noon at Teepee.

Women Entertained.

All women visitors will be entertained by women majors in geology at the home of Fredericka Fitch, 318 College avenue.

The Oklahoma Geological Survey will give a smoker at 7:30 p. m. in the survey offices, geology building.

An informal reception from 4 to 6 p. m. will be held in the geology building. All geology students will wear Rock Hound tags.

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Rolfe Engleman, Special Editor

WELCOME, VISITORS!

Our guests, Governor Robertson, the Board of Regents, and visiting geologists, and their families, who have come to take part in our dedication, all know what geology has done and is doing, so we won't talk much about ourselves; but we would like to have our visitors feel at home here, and know that the Rock Hounds are at their service.

For this is Rock Hound Day, and the Rock Hounds have taken everything, from the Oklahoma Daily to the University of Oklahoma, and are running away with it.

But we—800 of us—promise to bring it back as good as ever and considerably better, for we dedicate our own building today,—and you can't blame us for feeling exultant, as any rock-hound would under the circumstances.

But anyway, Visitors, You are welcome!

KEEPING UP WITH O. U.

There are several reasons why all alumni and former students, especially those in geology, who are scattered all over the world, should keep in touch with their alma mater.

Friends may lose your address, but if the head of the department you specialized in is kept advised of your wanderings, he can put you in touch with them. Getting in touch with friends is always a good thing, and sometimes a necessity.

Calls are constantly coming into the geology department for men on hurry-up jobs. Perhaps if the department knew something of your qualifications and connections, you would be in a position to profit by some of these calls.

Anyway, take a little time and write to the old school as well as to old pals once in a while. It'll help the school and you too!

MYSTIC KEYS TO MEET

Mystic Keys will meet tonight at 10 o'clock at the Sigma Nu house.

LOTUS CLUB MEETS

Lotus club will meet at the Kappa Sigma house at 7 p. m. today.

BASEBALL CANDIDATES CALLED FOR PRACTICE

General baseball practice will open this afternoon at 3 o'clock on Boyd field, according to the first open call issued Monday afternoon by Walter Fears, manager.

At least 50 candidates are expected to report for the first work-out. More than a dozen battery candidates have been training daily in the new armory in preparation for the opening of the season.

Russell "Stub" Hardy, captain, has withdrawn from the university.

FIRST SURVEY TRIP IN COVERED WAGONS

Many Present Faculty Members Boarded Prairie Schooner In Early Days.

Traveling in a covered wagon, the first geological field party sent out by the state, consisting of Dr. A. H. Van Vleet, professor of biology at the university and territorial geologist, Charles N. Gould, then a graduate student from the University of Nebraska, Paul J. White, botanist, and S. R. Hadsell, cook and teamster, left old administration hall in June, 1900, after waiting two years for the accumulated appropriation of $200 per year for field equipment.

Today 22 years after the territorial legislature established the Oklahoma Geological and Natural History Survey, the Oklahoma Geological Survey has excellent officers and equipment, field parties over the state all the time, more than a dozen staff members all the year round, and an appropriation of $88,190 bienally for salaries and maintenance.

These statements are taken from a report made recently by C. W. Shannon, director of the Oklahoma Geological Survey.

Had Steady Growth.

During this time the steady growth of the survey seems to have paralleld interest in the state's resources as these resources have been developed.

Dr. Van Vleet was territorial geologist until 1908, when a geological survey was provided for in the constitution of the state. Dr. C. N. Gould was then appointed director, in August, 1908, and served until October, 1911. Dr. Gould is now a consulting geologist in Oklahoma City.

Upon his resignation, Dr. D. W. Ohern was appointed to take his place. Dr. Ohern, who is now in Oklahoma City, resigned in December, 1913, and C. W. Shannon, M. A., Indiana, then field geologist of the survey, was appointed director.

The Survey maintains an office in Oklahoma City for the giving out of general information along this line.

Until 1913 the survey had been housed in frame buildings about the university campus, three of which burned down during the time of their occupancy. In 1913 the survey was moved to the basement o fthe old library building, where, Director Shannon says, the department was very cramped for room. In 1918 the present Geology building was completed and the survey was installed there, where it remains at the present time.

