EARTH SCIENTIST

Magazine 2003

The University of Oklahoma — School of Geology & Geophysics

From The Director's Desk. . .

VISION STATEMENT:

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

Cover: "Cave of the Crystals" at Naica, Chihuahua, Mexico. Photograph by David London. See his article on pages 24-27.

Roger M. Slatt
Director

Where We Are and Where We Want to be in Five Years

Like most universities in the U.S., OU was hit this past year with several state-mandated budget cuts, which felt their way down to the School. We returned more than $63,000 in state-appropriated funds during the period June—October 2002. Fortunately, later state-mandated cuts were absorbed by the OU administration, though we were warned to spend frugally and cautiously in case any more cuts are forthcoming. No one knows how long the state and national economic downturn will last. Thus, long-term planning for the School is challenging at best. Never-the-less, it is important to have a business plan in place even if it must be modified by unexpected events. With this in mind, the School put together a five-year business plan for review at its Fall 2002 Alumni Advisory Committee meeting. The plan involves projections for income, expenses, undergraduate and graduate students, and faculty. The plan for 2002-2007 is presented in Fig. 1, but also includes information for the years 2000 and 2001 for comparative purposes. Before discussing where we want the future to take us, it is important to highlight where we are at the present time.

We currently have 21 faculty members who represent a broad range of geological and geophysical expertise. Our enrollments continue an upward trend, as shown in Figure 2. Although the undergraduate enrollment is not rising at the rate we would like, at least the declining trend of the late 1990's has been reversed. The quality of our undergraduate students remains high, with 20 students above a 3.0 G.P.A., including some with a 4.0 GPA. Several of these students have received prestigious awards and internship

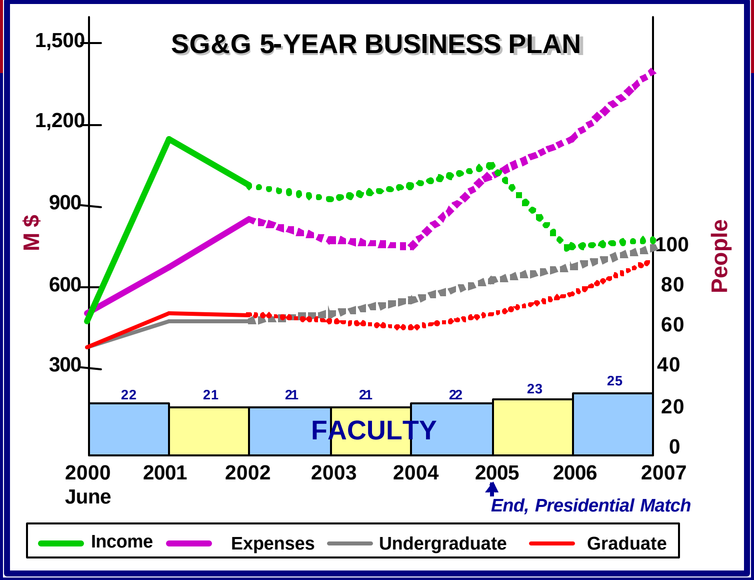


Figure 1

appointments (*see accompanying article on pages 32-37 of this* <u>*Earth Scientist*</u> *by Kathryn Gardner*).

Our graduate student enrollment continues to increase at a suitable rate. Fig. 3 shows our 2003 graduate student statistics. This spring we had over 70 applicants for admission in Fall 2003, and offered admission to 28. Of the 28, 18 were offered financial assistance and 10 were not. As of this writing, 13 of the 18 have accepted our offers, 3 have declined, and 2 have not responded. Not surprisingly, only 1 of the students admitted without aid has elected to attend OU in the Fall. The upside to the increased number of applicants and the increasing spread between those applying and those being accepted is that we can be more selective in the quality of new graduate students. Significantly, this May 2003, the School graduated a (near term) record of 16 graduate students, most of whom have been at OU 2-2.5 years. This number reflects the high quality of these students, their desire to complete their education and get on with a professional life, and their ability to accomplish their educational goals in a shorter time frame than in past years. It is also significant that we will be able to balance our teaching assistant financing by having about as many students graduating as will be attending the School in the Fall.

Additional statistics on our students are shown in Fig. 4-7. Fig. 4 illustrates the number of male and female undergraduate and graduate students and Fig. 5 summarizes the numbers of U.S. and international students in both categories. Fig. 6 and 7 show the distribution of undergraduate majors and graduate students by their chosen discipline.

This year, the School, the Oklahoma Geological Survey, and Sarkeys Energy Center hosted the third annual Student Spring Expo. The Expo was sponsored by American Association of Petroleum Geologists and Society of

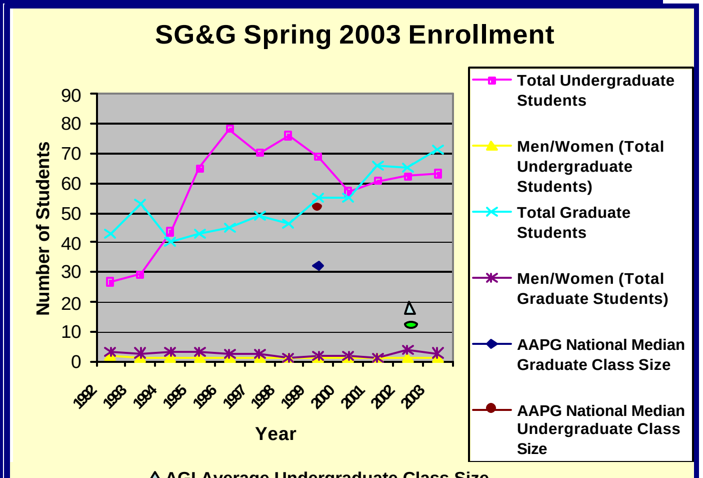


Figure 2

Exploration Geophysicists (*for the first time*). **There were a record number of 152 student participants from 43 colleges and universities representing 19 states, Canada and Nigeria.** Details of the Expo are provided on pages 66-70 in this *Earth Scientist*, but **it is important to note here that the Expo provides a means for prospective students and prospective company employers and sponsors to see what the School has to offer. An influx of new graduate students has been one of the upsides to OU of the Expo.**

Some additional highlights and statistics for the year include: **32 peer-reviewed publications by faculty and students, 82 abstracts and extended abstracts (representing oral presentations at scientific meetings), and $2,185,000 in new research funds from 21 new grants (compared with $1,811,000 in research funds from 25 grants in 2001)**. The School continues to be balanced in the three key academic areas of teaching, research, and service. Several faculty taught short courses for government, industry, and academic institutions, and one new book received public acclaim.

With this solid foundation, then, where should we be headed over the next five or more years?? Our undergraduate curriculum is versatile and complete, our graduate program continues to grow, and our research efforts are being acknowledged. The 5-year business plan, presented in Fig. 1, suggests that both people and money will be required to improve our status and stature in the scientific community. Since almost every organization in the world clamors for the same two things—people and money —some explanation is in order.

With the retirement in 2001 of Charles Harper, the School has a faculty of 21 (including the Director). The School currently holds two unfilled Chairs and two unfilled Professorships (one jointly with Petroleum Engineering). **One of the goals of the School that is noted in the Vision Statement, is to attain preeminence in Energy. The majority of new graduate students, and a growing number of undergraduate students, are seeking education in the energy area, as this is where professional employment is most common and lucrative.** Unfortunately, those faculty members who teach and conduct research in the energy area are at or near their limits of advising students, particularly graduate students who are required to write theses. To expand the graduate student population in the energy area is going to require more faculty. All four of the unfilled chairs and professorships are earmarked for energy-related faculty. The reason that these positions remain unfilled is because there is no state faculty salary line. The endowments provide insufficient funds for permanent salary, so they will remain unfilled until state lines are granted. Thus, as shown on Fig. 1, the increased enrollment in graduate students really begins in the year 2004, when it is hoped that at least one of the new positions can be filled. To maintain the steady increase in graduate students through 2007 will require filling a new position each year until all four are occupied. Without funding of the chairs and professorships, it is unlikely that the School will reach its intended goal of 100 graduate students by 2007. The School has

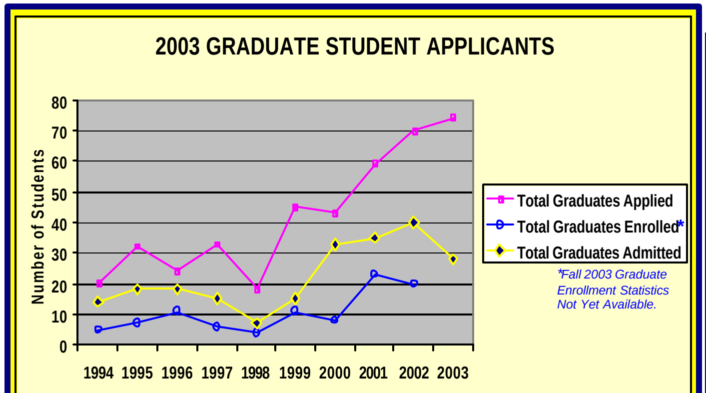


Figure 3

maintained that its top priority over the past few years has been to receive student Scholarships and Fellowships. **Thanks in large part to our generous alumni, we continue to get both corporate and individual Scholarship and Fellowship funding, which is necessary to grow the student body.** Assuming that this level of funding is maintained, the School's top priority is then to begin filling the vacant chairs and professorships. This will not be easy in the currently tough economic climate at OU and within the state.

A hindrance to attracting top Ph.D. students in Geophysics is the lack of a formal Ph.D. degree in Geophysics, something which the School has never had. This is strange, since OU is widely regarded as having provided the fundamental knowledge and inventions which initiated the era of exploration geophysics many years ago. Currently, a student wishing to earn a Ph.D. in the School is granted the degree in Geology, even though the student may have studied Geophysics. In the past three years, 10 such Ph.D. degrees have been conferred, and there are currently 6 Ph.D. students enrolled in Geophysics programs. Many potential student applicants decide not to apply to OU for Ph.D. studies when they learn that a Ph.D. degree in Geophysics is not offered. To correct this, the School recently submitted a proposal for a Ph.D. program in Geophysics. The proposal is currently working its way through the approval process, and the School has high hopes that it will be granted soon. Since we currently offer 18

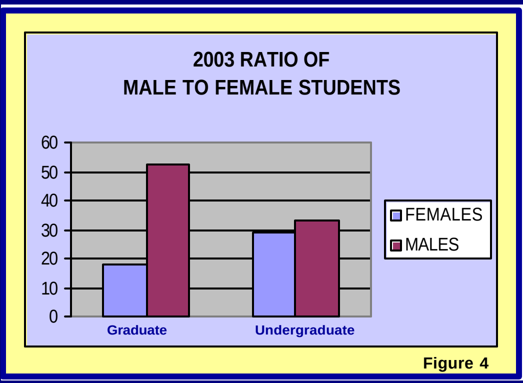


Figure 4

advanced undergraduate and graduate geophysics courses, and have 8 'geophysical' faculty, no additional resources are required to establish this degree program.

With regards to the undergraduate population, the School plans for an incremental annual increase in declared majors. This is to be accomplished by continual high school and junior college recruiting and by encouraging our faculty and teaching assistants to spread the word about geology and geophysics to undeclared freshmen and sophomores.

The income curve on Fig. 1 shows that the year 2001 was the high point in fund raising. This corresponds with the 100th year anniversary celebrations of the School and the renewed interest by alumni. When the new Director was hired, President Boren provided a 5-year challenge match of $850,000 for the School. The School has now completed raising its share and OU continues to provide its share on an annual basis. However, as indicated on Fig. 1, that match ends in 2005, and there will be a substantial reduction in budget. Since expenses are anticipated to rise dramatically with the planned increase in faculty and students, some additional income source is going to be required if the School is to maintain its standards.

We currently have a well-rounded faculty who provide a quality education to our students, and who conduct significant research as evidenced by publication and grants. However, as is usually the case, more funds and specialty-faculty are going to be required to continue along this upward path. **The Director and the faculty and staff are dedicated to maintaining the high level of activity and strong national and international reputation that the School currently enjoys and to enhancing these traits.** The 5-year business plan presented here is a realistic document to track our performance and requirements over the 5-year time frame. We will keep the plan updated as a measure of our success.

Our goal is clearly stated in the Vision Statement. We want to be 'a preeminent center of excellence for study and research in geology and geophysics, with emphasis in applied areas such as Energy.'

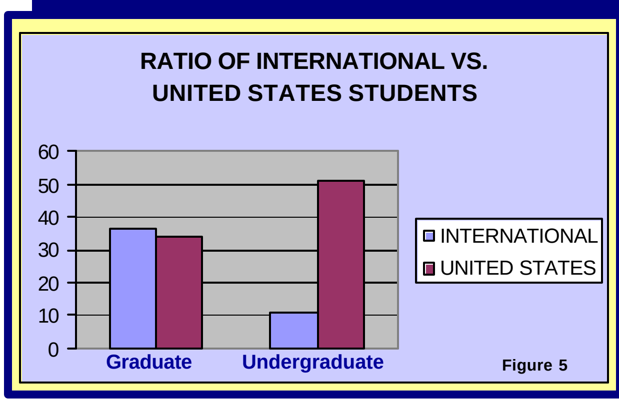


Figure 5

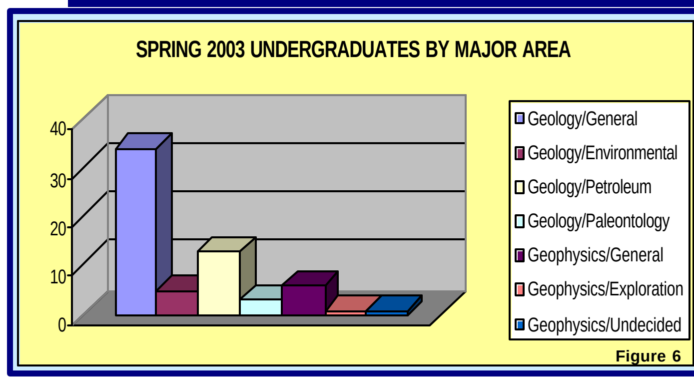


Figure 6

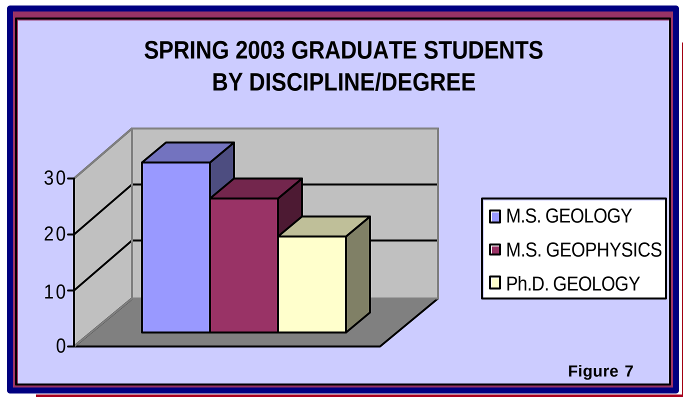


Figure 7

The Dean's Corner

John T. Snow,
Dean, College of Geosciences

Many of you no doubt recall the phrase, "May you live in interesting times", which in the original Chinese can be either a blessing or a curse depending on how it is inflected.

That certainly describes the last year at the University of Oklahoma and in the College of Geosciences. 2002 was my ninth year as dean of the College of Geosciences, and it was my most challenging yet. On the negative side, we worked through some interesting budget times. On the positive side, we saw the beginning of the construction of the National Weather Center and the establishment of the Oklahoma Petroleum Information Center.

As a consequence of the downturn of the national economy, the State portion of OU's budget has been cut significantly over the last 12 months. President Boren has absorbed a portion of these cuts centrally, but we in Geosciences have had to reduce our operating budget by almost 5% since last February. This budget cutting has come at time when the enrollment of the University continues to grow rapidly, increasing the demand for more courses everywhere on the campus, including in Geosciences.

So far, we have managed to reduce our budgets without letting any staff or untenured faculty go, but it has been very close. We are confident that President Boren will obtain from the State Legislature the authority for OU to adjust its tuition to better reflect the real costs of a quality education. **Currently, OU's tuition is the lowest in the Big 12. At the same time, we are providing students a world-class education. By every measure, OU is "under priced". I frequently have parents from states east of the Mississippi say that they can send their son or daughter to our programs cheaper than they could at in-state prices back home.** With an increase in tuition and a corresponding increase in fees, I believe we will at a minimum be able to stabilize our budget situation and continue to supply a quality education to our student body.

Left to right: **David Maloney, vice president for University Development; John snow, dean of the OU College of Geosciences; Tom Blackwell, BP vice president; and Charles Mankin, director of the Oklahoma Geological Survey and OU Energy Center, accept the inaugural shipment of cores from BP America Inc.**

I ask that all alumni and friends of Geosciences aid President Boren in his efforts to get the State Legislature to relinquish its historic control of tuition at the State-supported colleges and universities. Many of you know State Representatives and Senators. It would be a big help if you said a few words to each one that allowing the universities to set their own tuition, with reasonable bounds, is an idea whose time has come.

This past year has also brought many good things to the College of Geosciences. I will just highlight two events from last November. On November 1, 2002, we broke ground for the long-planned National Weather Center. I invite all of you the next time you are on the OU campus to visit the corner of Jenkins and Route 9. You will see one building—the Charles and Peggy Stephenson Multi-Purpose Research and Technology Center —already underway, and a large sign just to the south indicating the location of the National Weather Center. Behind the sign you will see contractors shaping the ground where this 244,000 square-foot facility will go. The University plans to have construction underway by mid-July 2003.

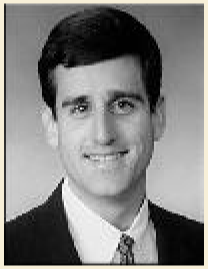
The erection of the **National Weather Center** will have major impacts on the programs of the College of Geosciences. If all goes well, all the weather-related units of the College will move to the Weather Center in the spring and summer of 2006. This will vacate the top five floors of the Sarkeys Energy Center. Just what will be done with this space will be the decision of OU Senior Vice-President and Provost Nancy Mergler. Sarkeys Energy Center Director Charlie Mankin and I have indicated to her that we would like to take advantage of this vacancy to renovate and update the whole tower area of the Sarkeys Energy Center, doing a general clean-up and fix-up, replacing twenty-year-old mechanical systems, installing a state-of-the-art information and telecommunications infrastructure, and restacking the various units that occupy the tower to obtain greater efficiency and more classrooms. If we are authorized to proceed with this plan, then Charlie and I will be appealing to the College's many alumni and friends in the energy business to help us "re-invent" the Energy Center.

On November 6, 2002, we dedicated the new **Oklahoma Petroleum Information Center** adjacent to OU's Research Campus – North (still known to most of us as "North Base"). This new facility, being developed and managed by the Oklahoma Geological Survey, will bring together under one roof all the information that the Survey has to offer those interested in exploring for oil and gas in Oklahoma and the surrounding mid-continent region. This facility occupies what was formerly the central Oklahoma warehouse of Sysco Foods. Establishment of this facility was made possible by a $3,000,000 gift from BP, together with all the cores, samples, and materials from the BP (formerly Amoco) Tulsa Core Facility. When combined with the cores, samples, scout tickets, well logs, and geophysical records already in the Survey, OPIC will indeed be a "one stop shop" supporting the Oklahoma oil and gas industry. The College is a full partner in OPIC, assisting the Survey in obtaining the BP donations and in establishing an on-site core analysis facility. Once everything is in place (as it will be sometime in late 2004), the shelves and cabinets in OPIC will house the source materials for future generations of MS and PhD students in Geology and Geophysics.

I would like to encourage those of you who hold personal or company collections of material such as cores, samples, well logs, scout tickets, etc... to consider donating them to OPIC. We have room to provide permanent storage and professional conservation for much more material than the Survey currently holds. I want to thank all of those who have already donated items for OPIC.

Let me close by thanking all the alumni and friends of the College of Geosciences for your support during this past year. In all honesty, we would not have been able to weather the financial storms of the last 12 months were it not for the many generous gifts that the College and the School of Geology and Geophysics have received over the years. The income from endowments and your annual gifts have provided us the wherewithal to continue to grow our programs and provide our students with that exceptional OU education that everyone expects. Thank you all for your continuing generosity.

John Snow
Dean, College of Geosciences



Hugh Peace
Chair, Alumni Advisory Council

Alumni Advisory Council Report

Greetings from the Alumni Advisory Council of the School of Geology and Geophysics! The last year has been a good one, with continued progress towards many of the goals established by the Alumni Advisory Council during 2001-02.

The School of Geology and Geophysics continues to shine in many areas, including increased enrollment at both the graduate and undergraduate level, and placement of students graduating with advanced degrees. Both of these trends indicate that the School is providing a world-class education in geology and geophysics. We believe that the School's strong performance in these and other areas are a direct result of the efforts of Director Roger M. Slatt and the faculty and staff of the School. We all knew that Dr. Slatt was something special, and it appears that the AAPG also shares this opinion, as it awarded Dr. Slatt an honorary AAPG membership in 2003.

AAC highlights of the last year included finalizing the conversion of the Alumni Advisory Council Professorship to the Alumni Advisory Council Scholarship, the completion of Dr. Slatt's enrichment fund, and the initiation of the "Vision for Excellence" campaign.

Fall 2002 Meeting

The Alumni Advisory Council's (AAC) fall meeting was held on November 22, 2002. Presentations by Dr. Slatt, Mr. John Ritz, Dean John Snow, Dr. Charles Mankin, and Provost Nancy Mergler highlighted the activities of the School of Geology and Geophysics, the College of Geosciences Development office, the College of Geosciences, the Oklahoma Geological Survey, and the University.

Dr. Charles Mankin of the Oklahoma Geological Survey described the recent donation of more than 430,000 feet of core and 3 million dollars from BP America. Both the newly acquired and the existing Oklahoma Geological Survey core will be housed in a new facility in Norman.Dr. Mankin and College of Geosciences Dean John Snow were instrumental in bringing the core to Norman and acquiring the new core storage facility. The University and the Survey will continue to seek additional donations of core and samples to add to this large collection. Subsequent to the fall AAC meeting, AAC member Robert Allen indicated his intention in the future to donate the samples contained in the Ardmore Sample Cut and Library, Inc. to the new Norman core and sample facility. The addition of the BP and Ardmore Sample cut materials to the existing Oklahoma Geological Survey core and samples will make this a world class collection.

Left to right: **AAC Members David Kimbell, Gene Van Dyke, and Grady Laughbaum in a lively discussion as they participate in the Fall 2002 AAC meeting. *Photo by Vance Hall***

John Ritz presented a plan detailing the school's funding priorities for the next five years. The top priority on the list was the completion of Dr. Slatt's enhancement fund. During the discussion of the funding priorities, AAC member Gene Van Dyke pledged half of the funds necessary to complete Dr. Slatt's enhancement funds if the remainder of the AAC would pledge the other half. As of this writing, it appears we have sufficient pledges to complete this funding item. We owe many thanks to Bob Stephenson, Gene Van Dyke and all the other alums and friends who contributed to this important goal.

Enrichment Committee Chair (and former AAC Chair) Deborah Sacrey and John Ritz described the "Vision for Excellence" campaign, which kicked off in late 2002. The campaign is intended to ensure the School of Geology and Geophysics continues as a preeminent center of excellence for study and research in geology and geophysics. Every alum should have received materials describing this campaign. During the fall AAC meeting, Deborah and John presented beautiful mineral specimens to the first charter members of "Mohs Club". Dr. David London did an exceptional job selecting and preparing the mineral specimens that were presented as awards to the charter members (*Photos of the Mohs Club specimens are located on pages 16-17.*) It's not too late to become a charter member in several levels of the "Mohs Club". If you are interested in further details, please contact Mr. John Ritz or Ms. Deborah Sacrey (*or see information on pages 78-79*) .

Spring 2003 Meeting

The AAC met on April 11, 2003, to discuss such items as the School's demographics, majors and degrees offered (including the School's application to offer a Ph.D in Geophysics), the current and projected financial status of the School, and on-line courses being offered through SG&G.

Enrollment of undergraduates has experienced a steady climb, while there has been a slight decline in the number of graduate students. This decline is due to both the drop in income caused by the university budget cuts, as well as to the fact that many of our current graduates are finishing their degrees more quickly than in past years.

Applications to the School for graduate work are increasing and the School is making offers to a smaller and more select percentage of those applying. SGG students are also being heavily recruited by petroleum companies -- 18 companies recruited this year.

Many on-line education courses are offered by SG&G and through EDGe. Dr. Slatt offered his course once through AAPG and twice through OU. Except for this course, the other on-line courses do not receive OU credit. Dr. Slatt will contine to work toward gaining credit status for the on-line courses.

Dr. Slatt reported that the School will experience an income drop in 2005 after the 5-year Presidential match is completed. The School's expenses are increasing as it acquires more graduate students. **None-theless, Dr. Slatt indicated that the School is in better financial condition than many other departments at the university due to the continued support provided by its alumni and friends.**

Future Projects

One of the future goals for the AAC is to develop a closer relationship with the advisory boards of other departments and academic units that have ties to the School of Geology and Geophysics. Our hope is that if each advisory board is familiar with the activities and goals of the other boards, we will be able to complement each other and strengthen the energy and geoscience disciplines at OU. We plan to have a joint session with one or more of these boards within the next year.

At this time last year, the AAC made its first venture into the online world with the establishment of an AAC website at http://sggalumni.ou.edu. Please take a minute to have a look at the website, as it contains lots of useful information for OU alums.

Although most of the news for the School is positive, budgetary shortfalls in the state of Oklahoma have caused budget cuts throughout the University. Now, more than ever, the School needs the support of its alumni and friends. If you would like to contribute to the school financially, or through your time or advice, please let us know!

MARK YOUR CALENDAR

November 7, 2003

Please "*hold the date*" for a special evening at the Oklahoma Sam Noble Museum of Natural History to be held on November 7, 2003, to honor a "special friend" to the oil and gas industry. We will encourage participation from all of our friends and graduates for a special fund raiser shared by the School of Geology and Geophysics, the Sarkeys Energy Center, the College of Geosciences, and the Curtis W. Mewbourne School of Petroleum and Geological Engineering.

SG&G Development News

John W. Ritz
Director of Development
College of Geosciences

THE NEW GEORGE LYNN CROSS HERITAGE SOCIETY HONORS DONORS OF PLANNED GIFTS

The George Lynn Cross Heritage Society has been established to honor and recognize donors who, through their estate planning, include a gift that will benefit OU for generations to come. Planned gifts take many forms, such as bequests, charitable remainder trusts, life insurance, or retained life estates. They may mention specific institutes or programs within the College of Geosciences School of Geology and Geophysics or any area at the University of Oklahoma.

The new society is named in honor of Dr. George Lynn Cross, who was the University of Oklahoma's revered seventh president and, in many ways, the architect of the University's transition from a college to a great comprehensive public university. Dr. Cross joined the university as an assistant professor of botany in 1934 and in 1943 was named acting president. Eight years later, he began the longest tenure of any president in OU's history, serving until 1968. Dr. Cross died January 31, 1998, at the age of 93.

Donors to the George Lynn Cross Heritage Society who give their permission will have their names printed in certain future OU publications. We encourage alumni and friends who have already made planned gifts to the University to notify us, as they will become founding members of the new society.

For additional information about the George Lynn Cross Heritage Society or planned giving opportunities, please call Mr. John W. Ritz, College of Geosciences, at (405) 325-3101; or call Mr. Paul Massad or Mr. John Hillis, University Development, at (405) 325-3701; Mr. Kenneth Conklin, OU Health Sciences Center, at (405) 271-2300; or Mr. Ron Burton, OU Foundation, at (405) 325-6478.

HIGHLIGHTS

The School of Geology and Geophysics is pleased to announce that the fifth year of Dr. Slatt's' Enhancement/ Enrichment Fund has been completed with the $100,000 challenge grant from Gene Van Dyke having been met in only six months. We will send a special thank you to Mr. Van Dyke and our many donors for making this possible. By the end of Roger's first five years as our Director, President David L. Boren will have matched the $850,000 raised by our many friends and donors.

In addition to the commitments to the Enhancement/ Enrichment fund, there is also a serious need for additional funding for graduate fellowships and discretionary student activities. The recent university and state funding deficits are accentuating this need and Dr. Slatt will devote special attention during 2003 to the raising of funds to meet this need. David London recently acquired some exquisite specimens to add to the Mohs collection for donors. Some of these specimens can be seen on pages 16-17 of this *Earth Scientist*.

James A. Gibbs has initiated an endowment for a fellowship/scholarship for students with major studies in the fields of fossil fuels and/or water resources.

Robert W. Allen has successfully nurtured the transfer of the assets from the "Ardmore Sample and Log Library" to the University of Oklahoma Foundation to be managed by the Oklahoma Geological Survey at our new *Oklahoma Petroleum Information Center* on the North Campus. Dr. Charles Mankin looks forward to accepting this gift in the late spring to early summer of 2003.

SG&G DONORS

CALENDAR YEAR 2002

We would like to thank our alumni, faculty, staff, friends of the school, and other donors for their financial contributions to the School of Geology and Geophysics. Your continued support is greatly appreciated.

ABOVE $100,000

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TOTAL CONTRIBUTIONS: $552,191.55

**Indicates matching funds included in corporate totals.*

Your Money at Work: The Wagner Challenge Grant 1995-2003

The $50,000 Challenge Grant offered by Cy and Lissa Wagner in early 1995 and matched in the summer of 1995 has been used to purchase over 825 titles including 38 geologic field trip guidebooks, 30 maps, 17 cd-roms or electronic databases (including GEOREF and the AAPG publications), 11 serial subscriptions and missing back issues of journals. Most beneficial to the library users have been the subscriptions to the comprehensive web-based database to geological literature (*GEOREF*) and to the full text of AAPG publications.

As of February 2003, the Challenge Grant has been expended and new funds, supplementary to the state provided University Libraries allocation, are needed to continue the excellence of the L. S. Youngblood Energy Library's collection.

Thanks go to Cy, Lissa, and the 34 contributors who together matched the Wagner Challenge.

MOHS CLUB

Our alumni and friends have played an extremely important role in creating one of the best petroleum geology and geophysics schools in the world. Your contributions are largely responsible for the scholarships, endowed chairs and professorships, computer labs, mineral exhibits, and world-class library that support the excellent programs we are able to offer our students.

To accomplish our vision of contemporary excellence, critical private investments are needed to build upon areas of historical excellence, as well as to foster emerging ideas, create new programs, and provide incentives to students, faculty, and staff.

There are several important ways alumni and friends can support our school. One such method is to participate in the annual support group, the Mohs Club, named after the Mohs Scale of Hardness.

The Mohs Club establishes levels for annual financial contributions to the School of Geology and Geophysics Director's Discretionary Fund. The first 10 donors in each category who make a three-year commitment will be identified as charter members and will receive a mineral specimen matching their donation level:

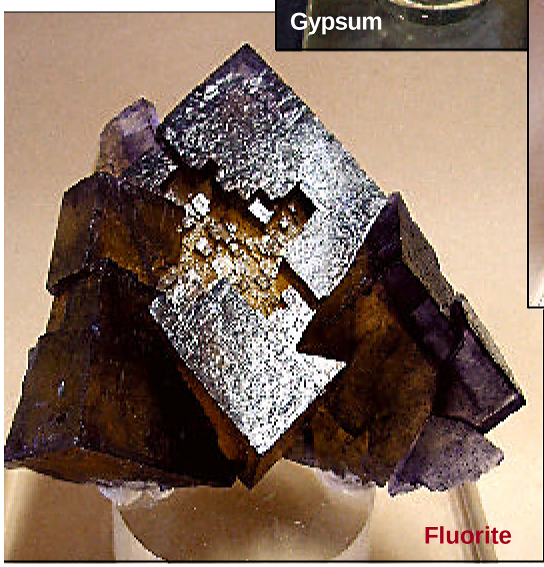
$0 - $99	Talc
$100 - $499	Gypsum
$500 - $999	Calcite
$1,000 - $1,999	Fluorite
$2,000 - $4,999	Apatite
$5,000 - $9,999	Orthoclase
$10,000 - $24,999	Quartz
$25,000 - $49,999	Topaz
$50,000 - $99,999	Corundum
$100,000 and over	Diamond

We invite you to view photos of the excellent specimens that Dr. David London has prepared for the Mohs Club participants on the next two pages. Additional information regarding this program is located on pages 78-79 of this publication.


Talc


Gypsum

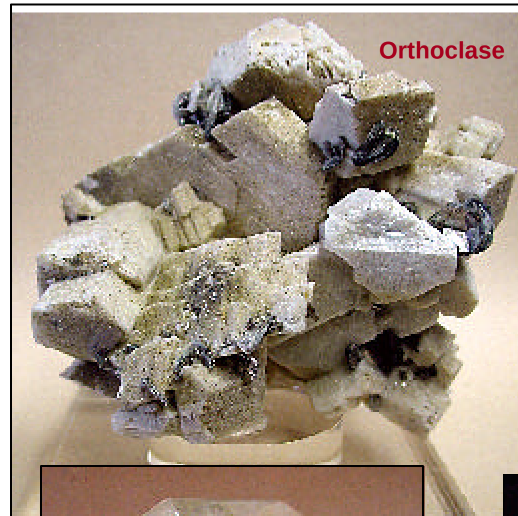

Calcite


Fluorite


Apatite

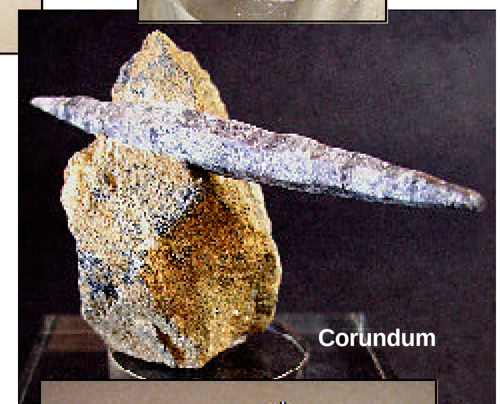
MOHS CLUB SPECIMENS

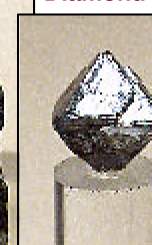
Photos by David London


Orthoclase


Quartz


Topaz

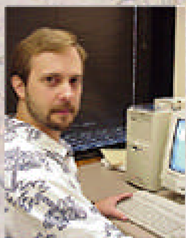

Corundum

Diamond

EXPLORING THE LARGE WORLD OF SMALL FOSSILS

Rick Lupia



When people imagine fossils, they usually picture dinosaurs with long necks and tails stretching impressively across cavernous museum halls. However, most fossils are much smaller, and many times the most important are difficult or impossible to see with the naked eye. Often overlooked by scientists on account of their small size, bulk sampling strategies and innovations in technology are revealing a wealth of new fossil species, with important implications for the evolution of life on Earth.

Last year, Richard Cifelli, Nick Czaplewski, Rick Lupia and Stephen Westrop, paleontologists in the School of Geology and Geophysics and Sam Noble Oklahoma Museum of Natural History (SNOMNH), were awarded a grant from the National Science Foundation, with matching funds provided by the Office of the Vice President for Research and by SNOMNH, to purchase and install a variable pressure scanning electron microscope (SEM).* The new microscope and supporting equipment are housed in dedicated lab space in SNOMNH (Fig. 1). The SEM is used to conduct detailed morphological and anatomical studies of living and fossil vertebrates, invertebrates, and plants with sizes ranging across six of orders of magnitude. Currently the SEM is being used by faculty, graduate students and undergraduate assistants to examine the fossil record of Paleozoic trilobites, Mesozoic plants and mammals, and Cenozoic bats:

Cambrian and Ordovician trilobites (Fig. 2)—Dr. Stephen Westrop [Professor, Geology & Geophysics; Curator, SNOMNH] is using the SEM to investigate the Cambrian (490-543 million years ago) and Ordovician (443-490 million years ago) trilobites, a completely extinct group of arthropods believed to be most closely related to crabs

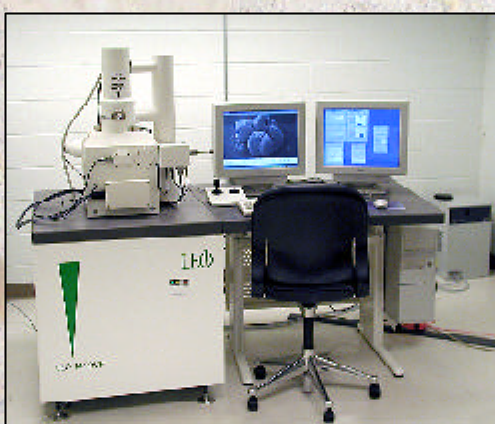


Figure 1—New scanning electron microscope purchased in part with a grant from the National Science Foundation. Housed in the Sam Noble Oklahoma Museum of Natural History, the SEM is currently being used to study fossils ranging in size from 10cm to less than 0.005mm. An image of a enrolled fern pinnule is displayed on the monitor.

**In addition, Dr. David London, Geology & Geophysics, administers the scanning electron microprobe laboratory in Sarkeys Energy Center for compositional analyses of rocks. Three additional electron microscopes are available for use by the OU community through the Samuel Roberts Noble Microscopy Laboratory (Dr. Scott Russell, Director).*

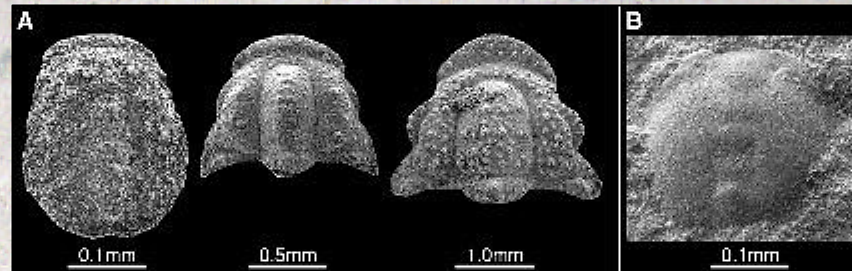


Figure 2—Cambrian trilobites. A) Protaspid (whole larva), meraspid (juvenile, head only) and holaspid (adult, head only) stages in the growth of Tricrepicephalus. These specimens are silicified, found by dissolving limestones collected in Nevada (500 million years old). Scale bars are approximate. B) Protaspsis (whole larva) of unidentified trilobite on the surface of limestone block from Newfoundland, Canada (500 million years old). ***(Photos courtesy of Stephen Westrop.)***

and lobsters. His goal is to understand the evolutionary relationships (systematics) and ecological dynamics (paleoecology) among the diverse groups of trilobites that dominated marine communities during the first hundred million years of the Phanerozoic.

Like many living arthropods, trilobites grew from larvae to adults by molting, shedding their exoskeletons and forming new ones. Exoskeletons of larvae may be extremely small, less than 1mm in length, but they bear unique combinations of morphological features that can be used to track the development of individual species from larvae to adults, and to distinguish one taxon from another. Although trilobites have been collected and studied for about 200 years, the small size of larval exoskeletons has caused them to be overlooked in favor of larger adult forms.

Bulk collections of silicified (carbonate skeletons replaced by silica) trilobites made by Westrop and colleagues in Utah and Nevada have yielded early larval stages for a variety of species (Fig. 2A). Their new data on tiny larvae demonstrate that two orders of post-Cambrian trilobites, the Proetida and the Phacopida, have previously unknown representatives in the Late Cambrian. **These new discoveries demonstrate that it will be possible finally to link important post-Cambrian groups to their Cambrian relatives, a problem in trilobite systematics that has defied resolution for more than 50 years.** Moreover, reexamination of "crack out" faunas—surfaces of rocks containing trilobite fragments that cannot be removed—from other sites has revealed previously unobserved assemblages of early larval stages (Fig. 2B) too small too be studied with light microscopes, but well within the domain of an SEM and almost completely unknown to science.

Cretaceous plants (Fig. 3)—I am an Assistant Professor in Geology & Geophysics [Assistant Curator, SNOMNH] and use the SEM to investigate the taxonomic diversity and paleoecology of flowering plants, gymnosperms (e.g., conifers), and ferns that lived during the Aptian to Campanian (71-121 million years ago) along the Atlantic and Gulf Coasts of North America. My research is aimed at examining how flowering plants, which appear only in the earliest Cretaceous, come to dominate much if not most of the landscape within about 75 million years (by the Paleocene)—an amazingly short period of time given that nearly every other major group of plants had existed for three times that long.

Leaves entombed in sediment or silicified tree trunks (as at Petrified Forest National Park, AZ) may be the most well-known type of plant fossils, but examination of Cretaceous sediments by

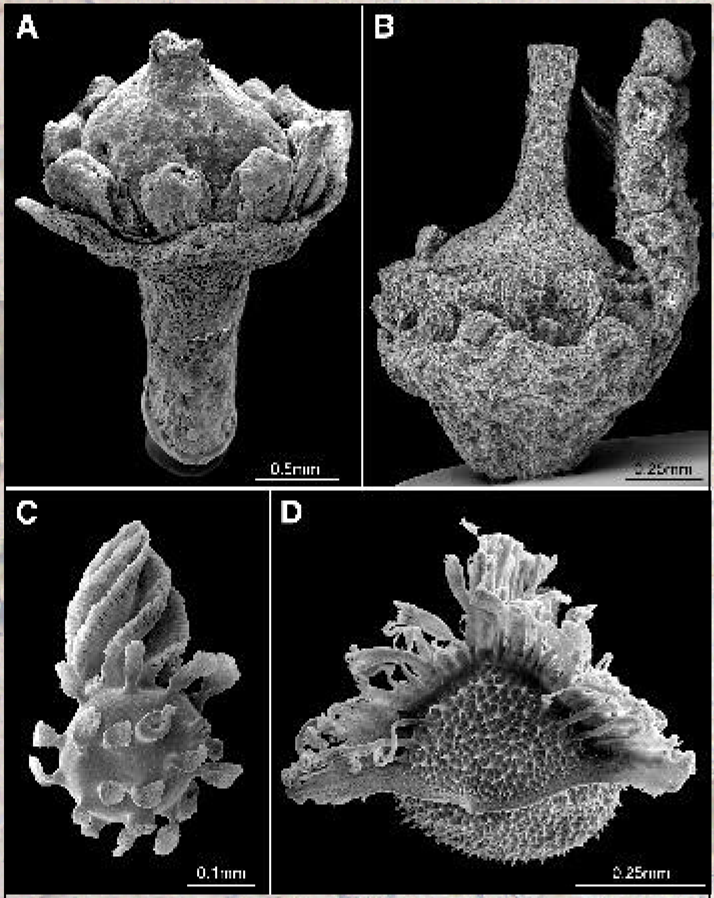


Figure 3—Cretaceous flowers and megaspores. A) New species of flower, related to living blueberries, preserved as charcoal. Note ring of large, bag-like nectaries to attract insects. B) Another new species of flower related to living blueberries. Both A and B were collected in Georgia and are approximately 84 million years old. C) Megaspore of a water fern related to living water clover (Marsilea); collected in Virginia (121 million years old). D) Megaspore of a lycopsid related to living quillworts (Isoetes); collected in Maryland (99 million years old).

gentle screen-washing has revealed remarkably well-preserved fossils ranging in size from <1mm to about 30mm. "Mesofossils" include flowers, fruits, seeds, pinnules and cones, and are preserved primarily as charcoal produced by wildfires that swept through ancient forests and fields. Several of the students in my Paleobotany class (GEOL 5413) have been using the new SEM to examine flowers as part of their class projects and their images are illustrated here (Fig. 3A,B). This approach to finding early flowers dates back only to the early 1980s and often involves seiving hundreds of kilograms of sediments to obtain a few flowers.

In addition to charcoalified plants, megaspores produced by ferns and other "lower" plants that lived in ponds and other wet habitats are recovered from the same sediments. Megaspores are similar in function to seeds and display remarkably intricate ornamentation (Fig. 3C,D) that can be useful in assigning fossils to modern families. Moreover, preservation is usually so good that it is possible to cut the megaspores to reveal wall structures. Comparing fossil megaspores with their modern relatives using an SEM promises to reveal much about the evolution of these groups whose ancestors lived alongside Cretaceous flowering plants.

Cretaceous mammals (Fig. 4)—Research being conducted by Dr. Richard Cifelli [Adjunct Professor, Geology & Geophysics; Curator, SNOMNH] involves the study of early to middle Cretaceous (93-121 million years ago) terrestrial vertebrates of Oklahoma, Utah, Montana and South Dakota in order to describe the diversity of vertebrates from this time period. By investigating the animals that lived in this region, Dr. Cifelli is working towards understanding the nature, magnitude and causes of faunal change from the Late Jurassic through the Late Cretaceous. Dr. Cifelli specializes in the systematics of the early mammals and has documented the presence in these faunas of highly specialized members of very old mammalian lineages, as well as some of the earliest representatives of "higher" or more

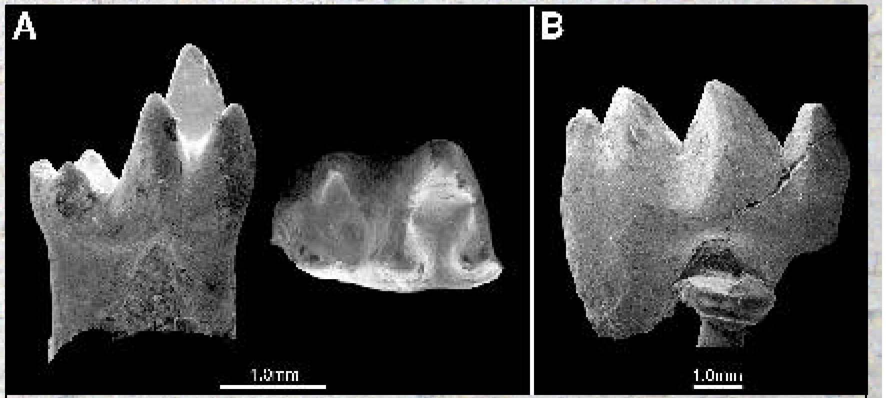


Figure 4—Cretaceous mammal teeth. A) Molar of Kokopellia juddi in lingual (from tongue-side, left) and occlusal (top view, right) views. Tooth shows the morphology of a typical "tribosphenic" molar, of which all marsupials and placentals have at least a variation. High cusps (points) were used for cutting and shearing and a lower shelf for crushing (a cusp on the upper tooth fits into this shelf). B) Molar of the largest known Cretaceous mammal, Jugulator amplissimus, in lingual view. Note that the tooth is mounted on the head of a pin. Both teeth were collected in Utah and are approximately 105 million years old. *(Photos courtesy of Richard Cifelli.)*

advanced mammal groups—marsupials and placentals.