During its existence the survey has issued a number of publications, including bulletins, pamphlets and maps, of which a number have been exhausted for many years. However, there are at present available bulletiis on every mineral resource the state possesses in commercial quantities, which are in general free of charge. The survey also gives such information as it may have available by means of correspondence, in case the subject is not covered by publications.

Members of the staff are C. W. Shannon, director, F. G. Rockwell, assistant director, Frank Gahrtz, draftsman, F. A. Edson, Helen Personett, Juanita Ramsey, Bess Stewart, Bess U. Mills, Lucile Carson Smith, Homer Conder, Fred Bullard, A. C. Shead, R. R. Somerville.

GEOLOGISTS NOW IN MANY FIELDS

Sooner Rock Hounds Into Mexico, South America And France; Many In Oklahoma.

University of Oklahoma is becoming a center of oil geology in this section of the United States because of the growing tendency of students to come here from other state universities, members of the geology faculty said Monday.

Geology graduates here work in practically all of the world. Oklahoma men are working all over the United States, in Mexico, and in South America, and only recently a graduate was sent to France to make oil investigations, it was shown.

Charles T. Kirk, B. S. '14, M. A. '05, a consulting geologist of Tulsa, was sent to France recently by New York clients to look over oil possibilities.

Some of the Oklahoma men who have become heads of geologic departments for oil companies are F. L. Aurin, B. A. '14, M. A. '15, assistant chief geologist, Marland Refining company, Ponca City Okla.; Ben C. Belt, B. A. '10, Gulf Production company, Ft. Worth, Tex.; Richard Conkling, B. A. '11, Roxana Petroleum company, Tulsa; Everette L. DeGolyer, B. A. '11, Amarada Oil company, 65 Broadway, New York City; Charles R. Eckes, B. A. '10, The Texas company, Houston, Tex.; F. Park Geyer, Marland Refining company, Ponca City; Charles W. Hamilton, A. '12, general manager Mexican Gulf Oil company, Tampico, Mexico; L. C. Snider, B. A. '14, Empire Gas and Fuel company, Bartlesville.

Graduates who are now consulting geologists are: Frank Buttram, B. A. '10, M. A., '12, Oklahoma City; J. Russell Crabtree, B. A., '12, Wichita, Kan.; R. L. Dawson, B. A. '15, Oklahoma City; R. D. Goodrich, B. A. '16, Tulsa Okla.; L. L. Hutchinson, B. A. '07 (former State Geologist), Tulsa Okla.; W. Casper Kite, B. A. '16, Oklahoma City; Pierce Larkin, B. A. '09, Tulsa, Okla.; Jerry B. Newby, B. A. '12, Tulsa. Okla.; E. L. Rhodes, B. A. '12, Lexington, Ky.; and L. E. Trout, B. A. '12, M. A. '13, Oklahoma City.

Chester A. Reeds, B. A. '05, is curator of the American Museum of Natural History, Columbia University, New York City.

Some of the companies that employ Oklahoma men are: Emerald Oil company, Winfiel, Kan.; five Oklahoma men; Roxana Petroleum company, Tulsa, Okla, Okla.; nine; Marland Refining company, Ponca City, Okla., 14; Gulf Production company, Ft. Worth nand Houston, Tex., three; Atlantic Petroleum company, Dallas, Tex., 10; Sinclair Consolidated Oil comp Ft. Worth, two.

Only one Oklahoma graduate, V Monnet, B. A. '12, is teaching in university, bu Eck F. Schram, B. '06, is in the geology department of University of Nebraska.

THE DINOSAUR

Behold the mighty dinosaur,
Famous in prehistoric lore,
Not only famous for his strength,
But for his intellectual length.
You will observe by these remains,
The creature had two sets of brains:
One in his head, (the usual place,)
The other at his spinal base.
Thus he could reason a priori,
As well as a postreriori.
No problem bothered him a bit;
He made both head and tail of it.
So wise was he, so wise and solemn,
Each though filled just a spinal column.
If one brain found the pressure strong,
It passed a few ideas along;
If something slipped his forward mind,
'Twas rescued by the one behind;
And if in error he was caught,
He had a saving afterthought.
As he thought twice before he spoke,
He had no judgments to revoke;
For he could think without congestion
Upon both sides of every question.
O, gaze upon this model beast,
Defunct ten million years at least!

—Chicago Tribune.