It is often quipped that a mammal is just a tooth's way of making more teeth. While obviously untrue, it is certainly true that the fossil record of mammals is dominated by teeth. The teeth of Cretaceous mammals are small, typically between 1mm and 7mm in length, and show high relief making the SEM the ideal tool to capture minute details with high depth-of-field. It is usually possible to identify a single tooth to the family, genus or even species of the mammal that produced it because the cusps (points) and shelves are rich in features and highly diagnostic (Fig. 4). Although not usually as diagnostic below family, Cifelli and colleagues also have identified the teeth of crocodiles, lizards, snakes and dinosaurs in association with early mammals.

Beyond systematic identification, mammal teeth also contain information about body size and diet in the length of molars and the size and shape of shearing edges and grinding surfaces. Although enamel is very durable, as cusps slide past each other during chewing, minute wear striations are produced that reveal information about the mechanics of jaw motion. As small as they are, close examination of teeth provide scientists with valuable information about the evolution and ecology of the animals that produced them.

Oligocene to Pleistocene bats (Fig. 5)—Dr. Nicholas Czaplewski [Staff Curator, SNOMNH] uses the SEM to examine the evolutionary relationships and biogeography of families of New World bats. As part of his studies, Czaplewski has collected fossils from deposits at several Oligocene to Pleistocene sites in Oklahoma and Arizona as well as at Miocene sites in Florida and in Colombia (South America). Many of his excavations are conducted deep underground in caves and sinkholes. Preliminary findings based on fossils from these sites show that many groups, including "vampire" bats, currently restricted to the Neotropics, lived in North America thousands to millions of years ago.

The fossil record of bats is among the poorest for any group of mammals in spite of being the second most diverse group of living mammals (ca. 1000 species) after rodents. Bats first appear in the fossil record in Eocene (33-55 million years ago) deposits in Wyoming and Tanzania and evidence suggests that the group underwent a significant evolutionary diversification during the Oligocene and Miocene (5-33 million years ago). The average specimen studied is an isolated tooth about 1.5mm in length (Fig. 5), but specimens from 0.5mm-long teeth to jaw or postcranial bone fragments up to 20mm long may be encountered. In addition, many of the best-preserved specimens in one of the new cave sites are hundreds of isolated inner ear capsules with attached semicircular canals. Inner ear capsules are probably diagnostic of individual species, but their potential for documenting evolutionary relationships among species is unknown; future SEM analyses by Czaplewski and students will explore this new source of systematic data.

The use of scanning electron microscopy in paleontology has led to the description of diverse new species that lived on land, in the sea and in the air during Earth's geologic past. Discoveries like those above by researchers around the world motivate expeditions to new sites and reevaluation of conventional wisdom and old theories. Electron microscopes have become indispensible tools in our exploration of ancient worlds.

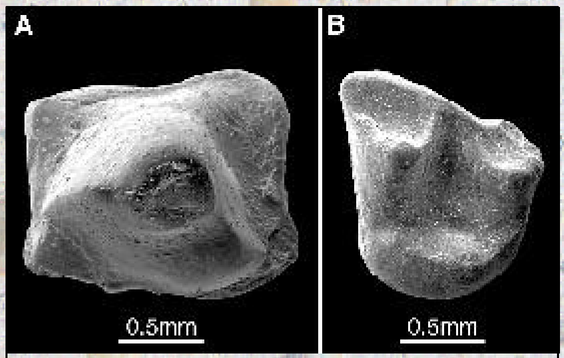


Figure 5—Miocene bat teeth. A) A premolar (occlusal view) of a new species of bat that lived in Florida approximately 17 million years ago. Note the large, grinding cusp in the center of the tooth. B) A molar used for grinding (occlusal view) of another new species of bat that lived in Colombia, South America approximately 12 million years ago. *(Photos courtesy of Nick Czaplewski.)*

ONLINE COURSES OFFERED THROUGH EDGe

Susan Smith Nash

Roll-out of online courses in geology and geophysics continues in EDGe's Center for Online Energy Education (COEE), where students from around the world are enrolling and taking advantage of the popular new delivery method.

Skeptics often think that geology and geophysics are areas of study that do not lend themselves to online instruction. However, the reality is that students appreciate the delivery method, and their coursework is often better than in the traditional classroom.

"The key is personalized instruction and interaction. The quality of an online course is a function of the quality of the content and the interaction," said Dr. Susan Smith Nash, manager of the online courses. "Roger Slatt's Reservoir Characterization course is one of the best courses I've seen anywhere, primarily because he personally guides the students in their acquisition of knowledge. He has a one-on-one relationship with the student over the internet, which assures that the work they do is meaningful and real."

"I've been developing online courses since late 1995 as a complement to onsite courses, and a service to students who have had to travel and thus needed a way to complete their coursework," said Dr. Nash. "Over the years, I have seen the demand for such courses absolutely sky-rocket, particularly after 9-11. With the recent wars and outbreaks of disease, we're seeing another surge."

Students who enroll in the online courses receive a certificate upon successful completion of the course. In some cases, they receive college credit. Courses now available include Reservoir Characterization, Seismic Interpretation, 3-D Seismic, Geophysical Exploration, Technical Writing, Scientific Writing, Earth's Mechanical Systems, Petroleum Geology, and Well Log Interpretation. Courses under development include Petrophysics, Direct Hydrocarbon Indicators, Environmental Chemistry, and Satellite Imagery.

In the future, it could be possible to offer lab online lab courses via thin-client software, which allows students to log into a large central computer where data and software is already loaded. This could be implemented in geophysics, well log interpretation, and some geology courses, and would allow students to learn how to process and analyze data.

New “Cave of the Crystals” at Naica, Chihuahua, Mexico

David London

Mineral collectors are familiar with the large, clear gypsum crystals that come in abundance from the state of Chihuahua, Mexico. Some fine samples are on display in the Youngblood Energy Library and in the School’s Geologic Gallery on the second floor of the Sarkeys Energy Center. Though large gypsum crystals are sometimes attributed to “The Cave of Swords” in the base-metal mine at Naica, Chihuahua, “The Cave of Swords”, which was discovered at a depth of ~ 120 m in 1910, is probably not the actual source. It is a sealed national treasure that is, today, mostly intact and accessible only with difficulty through the current mining company, Peñoles.

Figure 1

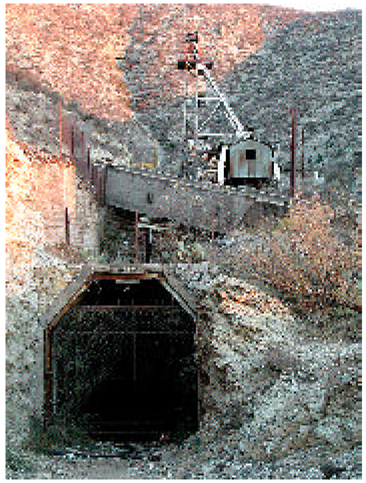


Figure 2

Recent news of new caves full of gypsum at Naica started coming out a year ago, and some sketchy information is available on the web*. At the 2002 Denver Gem & Mineral Show, Mexican mineral dealer Benny Fenn (Las Cruces, NM) told me he had recently been able to visit the new “Cave of the Crystals”, and he urged me to join him or his son if he could arrange a return trip. That trip finally materialized for me and professional cave photographer Kevin Downey (Amherst, MA) on December 14, 2002. The cave visit was preceded, of course, with a fine day of buying minerals (Fig. 1) and visiting mine sites (Fig. 2) in the famous mining center of Santa Eulalia, just southeast of Chihuahua City. Once at Naica, all talk of collecting or buying minerals ceases, as it is a Federal crime to remove specimens from the mine (naturally, in Santa Eulalia, I was offered specimens from Naica).

As we drove into Naica, I noticed mine waste water that was “steaming” on a balmy day of 21°C (70°F) (Fig. 3), a harbinger of conditions to come. At the headquarters, Peñoles has created an excel-

Figure 3

lent display of minerals from the mine, featuring gypsum (Figs 4, 5), that gave us something to look at for the three hours it took to arrange our (prearranged) underground trip. The trip down by pickup truck followed a long series of circular inclines to the ~ 300 m. level of the mine. There we faced a

Figure 5

Figure 4

locked steel & concrete barricade (Fig. 6). The barricade serves mostly to protect the gypsum in the new “Cave of the Crystals”, but as it turns out, it is also a thermal barrier.

During our mine overview, the mine geologist explained that following the main orebody down to ~ 700 m., temperatures at the bottom of the mine rose to 71°C (160°F), and miners can work only a few minutes before having to be removed to shallower and better ventilated areas. So the company drove exploratory adits laterally, seeking ore at shallower levels. One of these lateral shoots at ~ 300 m. crossed a fault and opened into the “Cave of the Crystals”.

Past the steel barricade, the temperature rises slightly but perceptibly from ~ 27°C (~ 80°F) outside to ~ 32°C (~ 90°F) inside the barrier (based solely on my perception, not on any measurements). Walking along the adit toward the new cave (Fig. 7), temperature does not rise much, but one notices immediately that the air is saturated in water. At just 50 cm. from the portal to the new cave, temperature ramps up sharply, and proceeding just 1 m. across the barrier, temperature rises to 65°C (150°F), measured and steady, at 100% relative humidity. It’s hard to recollect which was the greater shock, the clear gypsum crystals measuring up to ~ 1 x 2 x 9 m (Fig. 8, 9), or the stifling, steaming heat. The combined effect, in any case, was as invigorating as it was awesome.

I had heard that the caves were hot. Our professional photographer came prepared with a

Figure 6

New "Cave of the Crystals" at Naica, Chihuahua, Mexico, *continued*

Figure 8 *(as seen on the front cover)*

home-rigged cooling circuit for his body (Fig. 10). The rest of us just gritted it out. Except for the ice-bath-cooled photographer (24 minutes, by his count), we lasted nearly 12 minutes in the cave, with the previous record at 14 minutes. I made two trips in as well.

I had not heard about the fact that the air was water saturated. Glasses and cameras don't just fog up, but water starts condensing in buckets on everything that comes into the cave. With experience and inside information, the photographer was again prepared, with water-tight cameras in plastic glove bags. The rest of us had expensive but otherwise ordinary camera equipment, certainly not rated for under-water use at high temperature. You might think, "fine, just wait until everything comes up to equilibration temperature", but if that includes your body, then you're dead. I was surprised when I took off my glasses, wiped them until they remained clear, only to have them fog up again when I put them on my head. My face was that much cooler than the air, even after 10 minutes in the cave, that water condensed immediately on my glasses. I was able to get a clean camera lens, but just as the lens started to come clean, I noticed on my digital viewer that the image was fully fogged—water had condensed on the photodiode inside my camera. The only solution—go out, let the water evaporate from the hot camera body, then reënter—doesn't work, of course, because you go through the same sequence again.

Figure 7

Figure9

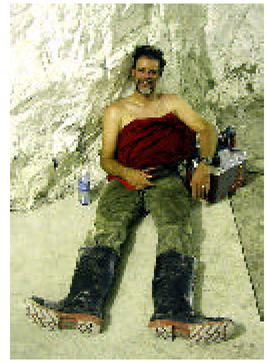


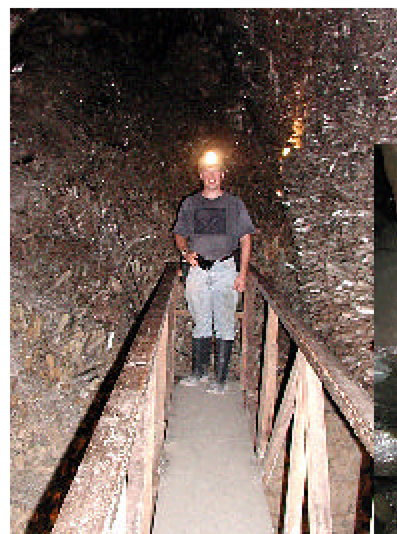
Figure 10

Despite all this, I was able to enjoy a true marvel of nature. The gypsum crystals are sharp, clear, clean, perfect. They are immense, and not a single crystal in the new "Cave of the Crystals" is broken, that I could see. Crystals of 1 m. fan across the roof (Fig. 9), and the real giants grow up from the floor (Fig. 8, 9).

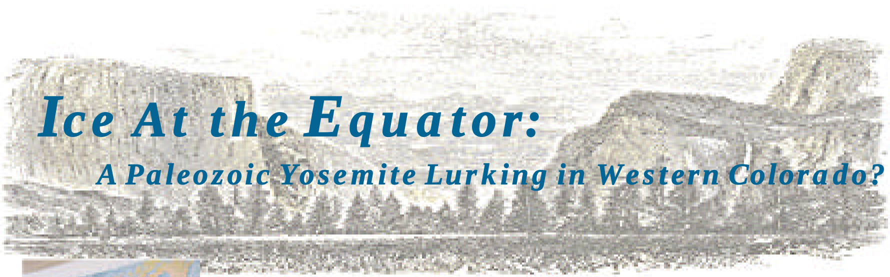
A visit to the "Cave of Swords" (Fig. 11, 12) on the way out proved as disappointing as a dust devil must be to a meteorologist who's just witnessed an F5 tornado. I missed the heat as much as the flawless perfection and giant scale of the "Cave of the Crystals".

I doubt that the "Cave of the Crystals" will ever become a tourist attraction. For the sake of the crystals it contains, I hope not. I thank Benny Fenn, profusely, for giving me the opportunity to see it.

- http://www.smithsonianmag.si.edu/smithsonian/issues02/apr02/phenomena.html
- http://www.showcaves.com/english/mx/caves/Naica.html
- http://www.cesmat.asso.fr/English/naica.htm

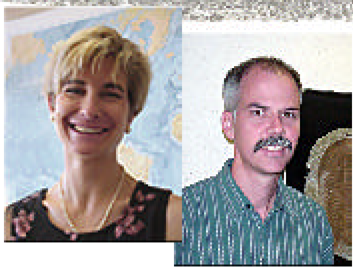


Figures 11 and 12



Ice At the Equator:

A Paleozoic Yosemite Lurking in Western Colorado?



Gerilyn and Mike Soreghan

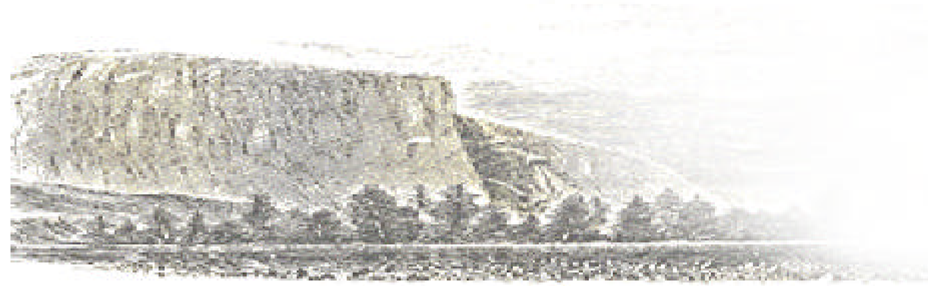
"To attribute this cañon to the streams now draining it is manifestly absurd."

-Henry Gannett, 1882

Unaweep Canyon of western Colorado has always been a paradox. A spectacular gorge carved in Precambrian crystalline basement, Unaweep is occupied by two puny creeks that flow in opposite directions from a subtle divide within the canyon. Clearly, these creeks didn't carve Unaweep Canyon. But what did, and when and how? And why is any of this important, anyway?! Drs. Lynn and Mike Soreghan recently received a grant from the National Science Foundation to explore these and related questions.

Most geologists consider Unaweep Canyon to be a former stream course of the Colorado and/or Gunnison rivers that was abandoned during recent uplift of the Uncompahgre Plateau associated with development of the modern Rocky Mountains. But there are problems with this idea. The very shape of the canyon and its tributaries are not consistent with fluvial incision. It is remarkably steep-walled and flat-bottomed, with tributaries that fail to extend headward, and commonly hang at their join with the trunk valley (see figures). In other words, it strongly resembles a classic alpine glacial valley, complete with a U-shape and inferred cirques, truncated spurs, and hanging valleys. There are certainly multiple examples of Pleistocene glacial landscapes in nearby peaks of the San Juan and La Sal Mountains. But a Pleistocene glacial explanation also poses an insurmountable problem, because Unaweep Canyon, with its peak elevation of 7000' at the Divide, is well below Pleistocene terminal moraines in the region. Pleistocene glaciers simply did not persist to such low elevations in these parts. So, what carved Unaweep Canyon?

View of Unaweep Canyon looking west



The Soreghans have gathered preliminary evidence suggesting that Unaweep Canyon may well have been carved glacially, but not during the Pleistocene Ice Age. Rather, they suggest it may represent the only known example of an ancient alpine valley—carved by mountain glaciers during the late Paleozoic (300 My ago) icehouse. Their evidence stems from the remarkable geomorphology of the canyon – the glacial landforms and buried paleotopography—together with the discovery of apparent Permo-Pennsylvanian glacial deposits preserved within the canyon interior, and the inferred proglacial origin for the Permo-Pennsylvanian Cutler Formation exposed at Unaweep's southwestern end (near Gateway, CO). Although the Cutler Formation has long been considered an alluvial-fan deposit, the Soreghans have discovered deposits most consistent with a glacially influenced origin, such as remarkable dropstones (see figure).

Earth has experienced large-scale glaciation only a handful of times during its four-and-a-half billion-year existence. Apart from our current (Quaternary) glaciation, the best-documented example of such an "icehouse" occurred during the late Paleozoic (Permo-Pennsylvanian), about 300 million years ago. During this time, ice covered much of the southern polar region of "Gondwanaland", including parts of South America, South Africa, India, Australia, and Antarctica, as evidenced by well-documented glacial tills, striated surfaces, dropstones

An arête-like landform, typical of glacially influenced landscapes (think "Matterhorn!") [central Unaweep]

A U-shaped tributary canyon [western Unaweep]

Ice At the Equator, continued

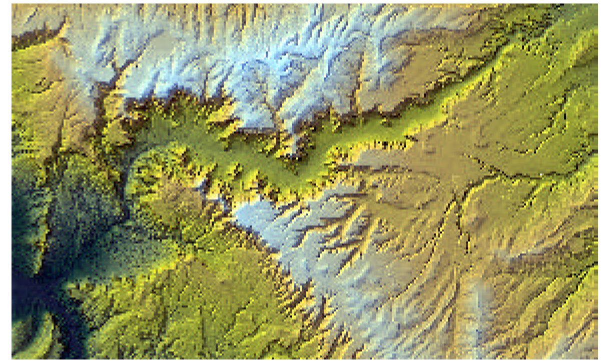
Dr. Mike Soreghan examining an apparent "dropstone" horizon exposed within the Cutler Formation near Gateway, CO. The large boulders are thought to have been released from melting icebergs within a glacial alpine lake that formed at the western outlet of Unaweep Canyon during the Late Paleozoic ice age (300 Million years ago). Emily, Anastasia, and Nicholas Soreghan serve as field assistants. Inset shows close-up of a dropstone that deformed underlying layer.

and the like. But to date, evidence for glaciers outside the limits of these classic Gondwanan ice centers is lacking. To further complicate matters, western Colorado's Unaweep Canyon wasn't where it is now; rather, it was at the equator.

Ice at the equator poses some obvious questions. Tropical glaciers exist today, and were even more extensive 18,000 years ago, during the Last Glacial Maximum (LGM). But they are limited to high-elevation mountains (generally above 13,000' LGM). Was the Uncompahgre uplift, one of the primary uplifts of the Ancestral Rocky Mountains, really that high? Or, was the climate system somehow different, to allow equatorial ice to exist at lower elevations? Further, how did an alpine valley survive? Don't mountains usually erode away? If Unaweep Canyon is really an alpine glacial landscape of the late Paleozoic, there are significant repercussions for our understanding of both tectonic and climatic issues.

Let's take the tectonic issues first. Before the Rocky Mountains were the Permo-Pennsylvanian *Ancestral* Rocky Mountains—a puzzling collection of discrete uplifts and basins that formed in interior western North America, and that preserves a fabulous record of tectonic and climatic processes, as well as enormous domestic hydrocarbon resources. Judging by the thick, coarse sediment that fills the basins adjacent to many of the uplifts, most geologists think that the mountains were "significant". But what does "significant" mean? The answer is important, because the Ancestral Rockies formed far from any obvious plate boundary, and thus don't readily fit our standard plate tectonic models. Furthermore, if Unaweep Canyon is a remnant alpine landscape of the Ancestral Rocky Mountains, then the mountains themselves must have—to some extent—collapsed. At first blush, this seems a bit odd, but OU's own Charles Gilbert has documented such post-orogenic subsidence in another part of the Ancestral Rocky Mountains—here in the Wichita Mountains of Oklahoma. A better understanding of Unaweep Canyon could contribute to our understanding of the remaining vagaries of tectonic behavior.

Now for the climatic issues. If Unaweep Canyon and the Cutler Formation are related to late Paleozoic glacial activity, then either the mountains were high, or Permo-Pennsylvanian icehouse climate was much cooler than today's. Atmospheric CO_2 back then was comparable to the present, but solar luminosity was about 3% less than it is today. By comparison, solar luminosity during



Digital elevation model of Unaweep Canyon, showing the cirque-like margins [image is 45 km across].

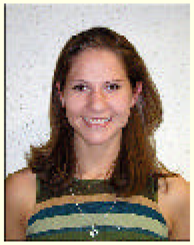
could make a difference; the question is—how much of a difference? That is, how low could the mountains go and still be glaciated? How different from today was the world of the Late Paleozoic, and why should we care, anyway? Here's one good reason: we're currently conducting an uncontrolled experiment in anthropogenic climate change; we need to know how Earth's climate system works—now and in the past—if we wish to predict the future.

There are more issues to consider as well. Permo-Pennsylvanian strata of the West have been well studied by both academic and petroleum geologists, and depositional models are well established. Or are they? The Cutler Formation at the southwest end of Unaweep Canyon is a favorite fieldtrip stop for viewing "classic" proximal alluvial-fan strata that prograded into the petroliferous Paradox basin. But were they really alluvial fans? If the mountains were glaciated, then the associated sedimentary strata in many of the Ancestral Rockies basins merit reinterpretation as various types of glacially related deposits.

The best part about all this is that the answers lay in the (very scenic) field. And the Soreghans and students will soon be out there, in search of the answers. They'll be employing classical field geological techniques, including mapping and describing the rocks. With a little additional funding luck, they may even be able to probe the "deep" secrets of Unaweep using water-well or seismic technology to test the depth of the sediment fill in the canyon, which remains a long-standing mystery. If their hypothesis proves correct, they will confirm the uniqueness of Unaweep – as the only known example of a Paleozoic, glacial alpine valley on the face of the planet. Stay tuned!

Dr. Lynn Soreghan and son Nicholas, at overlook. Unaweep's distinctive U shape visible in the background.

FEATURED STUDENT PAPER:



Kathryn Gardner

SG&G student KathrynGardner participated in the NASA-Undergraduate Student Research Program NASA-Goddard Space Flight Center Laboratory for Extraterrestrial Physics, Astrochemistry Branch, Code 691, during her sophomore year.

She was the senior author of this research article in conjunction with: Joseph A. Nuth, Natasha Johnson, Jason Dworkin, George D. Cody, and Jean Li. Her goal is to earn a Ph.D. in Planetary Geology, which will enable her to have a career as a scientist and astronaut.

ABSTRACT:

Recent data obtained by astrophysical research suggests that a modification of the current solar nebula model is needed. Comets contain crystalline Mg-silicates (olivine) in addition to the expected amorphous Mg- and Fe-silicates. Since these bodies never went any closer to the sun than 5 astronomical units (AU) in the current model, it would be impossible for them to encounter high enough temperatures to crystallize olivine in a time frame reasonable for solar system formation. This implies that gas and grains were first processed in the inner nebula and then transported out to the regions where comets formed. We (myself and my research supervisor) condense Fe-silicate grains and coat them with organic material via Fischer-Tropsch synthesis to simulate the chemical environment of the pre-solar nebula and to analyze the chemical properties that will eventually be incorporated into comets and meteorites. Some of the grains will also undergo thermal annealing and hydrous alteration similar to what may have occurred on the parent body. We will compare our analog material to the organic molecules in meteorites.

I. INTRODUCTION:

The current theory on the formation of the solar system goes back to the work of Immanuel Kant in 1755 in which he hypothesized that a large cloud of gas and dust was the initial state of what became our planetary system. Within the next hundred years, P.S. de Laplace added to Kant's model the flattening and rotation of the nebula into a disk, and Edouard Roche solved the angular momentum problem for the rotating body (Oxley 1999). Ever since, new ideas have been added and supplanted to make the model of cosmogony fit the advances of scientific research. It is too presumptuous to boast that we as humans know very much about our origins, however, I do feel it adequate to state that we know more now than in Kant's day. As time creeps on and technology advances, researchers and theorists have an increasing quantity of information to add to scientific thought about the universe around us. This information, made available by comets, asteroids, and meteorites with such instruments as infrared spectrometers and scanning electron microscopes has allowed a more complete picture to be painted about what actually occurred 4.56 billion years ago.

II. THE OLD MODEL:

In science, it is quite acceptable to take a highly variable and unknown event such as the formation of the solar system and apply the simplest explanation to it until further information is available. Up to this point, scientists generally accept the work of Kant, Laplace, Roche and many others in the following model, and space scientists apply it to their research (Cameron, 1988; Stevenson, 1990; Fegley, 1999; Kerridge, 1999 etc).

Sitting out in the midst of space was a gigantic cloud of gas and dust. This presolar nebula basically "hung" around until a nearby event sparked its collapse. This event is highly speculative, and one possible scenario is that a supernova exploded sending shock waves to the presolar nebula, thus initiating an alteration from its otherwise happy state. In doing so, it supplied ^{26}Al to the nebula which can be seen in the chemistry of CAIs (calcium-aluminum inclusions) that make up chondrules, tiny crystalline stones that serve as the main component of most meteorites (Wood, 1998; McSween, 1999). Whatever the case, the gas and dust cloud was disrupted and began to collapse. As this occurred, the particles conserved angular momentum, and soon enough, the shrinking cloud was rotating rapidly. Through the application of physical laws, the nebula formed a disk. This accretion disk surrounded an object that will soon become large enough to call the sun.

Synthesis of Meteoritic Organic Material Applying a New Nebular Model

As infalling material fell on the accretion disk, it began to rotate. Eventually, particles collided enough to stick together. The collisions occurred over a long span of time, and consolidated bodies were soon made. The extra material not formed into planets still collected but made smaller bodies such as comets or asteroids, depending on their distance from the sun. These smaller bodies were much more susceptible to the forces of larger bodies, so many of them could not keep a well-defined orbit as a planet could. These bodies swarmed through the inner solar system.

In a holistic sense, the old model is perfectly fine. It gives reasons for the current orbits, eccentricities, and spatial distances of all the planets and planetary bodies. It also reasons the creation of the smaller bodies such as comets and asteroids. But now the time has come to explain the chemistry of bodies in the solar system, and this is not feasible with the old model.

III. NEW EVIDENCE:

It has been known for years that comets, asteroids, and meteorites all have different chemical compositions that can be studied to yield information on the material that made the sun and planets. Scientists all agree that the gas and dust from the nebula goes into these bodies, and it generally contains various grains, some of which might possess an organic coating. The important information to add here is that in current studies, crystalline magnesium silicate grains (in the form of the mineral olivine) are seen in addition to amorphous iron and magnesium grains (Hill, et al., 2001). The presence of crystalline grains demands that a new parameter be added to the astrophysical model of the formation of the solar system. Since Greenberg and Li (1999) declare that no evidence exits to indicate that crystalline particles exist in the interstellar medium, the material must originate in the nebula. To obtain a crystalline olivine grain in a time period consistent with the formation of the solar system, temperatures of 1100K are necessary (Nuth et al., 2000). How could temperatures be this outrageously high outside of 5 AU where the comets and asteroids formed by the old model? A comet is simply a dirty snowball and would have absolutely no chance of surviving a temperature that high, even if for a short moment, to crystallize its magnesium silicate grains. The old model must be modified.

IV. THE NEW MODEL:

Basically, the problem we see is that some components of comets (and asteroids for that matter) must come from both hot and cold environments in order to contain both amorphous and crystalline grains. When looking at the different temperature zones in the current nebular model, there is no way any one region could witness such a high variance in temperature (Seeds 1998). Some sort of movement inside the nebula is necessary. We already know that infalling material moves toward the sun from cold to hot, but if a previously formed comet did this, it would vaporize. Yet if grains became hot enough to become crystalline, they would already be much closer to the sun than any known comet. The only way to solve this problem is to crystallize the grains before accretion can take place to make the body and somehow transport crystalline material back to the outer nebula. Since material does not fall from the nebula directly into the sun (otherwise there would be no material left), the New Model (or the Large-Scale Mixing Model) will require that material fall into the nebula, travel into the hot zone, crystallize, and then move out of the inner nebula back to the outer zone. This cyclical action is a very plausible way to get a substantial amount of crystalline grains into the outer nebula, even if only a few percentage of the total nebular grains cycle throughout the system while the rest fall into the sun. Although a mechanism for the movement of material from the vicinity of the protosun to the outer regions of the accretion disk remains speculative, some considerations can be made from work on movement in the inner zone of the nebula. Magnetic fields, bipolar outflows, density waves on the accretion disk, and turbulence inside the midplane of the accretion disk have all been investigated as causes of movement and reprocessing in the inner disk (Stevenson 1990). It is important to note that, due to the overwhelming complexity of the physics occurring during the formation of the solar system, simulating the actual event is near impossible. Despite this pessimism, many scientists have taken smaller pieces of the event and simulated their physical processes with much success.

The most important model for outward flow thus far is one hypothesized by Frank Shu et al., which explains a way to obtain chondrules, composed of olivine and pyroxene crystals in a glassy matrix, and their corresponding CAIs (Shu, et al., 1996; Gounelle, et al., 2001). The model states that CAIs and chondrules were formed at a distance of 0.06AU from the sun and were thrown out toward planetary distances by an "x-wind" where they aggregated to form larger bodies. In the model, one gram of material is processed by the wind and two grams of material are dumped back into the protosun for every three grams of material. Although Shu does add that CAIs could be sent out to the entire solar system by the wind, there remains a temperature flaw. Peak temperatures in Shu's model reach as high as 1800K, so in his adaptation, crystalline grains of both Mg and Fe should be distributed in comets. Since only Mg-silicate crystalline grains appear in comets, another mechanism must come into play during annealing of the grains.

Although theoretically important, Shu's model does not account for crystalline grains in comets; it only explains the presence of crystalline grains in chondrules and CAIs that formed within several AU of the protosun. The mechanism to transport crystalline grains to comets near ~100 AU remains essentially unexplored. Ideas presented by Nuth et al. include material exchange between adjacent turbulent convection cells and vortices resulting from non-linear momentum transfer in the disk (2000). Fig. 1 demonstrates an idea by Nuth in a schematic diagram (Nuth, 2001). In all reality, Shu's model may be the precursor to an idea like the Large-Scale Mixing Model; the "x-wind" in conjunction with other nebular processes may create a mechanism to shoot material out to the Oort Cloud, an area near 100 AU that houses a countless number of comets. Despite the fact that it was not formulated to explain the presence of crystalline Mg-silicate grains in comets, we can still use the type of mechanism in the "x-wind" model to bring back to life the theory of Fischer-Tropsch type reactions as the way to form organic material in the solar nebula. This way, we can try to match the astrophysical scenario with what happens chemically in the laboratory. Unfortunately, technology has not advanced so far that we have direct samples of cometary material. We do, however, have indirect evidence from the comet's cousin, the meteorite. We can apply the techniques of Fischer-Tropsch synthesis to meteoritic chemistry and see if that chemistry matches what would occur under the Large-Scale Mixing Model.

V. FISCHER-TROPSCH SYNTHESIS

Two German scientists developed the Fischer-Tropsch reaction during the 1930's for use in the coal industry. The implications of the reaction, however, can be used across the board by any scientist to hydrogenate carbon monoxide. The reaction converts carbon monoxide and hydrogen into hydrocarbons, making use of a Fe (or Ni, Mn, or Co) catalyst. The reaction is expressed by the following equation:

$$nCO + (2n + 1)H_2 + \text{catalyst} \rightarrow C_nH_{2n+2} + nH_20 + \text{catalyst}$$

To keep things simple in this preliminary experimental research, we track the formation of methane, CH_4, thus making n=1, and with this, the equation becomes:

$$CO + 3H_2 \rightarrow CH_4 + 2H_20$$

Very useful in the astrophysical and astrochemical worlds, this catalytic reaction provides a way to obtain methane and other simple hydrocarbons from the combination of primarily N_2, CO, and H_2 that composed the solar nebula. It also yields an attractive mechanism to overcome the activation energy needed to hydrogenate carbon monoxide. The experiments of Nuth and Hill (2002) maintain that Fe silicate grains are excellent catalysts for the Fischer-Tropsch reaction as well as for the Haber-Bosch reaction, which converts N_2 and H_2 into ammonia, another prebiotic chemical.

Hayatsu and Anders presented extensive work with organic compounds in meteorites in 1981, and most of their work points toward validation of Fischer-Tropsch reactions as the way to obtain organic material in meteorites. They found that organic substances seen in meteorites such as hydrocarbons, oxygen-containing compounds, purines, pyrimidines, porphyrines, and organic polymers could be produced to some extent though Fischer-Tropsch synthesis. The formation of amino acids was not as successful, although they were present in some experiments.

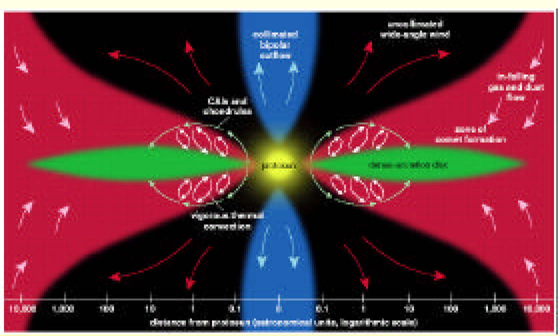


Figure 1 Schematic of Solar Nebula, from Nuth, 2001

There is considerable skepticism regarding the importance of Fischer-Tropsch synthesis in the solar nebula. The effects of the Hayatsu and Anders (1981) paper were far reaching, and many deny its worth as time has progressed. Ramadurai et al. argue that the grains would become "poisoned" too quickly thus ceasing any catalytic reaction to justify Fischer-Tropsch synthesis to the extent that organic material is seen in the smaller planetary bodies (1993). They also argue that the depletions of certain isotopes of carbon in meteorites cannot occur in FT type reactions. It is important to note here that basic experimentation on chemistry in the solar nebula has been formatted under the old nebular model in which grains travel through the accretion disk only once and stop at the sun instead of being recycled through the nebula and chemically reprocessed. Perhaps this recycling of already poisoned grains and recontamination through Fischer-Tropsch synthesis will yield a better analog of nebular chemistry as seen in current meteorite specimen.

Although some scientists would argue against Fischer-Tropsch synthesis in the solar nebula, many will be quick to mention that some sort of reprocessing or chemical alteration occurs after grains enter the nebula and before they become consolidated in a large rock body. Fegley notes in his explanation of solar nebula evolution that the extent of reprocessing of material outward from the hot inner regions of the nebula to "contaminate" the outer regions with processed grains from the innermost AU is still questionable (1999). He also adds that "disequilibrium assemblages of oxidized and reduced molecules [in comets] may have been produced by mixing presolar material with thermochemically processed nebular material." Even after Kerridge delivered several "blows" against Fischer-Tropsch synthesis in his 1999 study, he was quick to add that "no single mechanism can explain the full range of…meteoritic organic matter" and that "a concatenation of different processes" would be responsible for the chemistry. Now is the time in astrochemical research to question whether the Large-Scale Mixing Model could account for such chemistry.

All of these cases argue for a high temperature event to reprocess grains. It must be mentioned, however, that any other event that could yield high temperatures in the region of comet formation would be highly inefficient. Nuth et al. (2000) note that although crystallization of olivine is possible at 850K, it would take 2.4×10^{13} years! Yet at 1100K it only requires one hour. Finally, Nuth and Hill reaffirm with experimentation that "catalytic chemistry could convert a significant fraction of CO and N_2 nebular gas into interesting prebiotic molecules provided that adequate catalysts are readily available and that the gas spends sufficient time at relatively high temperatures and pressures" (2002). The combination of Fischer-Tropsch synthesis and the processing of the New Model provide a very efficient way to supply crystalline silicate grains to bodies forming near 100 AU.

VI. EXPERIMENTATION:

Our experiment is designed to create grains analogous to those in the solar nebula. These grains will simulate the material that may have been chemically and physically altered in reprocessing events in the solar nebula and eventually became part of the planetary bodies we research today. To synthesize organic material as it would be in the solar nebula and integrate the analog to larger parent bodies, three tasks must be completed: 1) the creation of Fe-silicate grains, 2) the establishment of organic material on the Fe-silicate grains via Fischer-Tropsch synthesis, and 3) simulation of particular aspects of the environment of the parent body via thermal annealing and/or hydration.

Step One: Creation of the Analog Grains

The grains are condensed following the combustion of silane (SiH_4) in the presence of iron pentacarbonyl ($Fe(CO)_5$) with pure molecular oxygen in a flowing stream dominated by hydrogen (H_2). Helium (He) is bubbled through iron pentacarbonyl ($Fe(CO)_5$) to facilitate the introduction of Fe to the gas phase. The gas is combusted in a furnace near 500ºC, and the resulting smoke coats an aluminum cylinder near room temperature (see Fig.2). After sufficient cooling of the system, the Fe-silicate "layer" of smokes can be easily scrapped off the Al-substrate and collected in a glass container. The grains themselves are very small, about 20-30 nm in radius; what you collect are fluffy aggregates of many grains with each grain connected to a few of the surrounding grains. Static electricity between the grains is an issue, although usually only a minor annoyance. Due to the small size of the grains, the great overall surface area, and their highly reduced state, grains often fly out of the container due to static charges and occasionally burst into flame.

Step Two: Deposition of Organic Material on the Grains via Fischer-Tropsch Synthesis

Our experimental system consists of the circular flow of gas through the Fe-silicate smoke. The smoke is kept near 500ºC; this temperature serves as one of the only fixed variables in the experiment, although not strictly enforced due to the high variance of temperature in the nebula. The grains are kept in a Pyrex tube that is then clamped onto a 2-liter Pyrex bulb. A plug of glass wool separates the inner connection of the tube with the bulb in hopes to keep the grains in place. (Cu-wiring was added to stabilize the glass wool after two "blow-outs" of the Fe-silicate grains due to a pressure differential created across the glass wool when the circulation pump was turned on). Heating tape accompanied by a thermocouple surrounds the tube to keep the reaction running at the desired temperature. To start a run, the system is pumped down close to zero torr, although absolute zero is not necessary. First, 75 torr of N_2 is added, then 75 torr of CO, and finally 550 torr of H_2; the system pressure will increase to 760 torr (1 atm) when the temperature of the catalyst increases from ~20ºC to ~500ºC. The system is then closed, furnaces turned on, and the temperature is stabilized near 500ºC (See Fig. 3). The gas travels through a cell in a BioRad Excalibur Fourier Transform Infrared (FTIR) spectrometer, which measures the spectrum of the gas phases in order to monitor the progress of the reaction. Water, methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO), and silica (SiO_2) features can all be monitored. This process is run 25-30 times to repeatedly coat the Fe-silicate grains' surfaces with organic material as could occur under the Large-Scale Mixing Model.

<u>Step Three</u>: Creation of the parent body environment via thermal annealing and/or hydration

Once enough organic material has been established on the Fe-silicate grains, work can be done to simulate particular aspects of the environment of the parent body such as an asteroid, meteorite, or comet. In this final step, the grains will be physically and chemically processed to simulate the conditions occurring in the solar nebula. It is important to note here that there is no scientific reasoning behind the fact that magnesium crystalline grains are seen in comets and not iron silicate grains. The information from Step Three can be used in conjunction with studies on hydrous mineral phases in meteorites (e.g. serpentine) to determine how crystallization takes place.

To conduct this portion of the project, we will take a third of the grains from Step Two and thermally anneal them. Another third will be hydrated, and the final third will be tested without processing. The three groups can then be compared with current meteoritic data.

VII. RESULTS:

<u>Step One Results</u>:

We created a sufficient amount of Fe-silicate grains after six runs in the Dust Generator. Each run created a variable amount, and we are uncertain as to the reason behind the inconsistency of the smoke creation. Most of the material used for Step Two was generated during the two most productive runs, the first and sixth. On these runs, the cooled smoke rested on the Al-substrate in multicolored layers. The material was scrapped off very easily and came off the cylinder in thick ribbons of connected grains as opposed to splinter-sized fluffy pieces as in the second through fifth run.

<u>Step Two Results</u>:

After the two initial "blow-outs" mentioned earlier, the catalytic system remained unopened from the third to the fortieth run. For the first two runs, the rate of methane production was very slow, but after three runs, methane was present in the first scan. Fig. 4 demonstrates the formation of the gas phases as seen by the spectral lines produced by the FTIR spectrometer. Water began to condense in the upper left bulb near the 18th run; until then, none had been seen in the system except via IR spectroscopy. After the 23rd run, we moved the length of each session to two days because the rates had slowed due to the extensive build up of organic material on the grains. On the final day of the 29th run, a condensation of volatile materials was collected for an analysis by a gas chromatograph. On the final runs, the rates had slowed even more noticeably. By the 40th run, methane was not present on the infrared spectra until the second run.

<u>Step Three Results</u>:

After the 40th run, the system was cooled to room temperature, and the Pyrex tube containing the thoroughly coated Fe-silicate grains was detached from the bulb. Eighty percent of the original grains were recovered from the system. A majority of the sample retrieved consisted of the grains from the Pyrex tube that remained beneath the glass wool plug after the forty runs. A small portion of grains had migrated above the glass wool throughout the experiment and was collected in a separate vessel. A third container was used for the small amount of grains that were trapped in the second bulb. Next, these samples will be hydrated and thermally annealed to perform the experiments as mentioned above. Step Three of the experimentation process, however, has not been performed as of yet. In turn, the results to the final portion of this project will not be available until a later date.

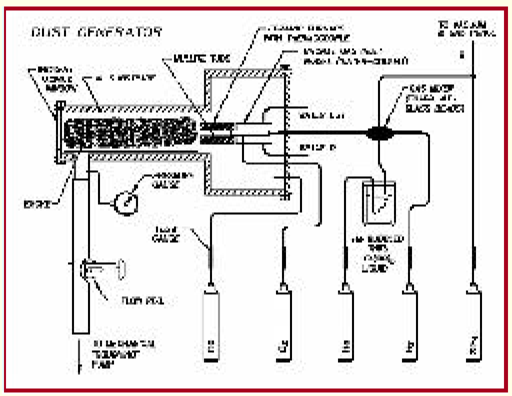


Figure 2 Dust Generator

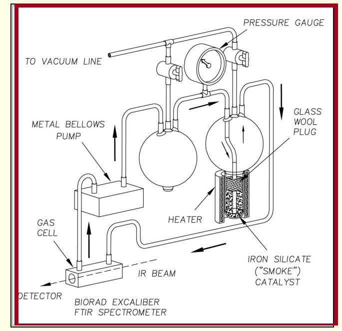


Figure 3 Gas Circulation System

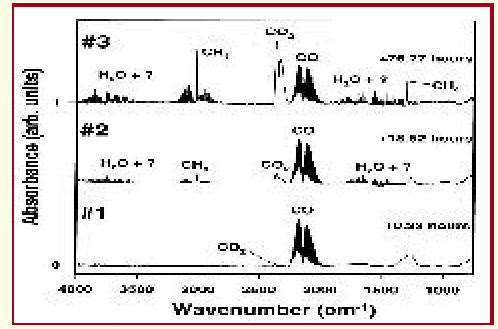


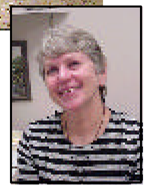
Figure 4 Spectral Progression of Gas Phases

VIII. CONCLUSIONS:

Our experiments successfully revive the concept of Fischer-Tropsch synthesis in the solar nebula. The catalytic system produced methane in each run and the rates apply to the parameters of dust in the solar nebula moving by way of the Large-Scale Mixing Model. Methane production was slow initially when the Fe-silicate grains were not well covered by organic material. As the layer of organic material on the grains increased, the methane peak appeared on the spectra more quickly. This refutes past claims that "poisoning" on Fe-silicate grains would stop any Fischer-Tropsch synthesis and thus stop organic deposition (Kress and Tielens, 2001). It is clear that more work should be done to resolve what actually occurs in the catalytic system as more organic material is present on each grain, since it is quite apparent in our experiment that organic synthesis still occurs after much organic material has been deposited on the grains.

Overall, a reassessment of past astrochemical research needs to occur to affirm the New Model. It will be very helpful when more data is available from comets, especially if *in situ* experiments are possible. Until then, meteorite evidence can be reexamined in hopes of better understanding the synthesis of their organic molecules. The chemical evolution of the Large-Scale Mixing Model does not end with Fischer-Tropsch synthesis. The use of the Haber-Bosch and Strecker synthesis in the solar nebula may also be equally effective.

Understanding the origin of organic material in our solar system will allow a better assessment of the importance of nebular contributions of organics to the inventory of pre-biotic molecules on Earth. This, in turn, will contribute to a better understanding of chemical evolution leading to the emergence of life on Earth and to a better assessment of the probability that life may have independently evolved on other solar system bodies or in other protostellar systems.