WOMEN MEET TONIGHT ON INSIGNIA OF LA

University girls whose homes in Norman or who live in houses represented on the woman's cou will meet for the third of a series talks on "The Insignia of a L tonight at the home of Chris Williams, 706 Asp. The meeting start at 7 o'clock.

PIONEER SERVICE IS OFFERED GEOLOGISTS

Need For Working Out Undeveloped Resources Shown By Monnett; Travel Attractive.

BY V. ELVERT MONNETT

Sice the earliest days of the science, geological principles have been successfully applied to the discovery and development of mineral resources as well as to the execution of he larger engineering projects.

The new profession of geological engineering is the outgrowth of the latter, while the profession of mining geologist is concerned with the problems of the former. The petroleum geologist may be considered as a highly specialized mining geologist in that his efforts are directed towards but one of the many mineral products.

The work of a geologist has long been considered pioneer work, especially in the petroleum industry, as it is part of his duties to locate new territory and pick out the most favorable areas for prospecting.

Companies Need Advice.

Many of the larger oil companies are now finding that their need for geological advice is just beginning when a new field is opened. Resident geologists whose sole duties are concerned with aiding in development are now being placed in nearly all the old as well as newer producing areas.

The pioneer work is more attractive to many geologists as it usually means etxensive travel, not only in this country but in many foreign countries. At the present time former students from this department of geology are working in Mexico, Panama, Venezula, Colombia, China and South Africa.

There is a great deal of this pioneer work yet to be carried out in this country, but the foreign work usually pays much higher salaries.

Resident Work Scientific.

The work of the resident geologist is usually of a more scientific nature and requires broader training and experience.

From the purely scientific side, geology is of more than general interest n that it offers the only book wherein may be read the history of the earth during the millions of years preceding the most ancient historical records.

The ancient geography of the continents and seas, the forms of life inhabiting land and water, and even the climate may be approximately determined. The innumerable "lost pages" of the book only add zest to the search for information, as new pages are constantly being unearthed through the researches of hundreds of interested workers.

The federal and numerous state geological survey organizations offer the greatest opportunities for this kind of work.

ENGINEERS OFF TODAY FOR UTILITY MEETING

Juniors and seniors will be excused from work in the college of engineering to attend the convention of the Oklahoma Utilities Association in Oklahoma City today, Wednesday and Thursday.

Dean J. H. Felgar, of the college of engineering, will deliver an address on "Inventory, Appraisal, and Valuation" in the telephone division meeting to be held in Convention Hall at 2:30 Wednesday afternoon.

Prof. Frank J. Tappan, head of the electrical department, will act as assistant secretary to H. A. Lane manager of the Oklahoma Utilities Association.

LEGION BUTTONS HERE

Membrs of the American Legion who have paid dues for 1920 may buy Legion buttons from Will Cruce in the registry office.

Members wishing to remain on American Legion rolls should pay 1920 dues immediately, officers of the university post said.

CALL BURLESQUE MEETING

All characters for the Junior Burlesque will meet tonight at 7 o'clock in the Old Chapel for a rehearsal.

Dinner guests Sunday at the Theta house were Mrs. John Taylor, Floyd Haynes, Parker Prouty, Dewey Neal, and Finis Huber.

15,000 Well Logs Shown By Survey

All Districts of Oklahoma Represented in Colored Sections In Library Here.

Fifteen thousand well logs, representing every oil district in the state, and newspaper clippings on the oil development of more than two thousand sections, including every county in Oklahoma, are sources of information now open to the State in the offices of the Oklahoma Geological Survey.

A map, five and a half by ten and a half feet, drawn to a scale of four miles to the inch, shows by colored pins the nature of development in a section, a green pin signifying oil production, a red pin gas, a yellow pin a dry hole, and a white pin a location or drilling well. Sections where drilling has not yet been started are colored yellow.

The map is kept up to date from information from the Daily Oklahoman and the Oil and Gas Journal. These clippings are maintained is a special filing system and can be found when the section, township and range of the area desired is known Two thousand and thriteen sections have been explored for oil and gas since 1916 when the record was started.

Production Is Recored.

The production, depth and date of completion of each producing well is kept in a production recard book.