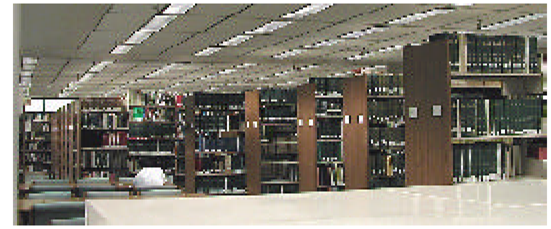


Claren Kidd

The L.S. Youngblood Energy Library is a vital research and information resource that has aided students, faculty, staff and persons off-campus in their study and research activities for decades. Housed in a beautiful facility, the library encompasses a comprehensive collection of geological literature not limited by political boundaries, geography, format, or language.

Alums and faculty who work in other libraries tell me that the Geology Library is very complete and that they wish they had immediate access to it. Most did not realize its value until they did not have it within the same building. Directors, faculty and staff members of the Oklahoma Geological Survey and the School of Geology and Geophysics have taken personal interest in the Library and have helped the University Libraries develop the Library's collection. Exchanges of geological literature come to the Library from all the U.S. state geological surveys and from international surveys. A federal library program in the 1950's selected libraries possessing good subject collections and provided funds to make them better. OU was selected for the Farmington Program to add to the already strong geology collection. Journals going back to the first volume were purchased via the Farmington Program and added to the Library. Dr. Carl Branson, a bibliophile who was reported to have a photographic memory, scoured lists of geological titles and had many of those not a part of the collection purchased for the Library. The OGS and the University Libraries receive the USGS publications (Bulletins, Professional Papers, Circulars), topographic maps, and maps in series via the federal depository program. In the early 1990's when our state-provided acquisition budget was low, a grant from Phillips Petroleum provided $5,000 that was matched by alums. In 1994, Lissa and Cy Wagner offered $50,000, if a match of that amount was successful. Within six months, alums and friends of the Library made the match and since that year the $100,000 has been spent to buy books, journal back runs and subscriptions, maps, and electronic databases. The Wagner fund was expended in December 2002. New funding is needed to supplement the University Libraries'

all materials can be checked out; only reference and fragile materials can not be checked out for use outside the Library. Persons from off-campus use the library via interlibrary loan. Both domestic and international academic, public and corporate libraries borrow from the Geology Library. ***During the last couple of years the heaviest interlibrary loan users have been Texas Tech, Texas A&M, Oregon State University, Oklahoma State University, University of New Mexico, University of Kansas, Rice, AAPG, Conoco, and EPA (Ada, OK).***



Students, faculty and staff have access to online databases including WorldCat, which pulls together the bibliographic records of over 20,000 national and international libraries. The Libraries have a web subscription to GeoRef, the most important index of the world's geological journal papers, guidbooks, maps, theses, etc.

Electronic Bibliographic Databases available through the Youngblood Energy Library include:

- **GeoRef is compiled by AGI from the USGS Library in Reston. It includes bibliographic citations about papers in journals, conference proceedings, theses, maps, abstracts, etc.).**
- **AAPG Datapages has the full text of AAPG Bulletin, Memoirs, and other publications. It also includes Journal of Sedimentary Research. SPE Oil holds the full text of Society of Petroleum Engineers publications.**
- **Compendex indexes and abstracts engineering journals, conferences, and reports.**
- **SciFinder Scholar indexes journals, dissertations, bibliographic and substance records and chemical reactions (some full text).**
- **Web of Science includes Science Citation Indexes and over 8,000 journals in the sciences, social sciences and humanities, some of which are in full text.**
- **Geobase compiled in the UK, indexes journals, books, conference proceedings, and reports in geography, geology, ecology, international development, and related disciplines.**

Mrs. L. S. Youngblood created and has maintained a beautiful facility with world class geological museum mineral and fossil specimens. She occasionally visits and has upgraded the facility since the Library opened in the Energy Center in July 1989. In 2000 she purchased and had installed new carpet for the 13,600 sq. ft. facility. Study chair fabric was purchased and many of the study chairs were re-covered in 2001. In 2002 she had the carpet replaced in the "study area" near the tower elevators. Her interest remains, as does that of alums and friends who continue to provide the support for the Geology Library.

Geology students at the University of Oklahoma have the ability to walk a few yards into a well-appointed, comprehensive collection of geological literature. It complements the excellent teaching, the expansive natural history museum, a huge core, sample and log library, a state geological survey and well equipped geological laboratories found on the campus or near to the University of Oklahoma.

To view the L.S. Youngblood Energy Library, check the library website at http://libraries.ou.edu/depts/geology/.

Teaching Field Geophysics at Archaeological Sites in Jordan

Alan Witten

Each fall I teach a course in field geophysics. This consists of several lectures early in the semester to review the principles underlying the techniques that we will be using. This is the easy part! More difficult is identifying locations where we can apply these methods. With limited time outside of normal class schedules, it is imperative that sites are selected such that all or, at least a majority of the techniques taught in this course can be effective. Seismic, for example, can be applied almost anywhere because it can usually reach depths at which changes in geologic structure occur. Since there are a number of courses taught in the School where there is a component of seismic field work, the general geophysics field course focuses on other techniques and these have depth limitations. This means that sites must be selected where near-surface "targets" are known to exist. While numerous sites can be found, student motivation must also be considered. It would be a boring course if the semester was spent mapping buried utilities.

There are two field studies that have been almost annual. The first is the detection and identification of utility tunnels on the OU campus. The OU underground is a maze of such tunnels and all techniques work. The second regular site is a limestone formation in southeastern Oklahoma. Most of the techniques also can be used at this site to map solution features in the limestone but what motivates the students is that, in the process, we might discover a cache of gold coins buried on the property by Jesse James, who did frequent this area. The remaining field studies are a perpetual problem and I rely on calls for assistance from people in need of geophysical services. Unfortunately, most of these don't happen, either because geophysics will not solve the problem or the magnitude of required work exceeds that which can be executed as an educational experience.

Figure 1. Khirbat en-Nahas as viewed from a nearby hill.

Figure 2. Photograph of the EMI instrument in use at Khirbat en-Nahas

The fall semester of 2002 was distinctly different. Six field studies occurred and the only repeat of a previous year was the one in southeast Oklahoma. All others were in response to real requests and these included a geologic mapping study in Wyoming, two forensic surveys for law enforcement, a funded counter-terrorism research project, and archaeological exploration in Jordan, which is the subject of this story.

Since 1992, I have worked with biblical archaeologist Tom Levy, first at site in Israel and, more recently in Jordan. The purpose of our collaboration is to use geophysics to map near-surface features, such as walls and artifacts, of archaeological significance. This has always been done in the summer when Tom leads a field school to train archaeology students. Our last venture to Jordan was in the summer of 2000 when temperatures reached 140^{0}. Concerns for dehydration and heat stress caused Tom to subsequently schedule his field schools during the fall when desert temperatures are a comfortable 110^{0}. With the field work schedule during a regular OU semester, an opportunity was presented whereby I could bring students along as part of the field course. In order not to deny any student's participation, travel funds were obtained from the OU Studies Abroad Program, the OU Foundation, and private benefactors.

The site of interest during this field season is known in Arabic as Khirbat en-Nahas, meaning ruins of copper (Fig. 1). It is a large site, dating to the Iron Age (about 900 BC), and, as its name implies, was associated with the production of copper in the southwestern part of Jordan. The most visually striking feature of the site is a massive collapsed stone-walled fortress. Other features evident on the site are architectural stone walls and numerous areas of slag that are remnants of copper smelting activities. Since this site is too large

Teaching Field Geophysics at Archaeological Sites in Jordan, *continued*

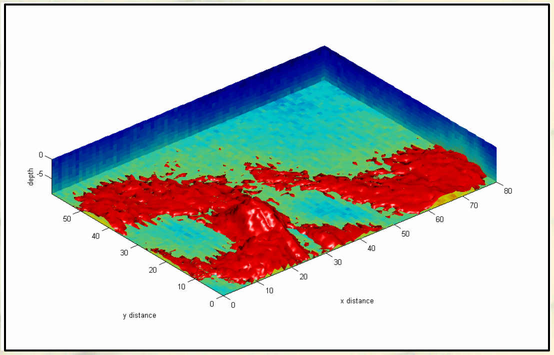


Figure 3. EMI data showing the likely location of a buried Iron Age copper smelting furnace.

week field season, three areas within the site were identified for geophysical surveys that would serve as a guide for subsequent excavations. These are an area of partially exposed architecture that could be the remains of buildings that supported copper production, an area around the perimeter of the fortress that is potentially artifact and architecture-rich, and a possible copper smelting area. Because of issues associated with transporting geophysical instruments, only the two most portable were taken to Jordan. These were a magnetometer and an electromagnetic induction (EMI) tool (Fig. 2). The magnetometer will respond to shallowly buried ferrous objects and can be used to locate iron-bearing artifacts. The EMI instrument responds to spatial variations in electrical conductivity and has been used successfully at archaeological sites in Jordan to map buried walls.

Perhaps the most interesting of the three areas surveyed is the suspect copper smelting area. Copper was smelted by placing the ore in a furnace to separate the pure copper. During the Iron Age, this was accomplished by constructing a furnace as a bowl of stones on a topographic high. Creating a fire under the furnace would melt the ore and copper would settle to the furnace bottom. To recover copper, the furnace walls were partially destroyed allowing the slag to flow out of the furnace and down the hill thereby exposing the purified copper. Finding a furnace was a priority for the archaeologists and EMI proved quite successful. If a furnace existed on the site it should be surrounded by a ring of slag, a consequence of the manner in which it was removed. Since the slag is more electrically conductive than the host soil or stones from the furnace, the furnace location should appear as a small circle of relatively low response surrounded by a ring of high response resulting from the more conductive slag. This "picture" was replicated perfectly in the data (Fig. 3) and provided archaeologists a starting point for the furnace quest.

Figure 4. A Bedoiun lunch in the field.

While geophysics was the primary reason for this trip, it provided students an exposure to the rich culture, both past and present, of a very foreign land. This included a traditional Bedouin lunch prepared by our guides during one of the days in the field (Fig. 4), snorkeling on a coral reef in the Gulf of Aqaba, and a day trip to a geologically, historically, and visually striking area at the border with Saudi Arabia known as Wadi Rum (Figs. 5, 6, and 7).

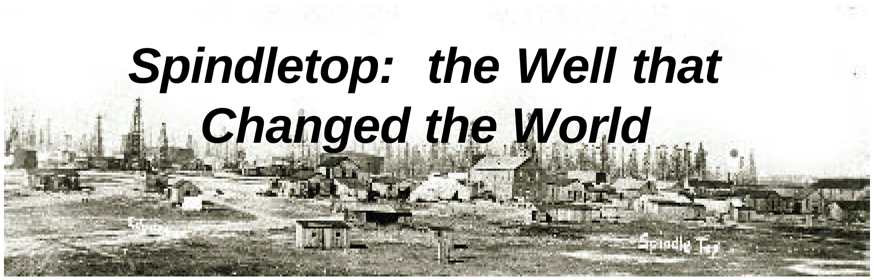
This field trip was an educational experience in many ways. Students learned geophysics at an exciting site, had an exposure to archaeology and spent a week in a foreign country. This was the first trip abroad for all of the OU students and the first time on a plane for one!

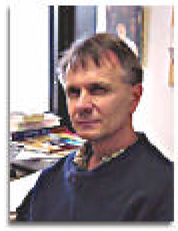
Figure 5. Learning to ride a camel.

Figure 6. Exploring sand dunes at Wadi Rum.

Figure 7. The Wadi Rum camp of T.E. Lawrence.

Spindletop: the Well that Changed the World



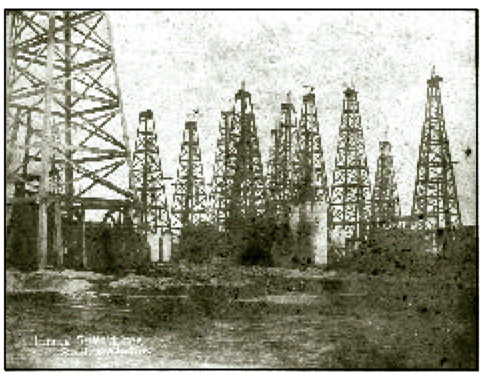


David Deming

At the end of the nineteenth century, the United States was still largely a rural society. Most people lived on farms. There were few telephones, and no automobiles, airplanes, or modern medicine. Infant mortality was high, and life expectancy was thirty years lower than it is today.

During the twentieth century, our entire society was transformed into an urban technological civilization. Oil was the fuel that made this possible, and Spindletop was the well that began the process.

Spindletop is the name of a low-lying hill located about 4 miles (6.4 kilometers) south of Beaumont, Texas. The hill was the site of occasional seepages of natural gas, and a local entrepreneur named Pattillo Higgins became convinced that oil could be found there. Higgins drilled his first well in 1893, and a second in 1895. Both wells failed. His drilling contractor tried a third hole on their own, which also failed. The standard cable-tool drilling rigs of the day could not make progress in the thick sequences of unconsolidated sediments found on the Texas Gulf Coast. After reaching depths of 300 to 400 feet (91 to 122 meters), the holes collapsed due to what the drillers described as “running quicksands”. Unsuccessful, Higgins advertised in an engineering trade journal, hoping to find someone who could invest the capital necessary to complete a well at Spindletop. His advertisement was answered by Captain Anthony Lucas, a naturalized American citizen and engineer who had explored for sulfur on the salt domes of South Louisiana. Captain Lucas was convinced that the gentle hills found throughout the Gulf Coast were the surface expressions of salt domes, great bodies of salt which had flowed and intruded upwards, tilting adjacent rock strata. Lucas’ main interest was in the discovery of sulfur; oil was a secondary concern. What interest he had in oil was not helped along by local geologists. ***In 1898, William Kennedy of the Texas Geological Survey published a newspaper article where he warned that looking for oil in the Beaumont area was a waste of money and time.*** His opinion was not unique. The US Geological Survey studied the Spindletop area and also issued a negative report.



Little Spindletop Striblings’ Addition

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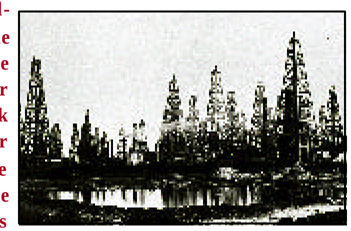
When Spindletop later produced the greatest oil well in American history, oilmen came to the conclusion that geologists and the application of geology were worthless in the search for oil. This conception persisted for decades.

Captain Lucas began drilling at Spindletop in July of 1899. However, his casing collapsed at 575 feet (175 meters) and the well was lost. Two days earlier, there had been a significant show of oil in the hole. Lucas now knew there was oil at Spindletop, but his money was gone. He traveled to Pittsburgh and presented his ideas to the greatest American oil explorationists, the team of John Galey and James Guffey. Galey and Guffey had drilled wildcat wells from Washington, DC, to the wilds of the Mojave desert, and they were looking for a new opportunity.

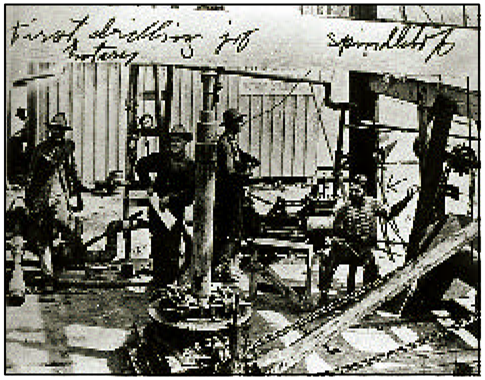
Galey and Guffey decided to drill at Spindletop, and they hired the best rotary drillers in the business, the Hamill brothers of Corsicana, Texas. At that time, the rotary method had been widely used in oil drilling for only about five years. After its success at Spindletop, it became increasingly popular, displacing cable-tool techniques almost entirely by 1930. The Hamill brothers found drilling at Spindletop to be extremely difficult. No one had ever successfully drilled a deep well in this t ype of geology. The water which was flushed through the rotary dill pipe was failing to bring up the loose sands.

Curt Hamill recognized that he had to increase the viscosity and density of the circulating fluid—but how? Hamill invented the world’s first drilling mud by driving some cattle through a shallow pond. The cattle stirred up the water enough to generate a thick mud. When the muddy water was poured down the Spindletop well bore, the hole was stabilized and the sands flushed out.

Drilling had started on October 27, 1900. After encountering and overcoming enormous difficulties, a total depth of 1020 feet (311 meters) was reached on January 8, 1901. The bit then became stuck and could not be freed. The rotary chain broke. It looked as if the well was lost. At 10:30 am on the morning of January 10, 1901, the drillers tried to re-enter the hole. The drill string had reached a depth of 700 feet (213 meters) when mud began gushing from the well. The mud was followed by six tons (5,443 kilograms) of pipe. The pipe shot into the air; where it came down it stuck in the ground like a giant spike. The eruption stopped, and all was quiet for a moment. Then mud started to flow again, followed by gas. Finally, a thick stream of greenish crude oil



Spindletop: the Well that Changed the World, cont.



gushed out. The oil stream erupted into the sky as a fantastic geyser, reaching a height of 100 feet (30 meters). ***It was the greatest oil well ever seen in the United States.*** The flow continued for nine days at a rate of 84,000 barrels (13.3 million liters) per day, until workers succeeded in capping the well. Prior to Spindletop, a substantial oil well was considered to be one which yielded 50 barrels (7,900 liters) per day. Oil production from the Spindletop well increased total world oil production by 20 percent, and United States oil production by 50 percent. This single well by itself produced as much oil as 37,000 typical oil wells in the Eastern United States, and more than twice as much oil as the entire state of Pennsylvania, which heretofore had been the leading producer of oil in the United States.

Spindletop changed everything. It proved the value of rotary drilling methods (see photo above), but the consequences were far more widespread and significant. The cheap energy provided by abundant oil changed the United States from a rural, agrarian society to an urban, industrialized nation.

In 1900, 39 percent of the population lived on farms. By 1997, only 2 percent of the population was engaged in farming. Perhaps the greatest facilitator of social change in the 20th century of the United States was the automobile.

In 1900, there were only about 8,000 cars in the entire United States. It was thought that the gradual decline of the Pennsylvania oil fields would ensure that there would never be enough gasoline available to make the automobile a common possession. Horseless carriages, like yachts, were a toy for the rich to enjoy.

When the Spindletop gusher came in, the price of oil quickly dropped from $2 dollars to 3 cents a barrel, recovering to 83 cents a barrel two and a half years later. With an abundant supply of cheap fuel, by 1910 the number of automobiles in the United States had risen to 450,000. The new automobiles needed paved roads, and asphalt, a petroleum byproduct, provided an inexpensive means of paving. ***Things would never be the same again.***

OU MPI BASIN ANALYSIS-SEISMIC STRATIGRAPHY LAB: *HOW TO BE IN FIVE PLACES AT THE SAME TIME AND GET MORE THAN 24 HOURS OUT OF A SINGLE DAY!*

John Pigott

By carefully manipulating earth time zones, Dr. John Pigott and his cherubs have discovered that they can have their days exceed 24 hours, and thus in theory exceed earthly limits of uniformitarianism. This to some degree explains why his graduate students and the SG&G staff can receive emails from Dr. Pigott that appear to come from one day into the future (especially when he is in SE Asia). As another example and but one snapshot of a very busy year, one week last Fall, Dr. Pigott chaired two sessions on the Regional Geology of Tethys at the joint AAPG EPEX SEG EGS EAGE International Conference in Cario while at the same time presenting three papers in different sessions at the INGEPET meeting in Lima, Peru, presenting a paper on interpreting tectonics from a 3D seismic interpretation of Lake Maracaibo, and having his seismic processing results for a USGS southern Louisiana study presented at the GCAGS in the U.S., he simultaneously consulted for PDVSA in Caracas on a design for restructuring its exploration management, all the while teaching his OU graduate class in seismic processing. Whew!

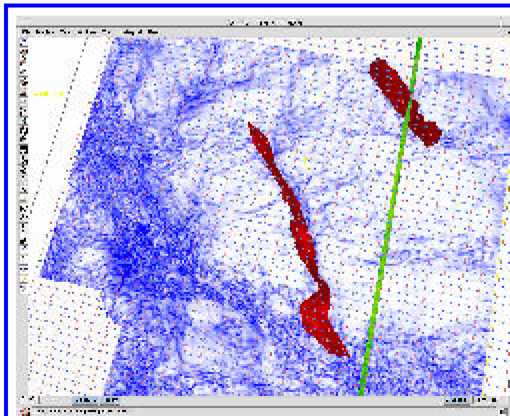


Figure 2: 3D seismic volume from an undisclosed location somewhere in Lake Maracaibo, Venezuela, revealing a surface view of a similarity cube where dark blue indicates phase discontinuities interpreted as faults. The horizontal dimension represents approximately 15 miles.The central red zone indicates an interpreted fault zone intercepted by Fig. 3.

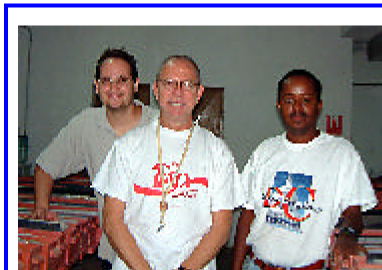


Figure 1: On location at CoreLab in Puerta La Cruz, Venezuela, are "Los Tres Salsa Hermanos": (left to right) Luis Cardozo (OU MS '02) presently with LandMark, Dr. P., and Eshetu Gebretsadik (Ph.D. Candidate).

A few telling snapshots of this past years work are those of the "Los Salsa Hermanos": Figures 1-4, an intrepid OU team (Dr. P., Luis Cardozo, and Eshetu Gebretsadik) who journeyed to Venezuela in order to geologically constrain their Geoquest seismic interpretations (never an easy job to accept the truth!).

Earlier this past year, "Los Hermanas Seismicas" (Dr. P. with Eshetu Gebratsadek, Ahmed

OU MPI BASIN ANALYSIS-SEISMIC STRATIGRAPHY LAB, continued. . .

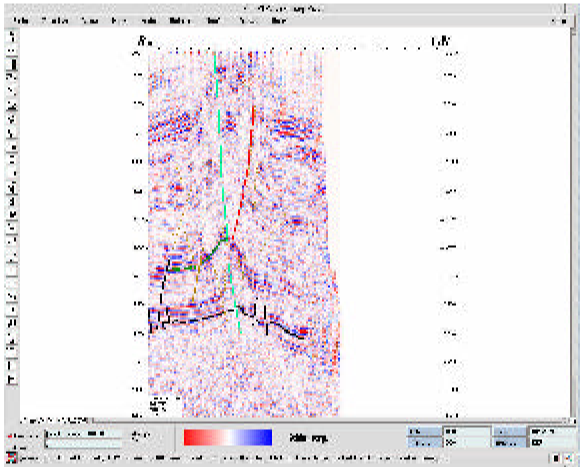


Figure 3. Reverse fault zone shown on a time section processed at the OU MPI seis strat laboratory and extracted from the previous 3D seismic volume (Figure 2). The bright alternating "rainbow" colors at 0.5 seconds indicate multiple gaseous "pay" zones. The horizontal dimension is approximately 15 miles and the vertical depth (to 3 seconds) is approximately 25,000 feet.

Figure 4. Drag folds along one of the thrust faults encountered in a Lake Maracaibo core which was drilled at the crest of the structure of the extracted seismic line from the 3D volume shown in Fig. 3.

Aladahl, and Kulwadee Lawwongnam) processed and interpreted southern Louisiana lines for the USGS's energy division in Denver using their state of the art Omega processing system. The objectives were to improve the imagery complicated by the salt tectonics and to define the ages of faulting as conduits and permeability barriers for hydrocarbon migration (see Figures 5-7). In addition, careful velocity work revealed several zones of velocity inversion (Figure 7). Such information greatly facilitates the USGS in determining its reserve estimates for the region.

Presently Dr. Pigott and his students continue to work on problems in basin analysis and seismic stratigraphy, specifically on reading tectonics from field fracture data, seismic processing experiments in subsalt imagery, Q analysis, 3D seismic mechanical stratigraphy of faulting, and the application of Bayesian risk analysis through fuzzy arithmetic and Monte Carlo hindcasting (see his web page at **http://geosciences.ou.edu//~mpi/**) .

Dr. Pigott is always open to opportunities *(read: financial funding of research)* from the industry on topics in basin analysis and seismic acquisition modeling, exploration, and exploitation!

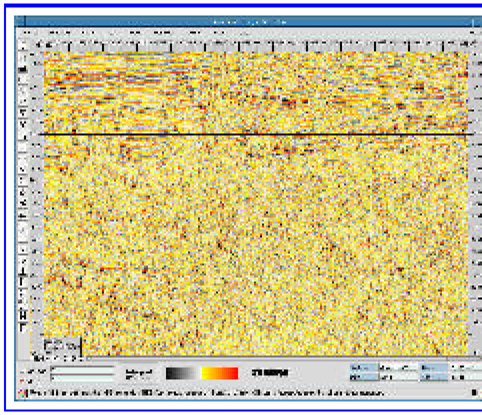


Figure 5: FK Stolt Migration of a USGS Line from an undisclosed location in southern Lousiana. Horizontal dimension of this and the following figures is approximately 10 miles with the vertical exceeding 25,000 feet.

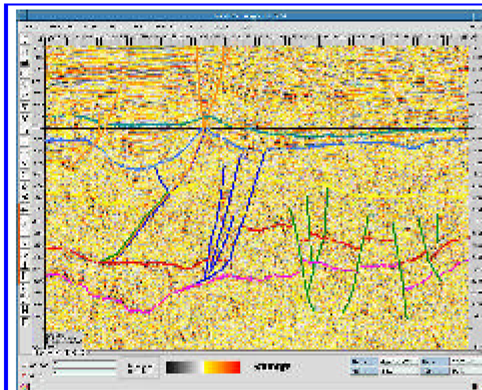


Figure 6: Interpreted seismic line. Vertical trending fault zones displace major sequence boundaries and are color keyed to times of deformation, e.g. Orange represents Tertiary-Quaternary activation, Purple that of Tuscaloosa activation, and Green for Jurassic-Early Cretaceous activation

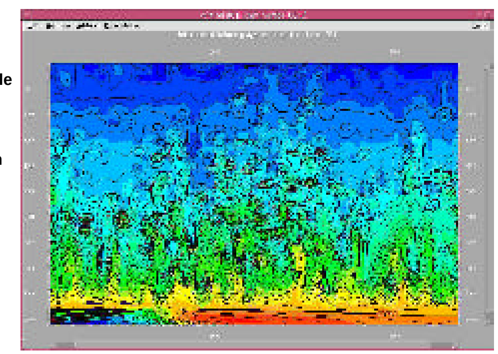
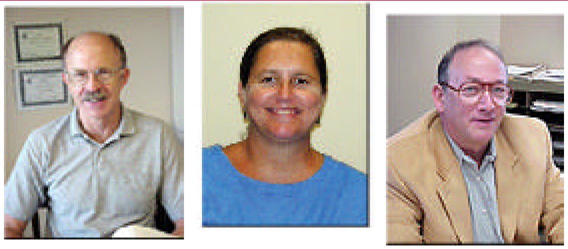


Figure 7: RMS Velocity profile along migrated line, with hotter colors indicating higher velocities and cooler colors lower velocities. Such velocity information when carefully conducted greatly assists the interpretation of anomalies owing to heterogeneities in geology and/or fluid-gas content.

IDENTIFYING A SINUOUS DEEPWATER CHANNEL IN OUTCROP USING GPR IMAGING



Roger Young*, Julie Staggs, and Roger Slatt

Summary

High-resolution GPR images over turbidite outcrop analogs can clarify understanding of depositional processes and channel geometry in ways not possible from even the best 3-D marine seismic data over deepwater reservoirs. This paper uses GPR images, outcrop mapping, and logs from behind-outcrop boreholes to identify a sinuous sandstone channel, which is analogous to those seen in less detail on seismic data.

Introduction

The ability of Ground Penetrating Radar (GPR) images to resolve sub-seismic depositional features and to detail the nature of the boundary between turbidite channel sandstones and adjacent levee facies has been clearly demonstrated at outcrops of the deepwater Lewis Shale, Wyoming. (Young et al, 2001), where ridges of the more resistant channel sandstones form spines consisting of offset, stacked channels (Slatt et al., 2002).The present paper treats Spine 1, where GPR profiles and a 3-D survey are supplemented by extensive geological mapping, trenching, gamma logs from shallow boreholes behind the outcrop, and petrophysical analysis of outcrop samples. We have interpreted the spatial distribution of channel-fill facies and cross-sections of channel geometry to be a small, sinuous channel fill analogous to larger channels recognized on present day, 3-D marine seismic data.

Spine 1, Channel Sandstone #1

The field area is near Dad in southeastern Wyoming. Figure 1 identifies Channel Sandstone #1, the main target of our investigations. Fig. 2 shows the locations of straigraphic facies identified on outcrop and their “radar facies” expression interpreted on three GPR surveys. The term “radar facies” denotes a portion of a radar profile characterizing a particular stratigraphic facies and associated depositional

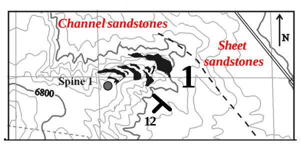


Figure 1 Topographic map of the Spine 1 area. Black features are the individual channel-fill sandstones of the Dad Sandstone Member. The largest outcrop is named Channel Sandstone #1 (“1” on the figure). Beds strike 20° NW and dip 12° SW.

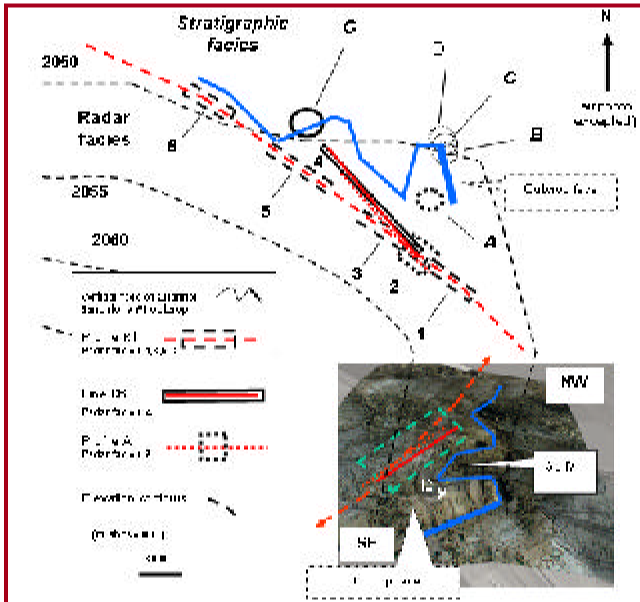


Figure 2 Channel Sandstone #1. The blue line marks a vertical outcrop face. Circles mark photograph locations. Stratigraphic facies are designated by letter and are shown in Fig. 3. A long GPR profile, a shorter profile, and a line from the 3-D survey are shown in Fig. 4. Distinct radar facies are designated by number (enlarged in Fig. 3). The air photo inset shows the outcrop face, the radar profiles, and the boundaries of the 3-D GPR survey.

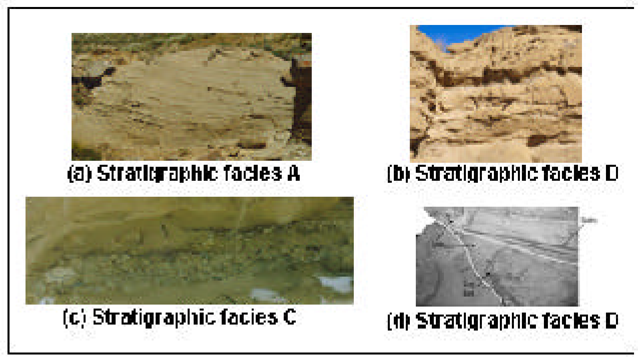


Figure 3 Stratigraphic facies of Sandstone Channel #1. (a) Facies A: low angle cross-stratification of fine-grained sandstones. (b) Facies B: interbedded shale-clast conglomerates, debrites, and structureless sandstones. (c) Facies C: shale clast conglomerate, and (d) large slump block in shale clast conglomerate. The block is composed of thin-bedded sandstone and siltstone.

IDENTIFYING A SINUOUS DEEPWATER CHANNEL IN OUTCROP USING GPR IMAGING, continued

features. Fig. 3 shows that cross-stratified sandstones and debrites, respectively, are found on opposite sides of a cut through channel-fill. The side of the channel-fill containing debrite beds is interpreted as the outside bend of a sinuous channel, and the cross-stratified side is interpreted as the inside bend. Thus, the outcrop is interpreted to expose a cross-section of a sinuous submarine channel-fill, and the analogy is made here of "cut-bank" and "point-bar" environments of a fluvial meandering channel system.

Radar profile R1 (Fig. 4a) shows zones of strong reflections, interpreted to be channel-fill, separated by opaque zones of no reflection, interpreted to be mudstones and thin-bedded sand/shale levee deposits. The levee deposits are interpreted to form remnant pedestals around which sandstones display on-lap. Examples are shown in the radar facies (designated by overlapping boxes in Figure 4b), which are enlarged and given a stratigraphic interpretation in Figure 5.

Geological synthesis

Radar facies 1 and 2 show the "point-bar" side of the channel and radar facies 4 shows the "cut-bank" side (Figure 5a,b and d, respectively). Radar facies 3 (Figure 5c) shows the intervening pedestal of levee deposits. The difference in appearance of features on adjacent profiles indicates rapid lateral variation in channel geometry, requiring use of the complete 3-D data set, which is presently being interpreted.

Conclusions

This paper demonstrates two successful results from GPR imaging: identification of distinct channel fill and channel/levee facies at a scale of 10 m and inference of sinuous channel geometry at a scale of 100 m.

References

[redacted]
71st Ann. Meeting, SEG, 1592-1595.

Acknowledgements

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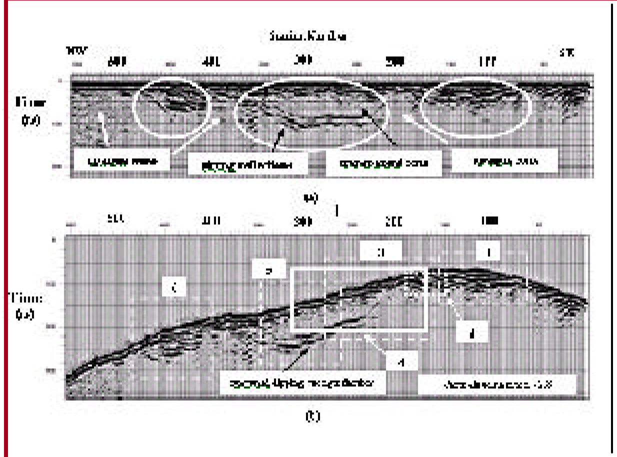

Figure 4 Radar profile R1. Station spacing is .3 m (a) Before elevation correction. Thick sandstone regions (ellipses) are separated by zones of thinning (arrows) underlain by an opaque zone absent of reflections. The central region shows strong reflections beneath a transparent zone. (b) After elevation correction. Boxes 1,4,5 mark locations of radar facies along profile R1. Boxes 2 and 4 mark locations of radar facies projected onto profile R1 from other lines.

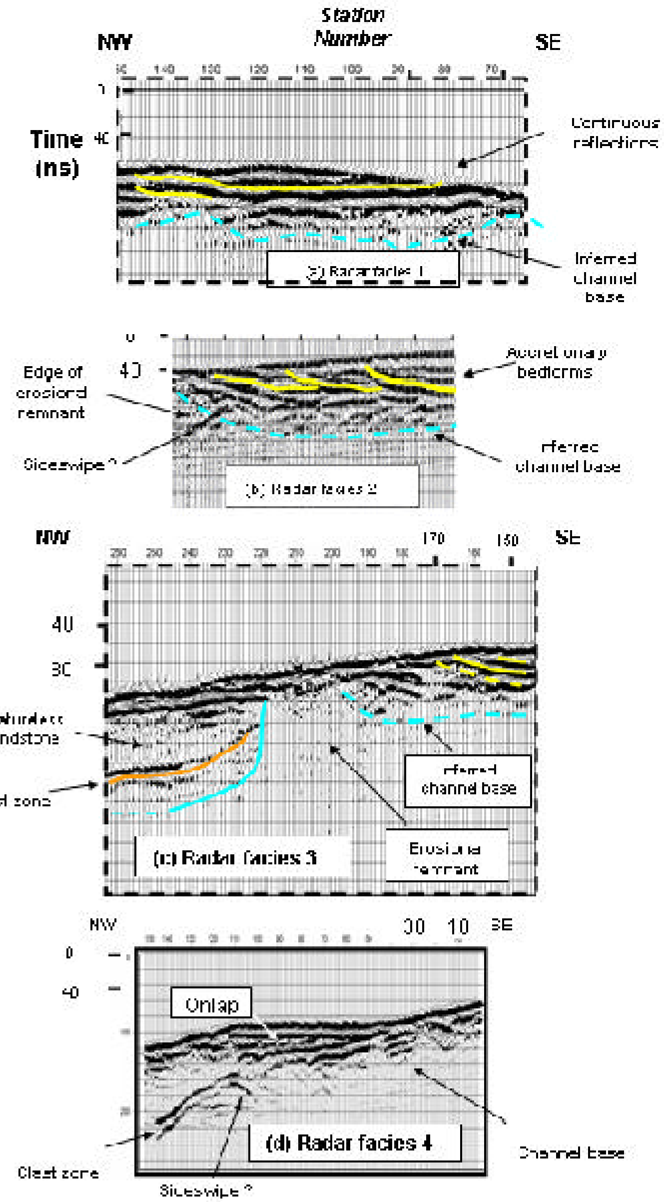

Figure 5 Geological synthesis. (a) Radar facies 1: thick sequence of channel-fill. (b) Radar facies 2: accretionary bedforms (c) Radar facies 3: Channel sandstone #1 thins on both sides of a thin-bedded erosional remnant. Boundaries of a clast zone generate strong reflections. (d) Radar facies 4: Channel Sandstone #1 onlaps an erosional remnant.

External Support: Faculty Chairs and Special Funds

Bartell Professorship in Geosciences
To endow a chair

Basin Analysis South America
To support the Basin Analysis Colombia Texaco Project directed by Dr. John Pigott

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

Beginning Geology Labs
To help and establish beginning labs

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

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

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

Dupont Young Professor
To help young U.S. professors begin their research

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An endowed fund to support the Director

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Establish and support personal research programs and professional activities.

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Provide support for faculty and students engaged in research areas that will offer educational and scientific benefits to those interested in the earth sciences

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

Geology Exhibits Fund
Provide support for displays highlighting G&G (primarily in the Sarkeys Energy Center)

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

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

Institute of Exploration and Development-Geosciences
To support general operating funds of the Institute

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

Lissa and Cy Wagner Professorship of Geology & Geophysics
An endowed fund to support a professorship

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

Nonesuch Shale
To provide support for investigations by the School of Geology & Geophysics on the sedmentary, diagenesis and organic geochemistry of Nonesuch shale

Paleomagnetics and Diagenesis Industry Program
To support Diagenetic Magnetite research in the School of Geology & Geophysics

Petroleum Geochemistry
To support petroleum geochemistry

Phillips, Inc., Computing Laboratory
A capitol grant to fund establishment of a student computing lab

Presidential Professorships(2)
Awarded for four years for discretionary purposes to full-time OU faculty member

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

R.E. & Doris Klabzuba Professorship of Geology and Geophysics
An endowed fund to support the Professorship

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To support research in structural geology including graduate fellowships, travel, expendables and equipment.

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

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An endowed fund to support the professorship

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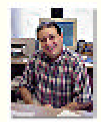

JOHN CASTAGNA
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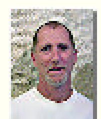

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DAVID DEMING
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TOM DEWERS
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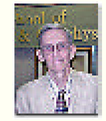

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DOUG ELMORE
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MICHAEL ENGEL
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JAMES M. FORGOTSON, JR.
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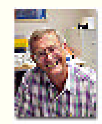

CHARLES GILBERT
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CHARLES HARPER
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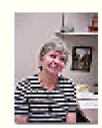

CLAREN KIDD
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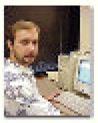
FACULTY

The University of OKLAHOMA School of Geology & Geophysics

DAVID LONDON

[redacted]



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CHARLES MANKIN

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SHANKAR MITRA

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PAUL PHILP

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JOHN PIGOTT

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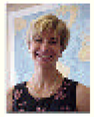

GERILYN SOREGHAN

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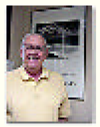

DAVE STEARNS

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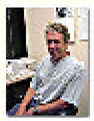

BARRY WEAVER

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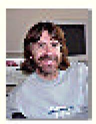

STEVE WESTROP

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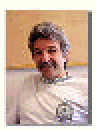

ALAN WITTEN

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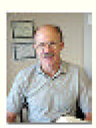


ROGER YOUNG

[redacted]

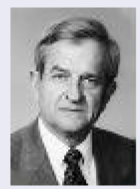
In The News!

HONORS AWARDED AT 2003 AAPG ANNUAL MEETING

Three individuals associated with the University of Oklahoma School of Geology and Geophysics were among those honored by the American Association of Petroleum Geologists at the AAPG Annual Meeting held May 11-14, 2003, in Salt Lake City.

Roger Slatt, professor and SG&G director, was given an Honorary Membership Award for distinguishing himself by his accomplishments and through his service. The citation reads: *"For sustained, innovative leadership in teaching and research; for outstanding contributions to the profession of geology and to the AAPG."*

Marlan Downey received the Robert H. Dott Sr. Memorial Award, to honor and reward the author/editor of the best special publication dealing with geology published by the Association. Downey, former Bartell Professor at OU's School of Geology and Geophysics and chief scientist of the Sarkeys Energy Center, was cited for AAPG Memoir 74: *"Petroleum Provinces of the Twenty-First Century."* Jack C. Threet and William A. Morgan, were also cited for their role in editing and publishing the Memoir.



SG&G alum Thomas Mairs (*BS Geol. '59, MS Geol. '62*) was granted the Honorary Member of the House Award. The citation reads: *"To Thomas Mairs, dedicated lifelong geologist, for exemplary contributions to the House of Delegates, to the profession of geology, and to the American Association of Petroleum Geologists."*

John Castagna Wins SEG Award

SG&G Professor John Castagna was recently awarded the "Best Paper Award" by the Society of Exploration Geophysicists for the article he co-authored with Alan Huffman, Conoco. The paper is entitled: "The petrophysical basis for shallow-water flow prediction using multicomponent seismic data."

***Left to right:* Alan Huffman; Walter Lynn, 2002 SEG President ; and John Castagna.**

Student Scholarships, Fellowships and Support

Undergraduate Student Sponsorships

Student	Sponsor/Scholarship
Nicole Baylor	Robert Edwards Lowry Scholarship; Harry J. Brown Memorial Scholarship; Frank Gouin Geology Scholarship; Summer 2003 Field Camp Scholarship
Sonia Bradley	Summer 2003 Field Camp Scholarship
Aaron Bell	Texaco Scholarship
Lori Bryan	Summer 2003 Field Camp Scholarship
Eric Carter	Jon R. Withrow Scholarship; George Huffman Endowed Scholarship
Willisha Davidson	Summer 2003 Field Camp Scholarship
Shannon Dulin	Robert Edwards Lowry Scholarship
Brandon Fritz	Summer 2003 Field Camp Scholarship
Kathryn Gardner	Energy Cup Scholarship; Harry J. Brown Memorial Scholarship
Ellen Gilliland	Robert Edwards Lowry Scholarship; Houston Oil and Gas Scholarship
Samuel Goeppinger	Harry J. Brown Memorial Scholarship; Summer 2003 Field Camp Scholarship
Brian Harms	Harry J. Brown Memorial Scholarship
Christopher Harms	George Huffman Endowed Scholarship; Jon R. Withrow Scholarship
Margaret Hayes	Harry J. Brown Memorial Scholarship; Summer 2003 Field Camp Scholarship
Ngoc Thi Bich Hoang	Houston Oil and Gas Scholarship
Rebekah Holt	Texaco Scholarship
Walter Jones	Summer 2003 Field Camp Scholarship
Sara Kaplan	Robert Edwards Lowry Scholarship; Questar Education Scholarship
Rebecca Kepler	Robert Edwards Lowry Scholarship; Houston Oil and Gas Scholarship
Kristen Marra	Harry J. Brown Memorial Scholarship
Meryl McDowell	Energy Cup Scholarship; Harry J. Brown Memorial Scholarship
Katherine Moore	Desk and Derrick Education Trust Scholarship; Kerr-McGee Scholarship; Harry J. Brown Memorial Scholarship
Abbie Negrey	Robert Edwards Lowry Scholarship
Colt Nickel	Harry J. Brown Memorial Scholarship
Mary Pearce	Robert Edwards Lowry Scholarship; Summer 2003 Field Camp Scholarship
Tra Thi Thu Pham	Houston Oil and Gas Scholarship
Jonathan Rush	Robert Edwards Lowry Scholarship; Harry J. Brown Memorial Scholarship
Tomieka Searcy	Summer 2003 Field Camp Scholarship
Aaron Siemers	Robert Edwards Lowry Scholarship; Harry J. Brown Memorial Scholarship; Summer 2003 Field Camp Scholarship
Carl Trexler	Summer 2003 Field Camp Scholarship
Don Walker	Summer 2003 Field Camp Scholarship
Matthew Worthy	Jon R. Withrow Scholarship