On the map are shown also the main geological features of the state, such as contacts between the Mississippian, Pennsylvanian, Permian and Cretaceous formations, the Choctaw Fault, drainage, railways, areas of igneous rocks and segregated coal lands.

Fifteen thousand well logs are available in the oil and gas department of the survey. They are copied on cards and indexed in drawers. Logs representative of every area in the state may be referred to and copied, if desired.

46 TO WRITE LETTERS

Names of 46 French students who are interested in corresponding with French students here have been received by th Frnch dpartmrft and have been posted on the bulletin board of administration building, Dr. R. T. House, head of the modern language department, announced Monday.

120 SOONERS GET INTO GAME OF OIL

(Continued From Page 1)

Okla.; Hamilton, Charles W., Apartado 106, Tampico, Tamps., Mex.; Hardin, E. G., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.; Herald, Frank A., care of Carl K. Marland Refining Co., Ponca City, Dresser, Fayetteville National Bank. Lexington, Ky.; Herald, John M., Roxana Petroleum Co., Tulsa, Okla.; Hudson, Kirk, Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.; Hutchinson, L. L., Cor. Glenn and Wheeling Sts., Tulsa, Okla.; Hyde, C. Edgar, Roxana Petroleum Co., Tulsa, Okla.;

Jennings, Grace, Marland Refining Co., Ponca City, Okla.; Jones, Hubert A., Norman, Okla.; Kirk, Charles T., 327 S. Wheeling St., Tulsa, Okla.; Kite, W. Casper, Taylor & Kite, 326 Baum Bldg., Oklahoma, Okla.; Kolm. R. N., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.;

Larkin, Pierce, 58 North Zunis, Tulsa, Okla.; Leeman, Ed, Atlantic Petroleum Co., A. E. N. B., Bldg., Dallas. Tex.; Lloyd, A., Sinclair Oil Co., Tulsa, Okla.; Logan, C. Z., care of L. Ansel White Oil Co., Clovis, N. M.; Logan, David, Marland Refining Co., Ponca City, Okla.; Lookabaugh, L. L., 2209 College, Ft. Worth, Tex.; Loomis, Harve, 411 Insurance Bldg., Dallas, Tex.

MacKay, Hugh, 216 South Oak, Sapulpa, Okla.; Mayginnes, Arthur H., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.; McGaha, C. P., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.; McGlothlen, Richmond Levering & Co., Chamber of Commerce Bldg., Albuquerque, N. M.; Meyers, George, Amarada Oil Co., 142 Kennedy Bldg., Tulsa, Okla.; Miller, R. K., Box 538, Tulsa, Okla.; Montgomery, Homer, 209½ Lane St., Dallas, Tex.; Morgan, George, Emerald Oil Co., Winfield, Kan., (Now Columbia University, New York); Morris, A. F., Gypsy Oil Co., Box 1212, Tulsa, Okla.

Nagle, Paul, Marland Refining Co., Ponca City, Okla.; Newby, Jerry, 601 West 14th, Oklahoma, Okla.; Newby, Warner, Sapulpa Refining Co., Sapulpa, Okla.; Norman, Crawford W., Grandfield, Okla.

Parker, E. C., Marland Refining Co., Ponca City, Okla.; Parsons, Frank, Marland Refining Co., Ponca City, Okla.; Reeds, Artie C., Box 1362, Tulsa, Okla.; Reeds, Chester, American Museum of Natural History, Columbia University, New York; Rees, Forrest R., 46 North Zeenis Ave., Tulsa, Okla.; Rhodes, E. O., City National Bank Bldg., Lexington, Ky.; Rider, Chas, R., Pierce Oil Corporation, Okmulgee, Okla.; Roark, Louis B., Roxana Petroleum Co., Tulsa, Okla.; Roark, Ralph B., Roxana Petroleum Co., Tulsa, Okla.; Roberson, Frank, Vincent Steele Process Co., 715 Bellevue, Detroit, Mich.; Rowe, Charles H., 606 Camden St., San Antonio, Tex.

Schram, Eck F., Box 1258, Lincoln, Nebr.; Scudder, E. W., Emerald Oil Co., Winfield, Kan.; Snider, L. B., Pemberton & Severy, 729 Kennedy Bldg., Tulsa, Okla.; Snider, L. C., Empire Gas & Feul Co., Bartlesville, Okla.; Stacy, Dean, care Stacy & Burress, 8th floor Colcord Bldg., Oklahoma, Okla.; Stiles, E. B., Siclair Consolidated Oil Co., Burkburnett Bldg., Ft. Worth, Tex.