Graduate Student Sponsorships

Student	Sponsor(s)
Michelle Abraham	Phillips Petroleum Fellowship; Society of Exploration Geophysicists (SEG)
Ahmed Alahdal	SEG
Lisa Amati	Alumni Advisory Council Scholarship
Alex Arias-Aguilera	Institute for Exploration and Development of Geosciences (EDGe)
Subhotosh Banerjee	Phillips Petroleum Fellowship
Angela Blumstein	DeGoyler Presidential Fellowship; Chevron Graduate Fellowship; Jaye and Bettey Dyer Endowed Scholarship
Raleigh Blumstein	Texaco Petroleum Fellowship; Jaye and Betty Dyer Endowed Scholarship; Department of Energy Grant
Hoa Bui	SEG; EDGe; Consortium Grant
Seth Busetti	Roger Denison Endowment Scholarship; Petroleum Research Fund (PRF) Grant
German Camargo	EDGe
Davmar Carciente	EDGe
Eric Cox	R.E. and Doris Klabzuba Professorship; Department of Energy Grant
Stephen Culbert	William Arper Memorial Scholarship; Sun Geology and Geophysics Scholarship
Walter Doyle	BP Education Fellowship for Geology and Geophysics
Michael Faust	BP Education Fellowship for Geology and Geophysics
Fred Gallice	EDGe
Alison Garich	Texaco Petroleum Fellowship; Dr. Charles Decker Geology Scholarship
Eshetu Gebretsadik	Edward Lamb McCollough Endowed Scholarship
Ben Geerdes	William E. Ham Scholarship; Elinor C. Morris Graduate Scholarship; Willard Miller Professorship
Chad Haiar	Gene and Astrid Van Dyke Scholarship
Kate Hartig	Hubert E. Clift Memorial Scholarship; PRF Grant
Diego Hernandez	EDGe; Consortium Grant
John Hooper	EDGe; Consortium Grant
Michael Hsieh	Petroleum Geochemistry
Ozzie Iláboya	Gene and Astrid Van Dyke Scholarship; SEG
Dongwon Kim	Petroleum Geochemistry
Scott Koza	Marathon Scholarship Fund
Ha Mai	SEG; EDGe; Consortium Grant
Katrin Mai	Phil and Roberta Kirschner Geological Scholarship
Efrain Mendez-Hernandez	EDGe; Consortium Grant
Jonathan Minken	Heston Geology Scholarship; Gene and Astrid Van Dyke Scholarship; SEG; G&G Director's General Research Support
Jochen Moser	EDGe; Consortium Grant
Andrew Moses	Harry A. Larsh Scholarship
Jerome Murphy	BP Education Fellowship for Geology and Geophysics
Tiffany Naeher	Lance Ruffel Graduate Assistant Scholarship
Miguel Nunez	EDGe; Consortium Grant
Olubukola Ojo	EDGe; Consortium Grant
Tosan Omatsola	Gene and Astrid Van Dyke Scholarship; PRF Grant
Xuemig Pan	Petroleum Geochemistry
Aisha Ragas	Gene and Astrid Van Dyke Scholarship; EOG Resources
Jaime Rich	Northeastern University Grant
Gloria Romero	Gene and Astrid Van Dyke Scholarship
Isabel Salazar	Robert Edwards Lowry Scholarship in Geology and Geophysics
Satish Sinha	Edward Lamb McCollough Endowed Scholarship; SEG
Kathy Sokolic	Cecil Von Hagen Scholarship; EDGe; Consortium Grant
Adémola Soyinka	Gene and Astrid Van Dyke Scholarship
Julie Staggs	PRF Grant
Ryan Stepler	Robert Edwards Lowry Scholarship in Geology and Geophysics; SEG
Sara Tirado	Gene and Astrid Van Dyke Scholarship
Staffan Van Dyke	PRF Grant
Isabel Varela	EDGe; Consortium Grant
Brent Wilson	Dewers Presidential Professorship
Jennifer Yaeggy	EDGe; Consortium Grant

Student Theses and Dissertations Completed 2002-03

ARIAS-AGUILERA, Alexis (M.S.GPHY) — Young
Applications of seismic converted waves to hydrocarbon exploration

BANERJEE, Subhotosh (M.S.-GEOL) — Mitra
Structural Analysis of Bear Creek and Big Elk Anticlines, Wyoming-Idaho-Utah Overthrust Belt, Idaho

BAYER, Walter (exchange student) — Mitra
Structure Analysis of the Sheep Mountain Structure, Colorado

BAYLOR, Nicole (B.S.-GEOL) — Smart
Geologic Mapping of the Quanah Granite, Wichita Mountains, southwestern Oklahoma

BLUMSTEIN, Angela (M.S.-GEOL) — Elmore
Paleomagnetic Dating of Burial Diagenesis in Mississippian Carbonates, Utah

BLUMSTEIN, Raleigh (M.S.-GEOL) — Elmore
Date and origin of multiple fluid flow events along the Moine Thrust Zone, Scotland

CALDERON, Jose Ernesto (M.S.-GPHY) — Castanga
Approaches for lithologic prediction using seismic attributes and geologic trends: Balcon Field, Colombia

GOMEZ, Frank (M.S.-GPHY) — Castagna

HARTIG, Kate (M.S.-GEOL) — Soreghan
Origin of dolomite and loessitic paleosols of the lower Permian Abo-Tubb Unit, Northeastern New Mexico

ILABOYA, Oziebge (M.S.-GEOL) — Pigott
Three dimensional fault mechanical seismic stratigraphy of LaConcepcion Field, Maracaibo Basin, Venezuela

KOZA, Scott Henry (M.S.-GPHY) — Castagna
The effects of noise on AVO crossplots

MAI, Ha (M.S.-GPHY) — Castagna
3-D spectral analysis applications

MAI, Katrin (M.S.-GEOL) — Smart
Microstructural and kinematic analyses of a Proterozoic quartzite-schist sequence in Blue Ridge, Colorado

MAUGHAN, Tyler (B.S.-GPHY) — Witten
Processing eletromagnatic induction data from archeological sites in Jordan

MINKEN, David Albert (M.S.-GPHY) — Castagna
A 3-D seismic case study of investigating AVO, acoustic inversion, and probabilistic neural networks in the Trenton-Black River interval, NE Ohio

MOSER, Jochen (M.S.-GPHY) — Castagna
Visualization and interpretation of spectrally decomposed seismic data from a wedge model and a carbonate oil field

MOSES, Anderew (M.S.-GEOL) — Soreghan
Loessitic origin, provencence, and paleoclimatic significance of siltstone within the Pennsylvanian-Permian Earp Formation and Equivalents, Arizona

NEGREY, Abbie (B.S.-GPHY) — Ahern
The probability of near earth objects colliding with the earth

NUNEZ, Miguel (M.S.-GPHY) — Castagna
Stochastic fluid substitution on the Furrial Field, Venezuela

OMATSOLA, Botosan (M.S.-GEOL) — Slatt
Origin and distribution of friable and cemented sandstones in outcrops of the Pennsylvanian Jackfork Group, Southeast Oklahoma

RAGAS, Aisha (M.S-GEOL) — Slatt
Characterization and Fracture Potential of the Viola Limestone, I-35 Roadcut, Carter County, Oklahoma

RICH, Jamie Paul (M.S.-GPHY) — Witten
3-D Imaging of buried waste using geophysical diffraction tomography

SINHA, Satish (M.S.-GPHY) — Castagna
Time-Frequency Localization with wavelet transform and its application in seismic data analysis

SOKOLIC, Katherine Jane (M.S.-GEOL) — Dewers
Arsenic occurrence in the Central Oklahoma Aquifer

STEPLER, Ryan Peter (M.S.-GPHY) — Witten
Three dimensional imaging of a deep marine channel beneath outcrop with electromagnetic induction and ground penetrating radar; Carbon County, south-central Wyoming

Van DYKE, Staffan (M.S.-GEOL) — Slatt
Fine-scale 3D architecture of the deepwater channel complex at Spire 1, south-central Wyoming

VARELA, Isabel (M.S.-GPHY) — Castagna
Stochastic pore fluid modulus inversion

YAEGGY (Siguenza), Jennifer D. (M.S.GPHY) — Castagna
Applications and limitations of spectral processing as a direct hydrocarbon indicator

Student News and Activities

Douglas Jordan, EOG geologist and sponsor of Aisha Raga's thesis, congratulates her on a successful completion. Roger Slatt, Aisha's advisor, looks on.

Jackfork Field Trip for the Tulsa Geological Society, Spring 2003. *Left to right:* Dr. Roger Slatt and G&G students Alison Garich and Tosan Omatsulu.

Participants in a recent Petra shortcourse conducted by geoPLUS vice president Bob Meyer, possible in large part because of the generous donation of software via Paul Baclawski by Devon Energy Corporation. *Left to right*, first row: Kulwadee Lawwongngam; Jan Dodson; Yoscel Suarez; I Suta. Second row, *l to r*: Bob Meyer, geoPLUS; Paul Baclawski, Devon Energy; Subho Banerjee; Marco Vignali; and Julie Staggs.

University of Oklahoma
AAPG Student Chapter

The University of Oklahoma Student Chapter of the AAPG has not been as active as in the recent past. This can be attributed to the majority of our 35 to 40 members being second year master's degree students in the midst of thesis work.

The executive committee of 2002-2003 academic year includes: President Ryan Stepler, Vice President Mike Faust, Treasurer Andrew Moses, and Secretary Katherine Hartig. All of the officers are second year graduate students. Once again this year the Faculty Advisor Dr. John D. Pigott, and the Director of the School of Geology and Geophysics, Dr. Roger M. Slatt, have been very supportive of the chapter.

Meetings and Speakers

We have continued our tradition of having meetings twice a month with great attendance and participation.

The University of Oklahoma enjoys the luxury of being heavily recruited by many companies in the oil and gas industry. Therefore there were no members of our chapter who attended this year's Student Expo at Rice University. But to prepare for the recruiting season, the chapter did sponsor a lunchtime interview tip session with members of the faculty.

During the Fall semester, the chapter hosted two speakers, one for the weekly Colloquium Series and the other for a special colloquium. Students of the chapter were able to spend time outside of the lecture with these speakers at a lunch and dinner. Additional speakers were hosted during the spring semester.

Fund Raisers

To start the year off right we received a check from AAPG for working in the 2002 national meeting's gift shop.

As we did last year, we have maintained our relationship with the Lloyd Noble Center and cleaned the center after a women's basketball game. We did this again in the Spring semester. This is a very unglamorous fundraiser, but has a high rate of return!

L. Austin Weeks

The Chapter's executive committee and Dr. Pigott nominated Donald Walker as this year's recipient of the L. Austin Weeks Undergraduate Grant. Donald is a good student, and one of a very few active undergraduate students.

Book Gift

Every three years a student chapter is eligible for a $500 book gift from the national organization. This was our year to receive this gift. All six titles we ordered are second copies of heavily used books in the Youngblood Library. Our librarian, Claren Kidd, was very excited about this gift and helped us to determine the titles to be ordered.

Ending the Semester

The AAPG national meeting in Salt Lake City, Utah, ended the school year. The coincidence of this event with graduation reduced the number of students attending, but the School was still well-represented.

Ryan Stepler
President
AAPG OU Student Chapter

Pick and Hammer Club

Pick and Hammer Club is a club open to all students who are interested in geology, despite their major. The club last semester took a weekend trip to Beaver Bend State Park. The trees were just changing color and despite the cold weather it was beautiful. The group stayed in a local log cabin and made s'mores by the fire. The club enjoyed hiking, riding horses, and collecting quartz. We also found lots of interesting outcrops where we discussed what we were seeing and took pictures of the folds. The trip was very enjoyable.

Last semester we also had a Big 12 Championship watching party as a fellowship event. The club also held a camping/caving trip on March 8th. Members drove to Little Sahara State Park where they camped the night. The next morning they looked at the sand dunes in the park and traveled to the gypsum caves in the area. Lastly, the club is looking for fundraising opportunities and hopes to set up a night at a local restaurant to get a portion of the proceeds donated to the club.

This year has been exciting and we are looking forward to the excitement yet to come.I would like to invite everyone to feel free to stop by and attend our meetings and come to the events we host.

Nicole Baylor
President
OU Pick and Hammer Club

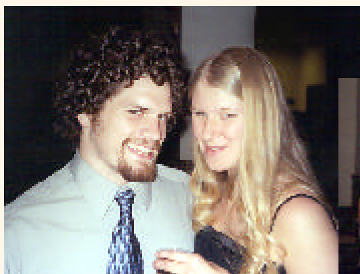
Club members Brandon Fritz, Kathryn Singer, President Nicole Baylor, Isabel Salazar, and Ben Geerdes.

Dr. Kevin Smart and G&G senior Nicole Baylor at the 2003 Geological Society of America South-Central and Southeastern Joint Sectional Meeting in Memphis, Tennessee. Nicole presented a poster titled "Geologic Mapping of the Quanah Granite, Wichita Mountains, Southwestern Oklahoma" (Authors: Nicole Baylor; Kevin Smart; and Charles Gilbert.

Sigma Gamma Epsilon

You are invited to attend the 1st Annual Sigma Gamma Epsilon Scholarship Ball hosted by the SGE Gamma Chapter.

April 4th, 2003
8:00 P.M.
Beaird Lounge, Oklahoma Memorial Union



Sigma Gamma Epsilon is a Geosciences Honor Society established to recognize scholastic achievement and professional advancement in the Earth Sciences. The @$800 in proceeds from this event will be used to revive a past SGE tradition of awarding an annual scholarship.

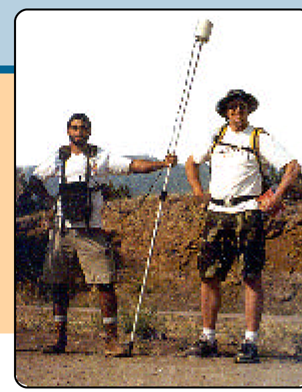
Meet You After Class. . .

Ryan and Stacy Stepler

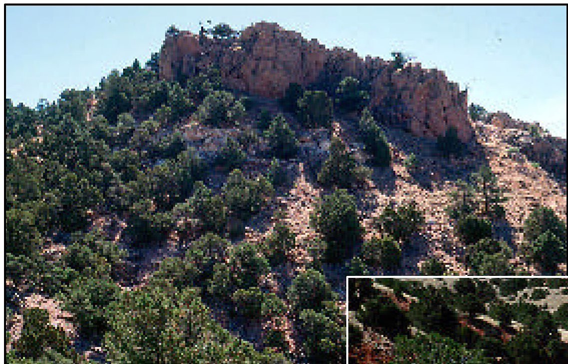
Raleigh and Angela Blumstein

German Camargo and Gloria Romero

Mike Faust and Allison Garrich



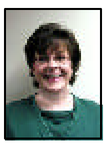
"The Few, The Proud, The Geophysicists"?!
SG&G students Ernesto Puche and Brent Wilson prepare to embark on other adventure in field work.



Field Camp 2002.
Students puzzling over geological complexity--*"is it Nasty Knob, or is it the Bulls Eye Place in the Twin Mountain map area?"*

2003 AAPG/SEG SPRING STUDENT EXPO

Sue Britton Crites



The third annual Spring Student Expo, sponsored jointly this year by the American Association of Petroleum Geologists (AAPG) and the Society of Exploration Geophysicists (SEG), was touted a great success. The Expo was held at the Sarkeys Energy Center on the OU campus March 14th and 15th in order to correspond with the Spring Breaks of several universities in the mid-continent region.

Designed to mutually benefit geosciences students interested in energy careers and energy industry representatives seeking quality summer interns and full-time employees, the 2003 AAPG Spring Student Expo experienced a ***21% increase in student attendance and an 84% increase in participation in the student scientific poster contest.*** Participating companies were able to meet with a diverse group of students from all over the United States, with individuals majoring in geosciences-related disciplines attending from 43 colleges and universities from over 19 states, as well as Nigeria and Canada.

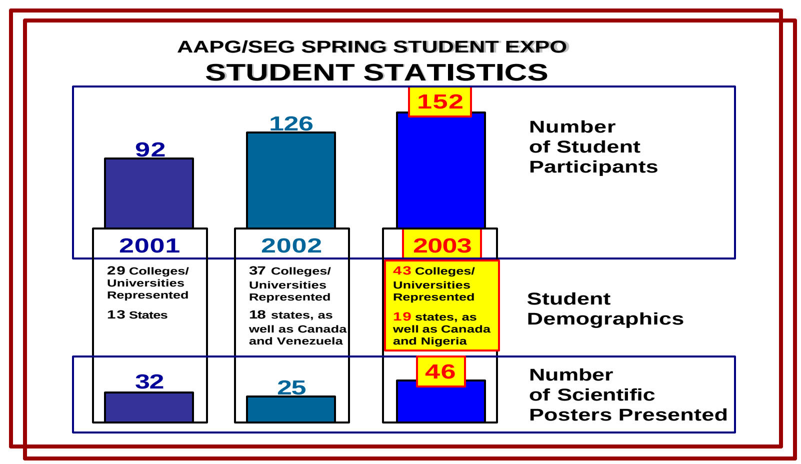
This year's Expo featured formal interviews with energy industry company representatives; a scientific poster contest for students; energy industry company exhibits; numerous opportunities for energy industry company representatives to network; as well as two mini-courses and a field trip.

Formal Interviews With Energy Industry Companies

The ten companies that conducted formal interviews were: **Continental Resources; Devon Energy Corporation; Dominion E&P; Encana Oil & Gas (USA), Inc.; EOG Resources; Exxon Mobil; Fusion Geophysics; geoPLUS Corporation; Pioneer Natural Resources; and Schlumberger**. Several students received offers for internships and full-time positions as a direct result of participating in the Expo.

Teresa Fairbrook, Human Resources Supervisor for Pioneer Natural Resources USA, Inc., felt her company's time at this year's Spring Student Expo in Norman was well-spent:

> "This was the first time that Pioneer had participated in this event and we thought it was well-organized and our objective of finding potential intern candidates was met. All of the planning for the interview schedules and evening events was well done, there wasn't any confusion like what one might expect at such a large event. In addition, thus far, we have extended 5 offers to students that we interviewed at the Expo. . . One of the great benefits of attending this event was the exposure to a variety of students from universities across the country. The students' poster sessions were well-done and they all seemed very enthusiastic about their research and presentations. We would gladly support any future Expo at OU and look forward to attending again next year."



2003 AAPG/SEG SPRING STUDENT EXPO, continued. . .

Several students also let us know what they thought of their experiences at the Expo. Southern Illinois University student Karyn Kasprzak:

"The AAPG/SEG Spring Student Expo let us (the students) meet the companies that are hiring and to see what type of people and work is needed in the industry. The Expo gave me a chance to show companies what I am doing and to get noticed (since I attend a school that is not normally recruited at). The Expo also gave me a chance to see the type of work other students are doing."

Iowa State University student Dan Tschopp said: ***"The Expo was an excellent opportunity to get a foot in the door. It was well worth the drive!"***

Scientific Poster Contest

This year, two sets of cash prizes were given out to reward the top three "geology" posters and the top three "geophysics" posters. The three levels of prizes were: First Place, $500.00, Second Place, $250.00, and Third Place, $100.00. ExxonMobil also contributed books to give away for honorable mention. Winners of the Poster Contest 2003 AAPG/SEG Spring Student Expo were:

For the Best Geology Posters:

1st Place: Cornel Olariu, University of Texas at Dallas, Richardson, Texas: *"Avulsion of terminal distributary channels in modern and ancient delta deposits"*

2nd Place: Angela Blumstein, University of Oklahoma: *"Origin of pre-folding and post-folding CRMs in the Deseret Limestone, Utah"*

3rd Place: Charles D. Howell, Jr., University of Texas at Dallas: *"Topographically controlled, mixed-influence [illegible] deltas: Turonian Wall Creek Member, Frontier Formation, Powder River Basin, Wyoming, U.S.A."*

Honorable Mention: Gloria Romero, University of Oklahoma: *"Identification of architectural elements of turbidite deposits, Jackfork Group, Potato Hills, eastern Oklahoma"*

For the Best Geophysics Posters:

1st Place: Marco Vignali (pictured below with Head Judge David Campbell), University of Oklahoma: *"Seismic structural interpretation of 3D seismic data located at the Borburata field, Barinas, Venezuela"*

2nd Place: Satish Sinha, University of Oklahoma: *"Single frequency attribute from continuous wavelet transform"*

3rd Place: Karyn Kasprzak, Southern Illinois University: *"Attenuation and suppression of multiple reflections of marine reverberations from a Lake Superior seismic reflection dataset"*

Honorable Mention: Andrew Rigor, San Diego State University: *"Using petroleum industry 3D surveys to improve understanding of active faults: The Palos Verdes fault in San Pedro Bay, CA"*

The posters were expertly judged by: Head Judge David Campbell, Earth Hawk Exploration; Tom Rowland, Consultant; Rich McLean, Marathon Oil Co.; George Troutman, Dominion E&P; Larry Lunardi, Chesapeake Energy Corp.; Raymon Brown, Oklahoma Geological Survey; and Stan Krukowski, Oklahoma Geological Survey.

AAPG/SEG SPRING STUDENT EXPO
PARTICIPATING COMPANIES

AAPG/SEG SPRING STUDENT EXPO

2001 AAPG Spring Student Expo	2002 AAPG Spring Student Expo	2003 AAPG/SEG Spring Student Expo
8 Interviewing Companies: ▪CEJA ▪EOG Resources, Inc. ▪Indian Exploration ▪Kerr-McGee Corp. ▪Phillips Petroleum Company ▪Marathon ▪Samadan ▪TotalFinaElf	**10 Interviewing Companies:** ▪Baker Atlas ▪Devon Energy ▪Dominion E&P ▪EOG Resources ▪Kerr-McGee Corporation ▪OMNI Labs, Inc. ▪Shell ▪Techniguide ▪Veritas DGC ▪Williams Company	**10 Interviewing Companies:** ▪Continental Resources ▪Devon Energy Corp. ▪Dominion E&P ▪Encana Oil & Gas (USA), Inc. ▪EOG Resources ▪ExxonMobil ▪Fusion Geophysics ▪geoPlus Corporation ▪Pioneer Natural Resources ▪Schlumberger
1 Add'l "Networking" Company: ▪Earth Hawk Exploration	**7 Add'l "Networking" Companies/Organizations:** ▪Chesapeake Energy ▪Flamingo Seismic ▪Hiawatha Exploration Company ▪Marathon Oil Company ▪Minerals Management Service ▪Vanco Energy Company	**6 Add'l "Networking" Companies/Organizations:** ▪AAPG ▪Chesapeake Energy Corp. ▪Minerals Management Service ▪PTTC ▪SEG ▪Vanco Energy Company

Energy Industry Exhibits

Industry representatives were also invited to present posters of company activities and/or host exhibits. This gave company representatives ample opportunities to talk with students. Our thanks to the following organizations that hosted exhibits: **Chesapeake Energy Corp.; Minerals Management Service; PTTC; Vanco Energy Co.; Pioneer Natural Resources; Devon Energy Corporation; Dominion E&P; Encana Oil & Gas (USA), Inc.; EOG Resources; Exxon Mobil; geoPLUS Corporation; Schlumberger; AAPG; and SEG.**

Our thanks to those organizations/individuals which also provided financial sponsorship but were unable to participate in the Expo: **CEJA; TotalFinaElf; Mack Energy; the Oklahoma City Geological Foundation; Jere McKinney; Marlan Downey; and Jack Taylor**.

Opportunities for Networking

Industry representatives also had the opportunity to talk with students in informal settings during the Ice Breaker Reception held March 14th and the Awards Reception on the 15th. A band of mostly geologists, a true "rock band", called Source Rock played for Expo participants at the Ice Breaker Reception.

2003 AAPG/SEG SPRING STUDENT EXPO, continued. . .

AAPG President Dan Smith *(photo right)* was the keynote speaker at the Awards Ceremony the next day. Smith was also on hand throughout the Expo to meet and speak with students, who were very excited to have such an opportunity.