Tatum, James L., Devol, Okla. (Now with Aguila Petroleum Co., Tampico, Tamps., Mex.); Taylor, C. H., Taylor & Kite, 326 Baum Bldg., Oklahoma, Okla.; Thompson, J. C., Home Petroleum Co., 12th Floor State Nat'l Bank Bldg., Oklahoma, Okla.; Toepleman, Walter C., 447 West Miffin, Madison, Wis.; Trout, Lawrence E., 3rd Floor Baum Bldg., Oklahoma, Okla.

Uri, Herbert, Okmulgee, Okla.; Waite, V. V., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dallas, Tex.; Walker, Don, 715 Asp Ave., Norman, Okla.; White, Luther H., 219 E. Jasper St., Tulsa, Okla.; Whitwell, Earl, Oklahoma, Okla.

Whisenant, J. B., J. Ansel White Oil Co., Clovis, N. M.; Williams, Herbert, World Blg., care Mr. Cutlett, Tulsa, Okla.; Wilson, E. B., Atlantic Petroleum Co., 311 A. E. N. B., Bldg., Dalas, Tex.; Wood, Robert H., 516 Daniels Bldg., Tulsa, Okla.; Wood, Samuel H., Altus, Okla.; Wood, V. O., 516 Daniels Bldg., Tulsa, Okla.; Woods, S. H., 413 Colcord Bldg., Oklahoma, Okla.; Woolsey, Vern, Southern Oil and Leasing Syndicate, Luling, Tex.

In Memory of our Friends Who Have Passed

Reported since June, 2007

Ralf Edward Andrews, Jr.
John C. Barcklow
Richard W. Blair
Edward Henry Bradley
Robert H. Brady
Robert M. Caron
J. Glenn Cole
Hyman V. Corman
Phillip Nixon Davis
Harry Marvin Douglass
Edith May Eskridge
Robert H. Forde
Mildred Virginia Frizzell
William Leroy Glidden
Otis Byron Goolsby
Robert Lee Halstead
Ben D. Hare
B. Pete Jackson
L. Paul Lamer
Tom Mairs
Norman Clark Miller
Lee Mills
Don O. Montgomery
Gene P. Morrell
Paul Tetreau Norwood
Francis Davlin O'Neill
John F. Preer
Wallace L. Saultz
Robert Joseph Schoelen
Jerry Douglas Scott
John Allen Stine
Robert M. Swesnik
James Bishop Talley
Mack H. Vaughn
Jack Cooper Wallace
Richard McCoy Zajic

"After Glow"

I'd like the memory of me
To be a happy one.
I'd like to leave an After Glow
Of smiles when life is done.
I'd like to leave an echo
Whispering softly down the ways,
Of happy times and laughing
Times and bright and sunny days.
I'd like the tears of those who grieve,
To dry before the sun
Of happy memories that I leave
When my life is done.

~ Author Unknown

The “NEW” Sarkeys Energy Center

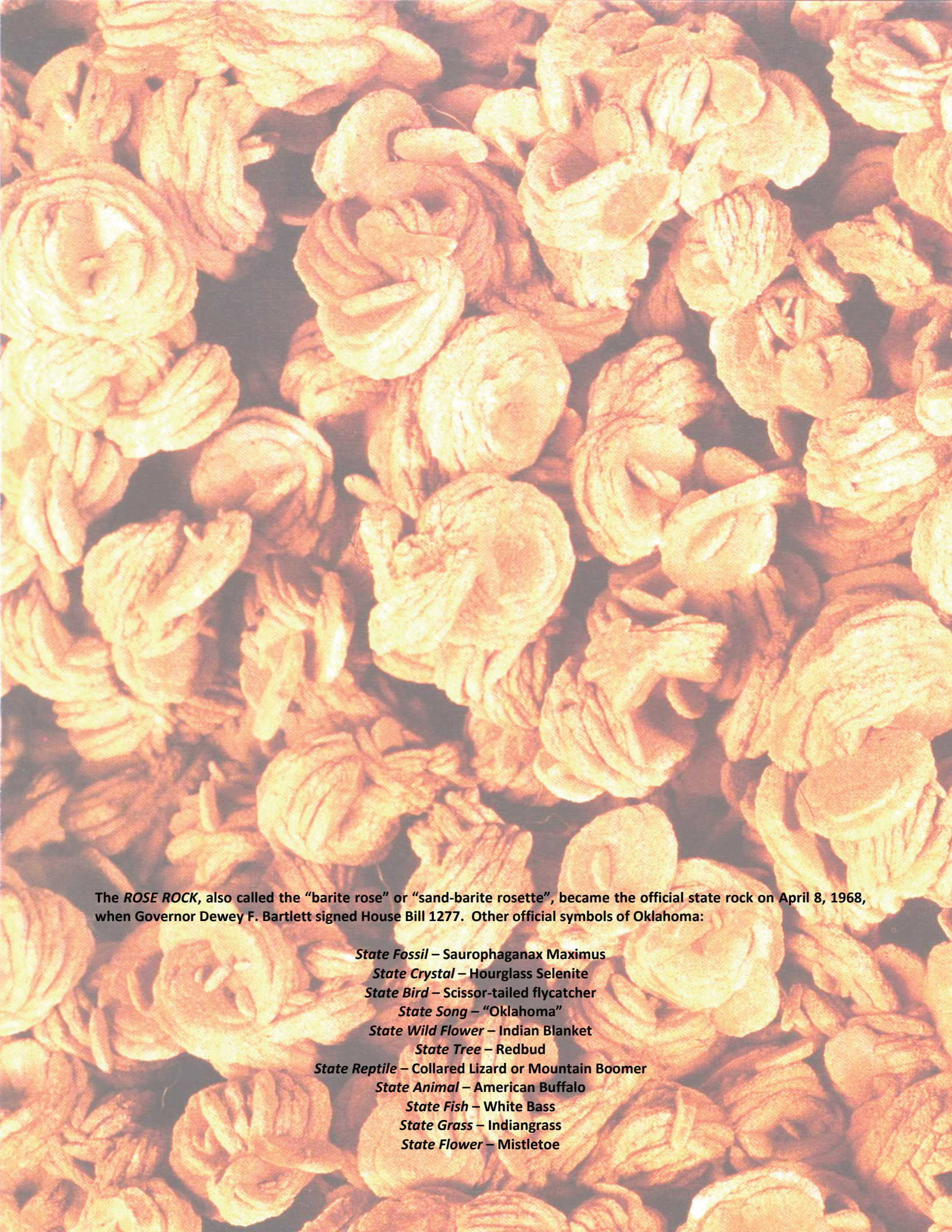
The Energy Center atrium, located at the heart of the Energy Center tower, got a significant remodel as part of the proposed $8.5 million renovation of Mewbourne College of Earth and Energy facilities. A key element of this renovation was to create two important new student spaces: the Mewbourne College of Earth and Energy Student Services Center and a new Student Study Area. The design in both areas features woodwork, glass, and textures reflective of the College’s image.

STUDENT SERVICES CENTER — This expansive and attractive 655-square-foot facility will serve as an important resource for prospective students and parents and for current students seeking advice about academic schedules, scholarships, internships, and career opportunities. The center is central to the College’s goal of providing a high level of personal guidance and support.

West Atrium before renovation…..

West Atrium after renovation (same area)…..

STUDENT STUDY AREA – This functional and comfortable 4,000-square-ft. study area is designed to give Earth and Energy students a central place to study and work. It is also designed to accommodate team learning activities.



The *ROSE ROCK*, also called the "barite rose" or "sand-barite rosette", became the official state rock on April 8, 1968, when Governor Dewey F. Bartlett signed House Bill 1277. Other official symbols of Oklahoma:

State Fossil **– Saurophaganax Maximus**
State Crystal **– Hourglass Selenite**
State Bird **– Scissor-tailed flycatcher**
State Song **– "Oklahoma"**
State Wild Flower **– Indian Blanket**
State Tree **– Redbud**
State Reptile **– Collared Lizard or Mountain Boomer**
State Animal **– American Buffalo**
State Fish **– White Bass**
State Grass **– Indiangrass**
State Flower **– Mistletoe**