Additional Special Events

Two Mini-Courses and a Field Trip (free to student participants) were also offered as part of the Expo:

- "Petroleum Geology of Deepwater (Turbidite) Depositional Systems" taught by AAPG Distinguished Lecturer Dr. Roger Slatt
- "Computer Graphics for Geophysics" taught by Dr. Alan Witten
- "One-Day Field Seminar to the Arbuckle Mountains" led by the Oklahoma Geological Survey.

All three of these events were well-attended and received many favorable comments from student participants:

"I attended the OU AAPG/SEG student expo and took Dr. Slatt's turbidite minicourse. I feel I benefited greatly from this experience, I had a great time, and I appreciate the effort the organizing committee went through to set all of this up and make it happen. Thank you – I feel like the students got a great deal!" – Matt Chapman, Miami University [Ohio]

"This was the first student expo that I've been to and I'm glad I had the opportunity. Everything was great, from the people who organized it to the people who attended, as well as the class I took in 3-D modeling for Geophysics applications. I really want to do it again (and possibly transfer to OU if I pursue a PhD in Geophysics)." – Sirel White, University of New Orleans

What Does Next Year Bring?

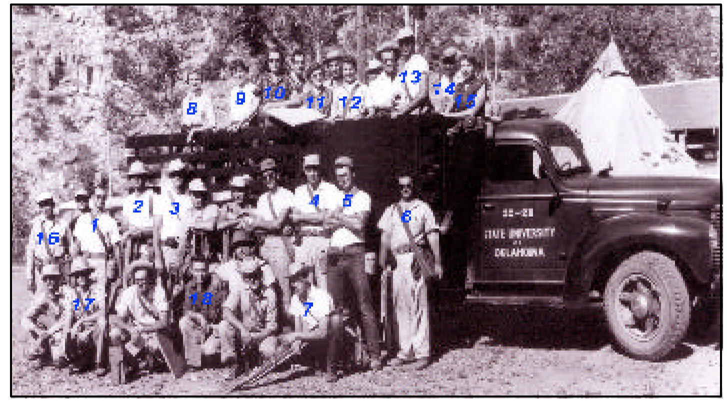
Next year's Spring Student Expo is tentatively scheduled for March 12-13, 2004. We will again invite students and companies from around the country to participate. We would definitely like to encourage those companies that anticipate having summer internships and/or full-time jobs open in 2004 to seriously consider conducting formal interviews at the Expo—we'll bring the students!

"Unfortunately, we have not had as many companies signed up to interview the many quality students who traveled from across the United States to interview in the petroleum industry. In order to sustain this event, we must have the Energy industry's support by sending representatives to interview students for internships and/or full-time positions or even to make contacts for future possible employment. As well, the students need to see that there are opportunities in the oil and gas industry, particularly since companies are so worried about demographics."

– Dr. Roger Slatt, Director of the OU School of Geology and Geophysics

Our thanks to all the organizations and companies that supported the Expo this year, including the AGI, which helped publicize the event and "get the word out" to the students. **Let's do it again next year!**

Alumni and Friends of the School



Who's On First?! ***It just wouldn't be the Earth Scientist if we didn't have some mention of the 1955 Cañon City Field Camp photo that was first re-printed in the 2001 Centennial Celebration edition, so. . .*** **Revised caption: July, 1955, Cañon City Field Camp attendees for the OU School of Geology. We know there were 23 men, 6 women, and 3 instructors, but our memories of field camp are not as clear as they used to be, so if you recognize any of those individuals not named, please let us know!**

(1) Dave Campbell; (2) Bill Coffman; (3) Dick Morgan; (4) Clyde Thompson; (5) Tom Rowland; (6) Warren Morris; (7) Jack Jones; (8) Carol Gungoll; (9) June Hughes; (10) Carolyn Hayes; (11) Ann Anderson; (12) Jane Hughes; (13) Al Giles; (14) Charles Cutright; (15) Dorris Jean Mohan; (16) Wilburn Cecil Kilgore; (17) Roger M. Wright *or* Barry K. Van Sandt; and (18) Thurman W. Dobbs.

Sue,

You are doing a great job of keeping up with people, I think. I am afraid that we are not doing as well at remembering the old times. Our memories seem to have a way of getting a little fuzzy. I viewed with interest the story of the Cañon City Field Camp of 1955 on page 67 of the Spring 2002 issue.

I attended the July 1955 field camp in Cañon City. It gave me enough credit hours to graduate in August of 1955 with a BS in Geological Engineering. Unfortunately, I do not remember too many of the other people that were there. I commuted to school all four years and therefore did not have many close friends at school. I had Dr. Moore as an advisor and we were very close. I stayed by his side most of the time. I was one of about seven that Dr. Moore took to the Cañon City Baptist Church every Sunday.

I also had a pith helmet that I took to camp and wore large print cotton short sleave shirts that my mother made. That is the reason that I claim that I am the one squatting to the right of Dr. Moore in the picture. If the hats did not cover the top of our heads it would be easier to identify. Barry Van Sandt claims that picture, #17, also. I do not remember what Barry looked like, but you can check out my picture in the freshman class of the 1952 annual.

After graduating, I went to work for Chevron Oil, where I had various geophysical assignments in Texas and Oklahoma before going with Chevron Overseas group for 10 years, working all over Africa and Europe. I spent the last 20 years in New Orleans as Division Geophysicist. I retired from Chevron in 1995 and now live in Sun City, Texas, in Georgetown, north of Austin. I am still a rabid OU football fan!

Regards,

Roger M. Wright
BS, Geol. Eng., 1955

Dear Sue:

I was unable to attend the 100-year anniversary of the School—but I have sure enjoyed the followup letters on the old timers in the 2002 spring issue of the Earth Scientist.

I only lived on campus for one semester and commuted the other four years. As I first entered the world of oil and gas exploration with my new degree in geology, I found I wasn't as rich as I thought I would be! I had worked for Humpty Dumpty Groceries through high school and college. I had worked way up the corporate ladder to second assistant manager, and at this lofty position, I was making more money than my starting salary in the oil business—but I have never regretted my decision to enter this exciting field full of challenges and opportunities.

My favorite instructors at the School :

- *Dr. Carl Moore and his work with the geology field camp in Colorado.*
- *Dr. Victor Monnett, as a teacher of geology. He usually taught Structural Geology, where we had a pop quiz the first day of class to see if we remembered the information from our Geology One lab, and those who didn't pass had to repeat the lab with no credit—I passed. Usually, each class period he would propose some structural problem on the blackboard, and everyone had to vote on a proposed solution. The solutions he proposed were usually wrong—he just wanted to see if you were paying attention!*

Memories of Field Camp, Colorado, August 1953

As I remember, our camp was the first to have women students—in our get-ready-for-camp meeting, we were threatened with our lives if there were any problems, improper actions or interference. The girls were housed in tents, as we were, across the creek, along with the cooks. The creek was the boundary—no men allowed across the creek! The only thing I remember was that they were "smart", and as I recall, they made better grades than I did.

Jim Caylor was the student assistant for the camp; he was unmarried at the time, and may have had more time to help them on their assignments. In August of 1952, I was already married and had a new baby girl.

In August of 1953, the only permanent building was the mess hall. The food for camp was the best, excellent quality and well-prepared. Our only hazard was the noon sack lunch -- there was no way to send a sack lunch to the field. Our living quarters was a tent on a cement pad, three to a tent. My roommates were Windell Smith of Oklahoma City and "John" (don't remember his last name or where he was from). We went up the road a few miles for a shower and shave.

Our field assignments were well-planned and gave us a good chance to use some of our learned class room skills. The mapping with the plane table and alidade was a challenge for our three-man-crew—John had not had any surveying prior to the field camp (even though it was a requirement). Each evening as we tied in to a bench mark, we always mis-tied! Wendell and I spent each evening searching for the error (usually made by poor John) so we could rerun the line the next morning.

This turned out to be a blessing for later work years. My first work assignment was on a seismic field crew and the second week on the job, our surveyor took sick and I was selected as surveyor. I have continued to use the surveying skills throughout my working years.

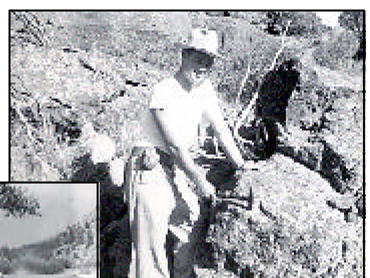
My work history has included: General Geophysical of Houston, Texas; Phillips Petroleum, Bartlesville, Oklahoma; and Rumiiner Exploration.

With all its up's and down's, I would never change my decision to be in the earth science field.

Sincerely,

Donal Ruminer
BS, Geology, 1954

Windell and "John"



Double Birthday Celebration

Shown at their recent 80th birthday celebration in Midland, Texas, *left to right*, first row: Phillip R. Becker (B.S., Geol, 1949) and Donald G. Becker, Sr. (B.S., Geol, 1949) *Second Row, l to r*: David K. Becker, Steven A. Becker, and Donald G. "Deeg" Becker, Jr. (*all geologists, we'd like to note*).

Twins Phillip R. and Donald G. Becker, Sr., held up by proud father and Oklahoma Oil Pioneer Clyde M. Becker circa 1926.

***Left to right:* Phillip and his wife, Ruth, and Donald Sr. with his wife, Alene.**

A Family Tradition: Clyde M. Becker was one of the pioneers in the petroleum industry. His six sons, Fred, Robert, Theodore, Donald, Phillip, and Clyde, Jr., all majored in geology at OU and all but one followed in their father's footsteps in the petroleum industry (*Fred later became a medical doctor*). Clyde Jr.'s son, Clyde III, and Phillip's son, David, also attended OU's School of Geology and Geophysics.

During the SG&G Centennial Celebration year, Clyde Becker, Jr. , established the *Clyde Becker, Sr., Endowed Chair in Geology & Geophysics* in honor of his father.

E.W. Marland, who once controlled 10 percent of the world's oil reserves and founded Marland Oil Co. (later absorbed by Conoco), controlled oil exploration in sites all over the world, with one major exception – his own backyard. Due to a Ponca City ordinance, Marland wasn't allowed to drill within the city limits on the vast acreage surrounding his home from 1916 to 1928, the Marland Grand Home.

Decades later, John Warren, president of the Warren Corporation in Oklahoma City, thinks there is a good chance of finding oil underneath the front lawn of the home and has been granted permission by city leaders to drill there.

SG&G alum Jack Ferchau (B.S., Geology, 1958; *photo right)* of Stillwater, Warren's friend and business partner, is helping out with the project, and offered members of the Oklahoma Geological Survey and SG&G staff member Sue Crites a chance to tour the drilling site last September.

"We have the opportunity to re-write history. We felt this was an opportunity to drill in a location that Marland might have wanted to but wasn't allowed to – after all, he did build this home on the highest point among 65 gas wells drilled in the early 1900s before such drilling was banned. Now that the city leaders and area residents have been so helpful in opening the way, we are ready to proceed."

Ferchau indicated that after researching the options regarding equipment, they brought in a drilling rig from Arkansas that is small enough to fit in the testing area and is also quiet enough to not be too disruptive in this residential neighborhood.

He said they are testing in four zones with the deepest drilling about 2,700 feet and the shallowest about 1,700 feet (crews in the early 1900s only had the capability of drilling to approximately 900ft down): "The zones look really good." Ferchau pointed out that one of the biggest problems facing the workers is moving the oil and natural gas from the drill site to a storage facility about 2,800 feet away. "We're going to have to tunnel and that's very expensive," he said. The company has leased a section of land for the drill site containing several hundred lots that have mineral rights owned by various people. If oil or natural gas is found, profits from it will be divided among the owners.

PROFILE: JAY GALLOWAY

Jay Galloway
B.S., Geol. Engr., 1954

Robert "Bob" Cowdery, Kansas Geological Society

Bob Cowdery has written several articles on individuals in the industry for KGS, some of whom happen to be OU SG&G alumni or affiliated with the School. He has graciously given us permission to reprint the next two articles.

This profile details the life of a prominent Wichita geologist who, although he was born in Halstead, Kansas in May 1928, has spent most of his life and career in Wichita, with occasional excursions to Oklahoma and Texas.

Jay's father, Jack was a drilling contractor who took a rig to the gas country of western Kansas, but later sold out to his partners, the Babb brothers. In 1942 he formed C & G Drilling with Dick Cook. Initially most of their drilling activity was in the Great Bend area, including a number of tests for Pierce Musgrove. Jay says that is when he first encountered Albert Abercrombie, who was a member of the Musgrove organization at the time. Jay's mother was a homemaker and still resides in Wichita. She is 96 years of age.

Jay has two sisters -- Ann Salome who lives in Lawrence with her husband, Bill, and Carol Hessling who resides in Overland Park -- and a brother, Tom, who lives in Oklahoma City. Jay's early schooling was at Fairmount Grade School and he continued his education at Roosevelt Jr. High until the middle of the eighth grade, when the family moved to a different area in Wichita. He completed the eighth grade at Robinson. Jay then spent the next four years at Wichita East High School, graduating in 1946.

Because he had been exposed to the "oil fields" at an early age, he had made the decision that he wanted to be a geologist. His plan was to enroll at the University of Oklahoma, but he received word from the university that there wasn't any dormitory space available, so he enrolled for one year at the University of Wichita where he pledged Phi Sigma, a local fraternity. The next year he was able to enroll at the University of Oklahoma where he joined the Sigma Nu fraternity. One of his fraternity brothers was Harry Larsh, later to become a respected and well-known geologist in Wichita.

Jay's advisor at OU was Dr. Carl Moore who persuaded him to enroll in Geological Engineering. Jay believes that the engineering portion of his degree served well in his later career in activities such as the completion of wells etc.

When asked what professor influenced him the most, Jay replies that Dr. Moore would be the one in part based on his advice to take Geological Engineering. While at OU, Jay had as lab instructors Rick Clinton and Al Siemens, who is currently a KGS member. Because of OU's decision not to accept some of his credit hours from WU, it was necessary for Jay to stay an extra year at OU and this delayed his graduation until the spring of 1951. After graduation, Jay interviewed with several companies and received an offer of employment from Humble Oil and Refining. He was assigned to the Houston office to do map work in the Gulf Coast area. After receiving field training from a geologist in Beaumont, the company sent him to do a field study of an area near Freeport. Later, Humble assigned several areas including Conroe, Galveston Bay to Jay to provide the geological input for Humble's operations in those areas.

After one and one-half years with Humble, Jay informed the company that he wished to return to Kansas, having in mind eventually a career as an independent geologist. Humble offered to transfer Jay to their sister company, Carter Oil which had operations in Kansas, but Jay says that "Carter really wasn't doing anything" and there didn't appear to be that much of a future with Carter. He returned to Kansas where he met Bob Aitken, who shared office space with E. K. Edminston at the time. Bob persuaded Jay to work in Edminston's office spotting maps, which he did for three months. Later in 1953, Jay joined the firm of Tomlinson, Kathol and Emmerich . Also employed by this partnership was Bill Stark, an acquaintance of a number of KGS members.

PROFILE: JAY GALLOWAY, continued

For the first time in his career, Jay was doing well site work on his own. He has a good recall of his first well, a test in Clark County. He said that he was so nervous that he was reluctant to leave the drill site and only left to make short trips into town to obtain food. This seems to be a malady that infects most geologists on their first test on their own. Jay considers this test to be probably his most challenging well. Jay later sat on a test in Ellis County that Bob Williams, Imperial Oil was drilling. Of the professional geologists that Jay has encountered in his career he believes that Warren Tomlinson and Jerry Kathol probably exerted the most influence on him. Over the years Jay was the well site geologist on many wells. The one embarrassing well that he recalls was one where he identified the Simpson Dolomite as the Arbuckle. Odds are that he is not the only geologist that has made this "call."

In 1954, Jay went to work for C & G, but before he did, he asked his Dad "Are you just hiring me because we are related," his Dad said, "No, if we didn't hire you we would hire some other geologist as we need one." They sent a rig to Creek County, Oklahoma where they drilled a series of Red Fork tests. For this period, Jay commuted between Wichita and Drumright, Oklahoma. With the completion of this series, they started moving the rig northward, first to Kay County, Oklahoma, then Cowley County, Kansas and finally to Ellis County, Kansas.

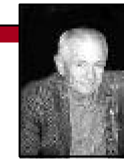
From 1949 until 1995, they kept a rig busy drilling for D. G. Hansen, including 44 wells in a row in the Norton Field. D. G. Hansen required a lot of individual attention from the officers of the company and when Dick Cook decided he wanted out of the contracting business in 1955, the job of satisfying Dane Hansen fell to Jay and he became a partner in the company. Jay estimates that they drilled between 600-800 tests for Dane Hansen.

In the ensuing years, the drilling contracting business went through some rough times. Jay recalls that at one time in the 70's, a rig sold for $18,000 in Ellinwood, Kansas. There was a period when there were 19 rigs running in Kansas and C & G had two of the 19. The name of the company was changed in 1960 to Galloway Drilling, since Dick Cook was no longer a partner and in 1997 they sold their rigs and production. They have, however, retained some non-operated properties. In 1976, Jay married Helen Jabara, who is one of the most active individuals on the Wichita scene. Jay has five children: Brad who lives in Partridge, Kansas and who is in construction; Kerri Tonn, a nurse in Hutchison; Casey, who is with British Petroleum as a Drilling Engineer on the North Slope of Alaska, but who has worked all over the world from Lake Maracaibo, Venezuela to Quatar in the Middle East; Lance also in construction in Topeka and Mike, working for the State of California doing Environmental Studies. Jay, also has two step-daughters: Buff Hukle who works with her mother at The First Place and Kara Haverty who lives in Kansas City.

Over the years Jay has continued his membership in the KGS and for SIPES he has served as Treasurer, Vice-Chairman and Chairman of the Wichita Chapter. He has also maintained a membership in KIOGA. He has also supported the community with his efforts in a number of organizations including Wichita Crime Commission, Friends of McConnell, East Heights Methodist Church and the Sooner Club of Wichita.

Jay does not regret at all his career path as a petroleum geologist; on the other hand, he has some reservations about recommending petroleum geology to those preparing to pick a career because of today's market in the field. With golf as his primary recreational activity, Jay has the goal of "shooting his age." He also indicates that one of his other goals is keeping up with his wife in her myriad of activities.

PROFILE: MIKE RAYMOND

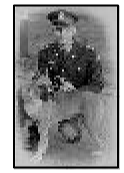


Mike Raymond
B.S., Geology, 1954

Robert "Bob" Cowdery,
Kansas Geological Society

One of the most successful companies over the years in Kansas's exploration and development has been Raymond Oil Co. Mike Raymond has followed in the family tradition and been an integral part of that success story for a large portion of that time.

Mike's father, Francis, first commenced his association with the "oilfields" in 1918 and continued that relationship until his death in 1986. Francis and Mike's mother, a homemaker, had two other children: Chuck who is deceased and Shirley Stark now residing in Wichita. Mike was born in Wichita on July 7, 1931.



He attended Sunnyside Elementary School where his friendship with fellow classmate Ted Sandberg developed into a life-long relationship that continues to this day. They spent considerable time together engaged in such activities as building model airplanes etc. He attended Roosevelt Jr. High School and then graduated from East High School in 1950. At both of these schools his classmate was Ted Sandberg. During his school years, one of his part-time jobs was delivering handbills for Luis Casado, an activity that Mike says Thornton Anderson was also a participant.

Mike then enrolled in geology at the University of Oklahoma. He wished to continue in the family business, but with the idea in mind of enhancing his contributions to that business with a technical background. He actually had an early start on his career as a geologist as he was plotting strip logs for his father while he was still in high school. At OU he found that a well-known professor, Dr. Carl Moore, exerted considerable influence on his career. A classmate of Mike's at OU was Charles Spradlin, well-known Wichita geologist and KGS member.

While at OU, Mike met Lora Connelly, from Oklahoma City and they were married in 1953. Lora died in 1998 after 48 years of happy marriage. Mike and Lora had three children: Leigh, Kelly and Bill, who is following in Mike's footsteps and participating in the family business.

Mike was making an additional contribution to the success of Raymond Oil while he was a student at OU. He went to the library and checked out all three volumes of the AAPG's "Typical American Oil Fields". In volume 3 he found a map contoured on a Permian bed of the Geneseo Field, Rice Co. Kansas. It indicated that there was an undrilled minor structural high. Mike made a tracing of the map and sent it home to his father. His father was able to secure an 80-acre lease and the result was 7 producers. ***Mike definitely recommends any new geologist entering the industry make a thorough study of all of the literature available on an area they are working.*** His own experience certainly "proves his point."

While at OU Mike was enrolled in R.O.T.C. Following graduation he was called into the service and commissioned as a 2nd Lieutenant. Following training at Fort Belvoir Virginia in the Corp of Engineers, he was assigned to Fort Riley, Kansas. Mike says that Fort Riley was not the greatest place to serve, but it did have the advantage of being close to home. At Ft. Riley he served as Company Commander of an Engineering Company. He was discharged in 1957.

After his discharge, Mike resumed his career with Raymond Oil. Although Raymond Oil has concentrated a lot of their exploration efforts in Kansas, at various times they have also maintained offices in Denver and Casper. Their geologist in Casper, Wallace Stewart, who was well-known throughout the Rockies, recently passed away.

One particularly interesting test drilled by Raymond Oil resulted from Bob Lewellyn submitting a log with a repeated section of either Simpson Sand or top of the Arbuckle, which indicated the presence of a thrust fault. After shooting, Bill Ham identified a fault on the seismic records. Drilling of this prospect resulted in the discovery of the Blackhall Field in southern Rice County. This field is unique because it produced oil rather than gas from the Lyons Anticline. When a dipmeter was run, it not only identified the thrust faulting but the drag associated with the fault on both sides of the fault plane.

Mike recalls that he was on his way to Clearwater at 10:00 pm one night to observe a DST. As he was driving near Haysville he noted a rig drilling. The next morning as he was returning to Wichita, he noted that this rig was shut down with 5 ½" sticking out of the table and with oil on the pits. This information allowed Raymond Oil to get an early start on leasing in the Gladys Field. Among the many excellent geologists who have worked for Raymond Oil are: Bill Capps, Rick Clinton, Tim Hellman, Clarke Sandberg and Charles Spradlin.

Even though he has had a very busy career, Mike has found time to pursue his hobby of "skeet shooting." **When asked what professional influenced his career the most, Mike says his Dad who was a "traditional oilman" exerted the most influence on his career. There isn't any question in Mike's mind that if he had it to do all over, he would follow essentially the same career as a petroleum geologist. He just wishes he had energy and the time to do it once again.** ***On the other hand, he doesn't plan to retire, for as he says, "oilmen never retire." And like many of those oilmen, Mike would still like to find one more good field.***

The University of Oklahoma
School of Geology and Geophysics

Vision for Excellence Campaign

*O*ver a century ago, Dr. Charles N. Gould arrived in Norman to establish what is now the School of Geology and Geophysics at the University of Oklahoma, the first school of petroleum geology in the world. Since then, the school has trained more than 5,000 geologists and geophysicists, including leaders in industry and academia.

OU graduates have become chief executives of major industrial companies, research scientists in industry, and members of large academic institutions. They currently live and work in 50 states and 112 countries.

Our alumni and friends have played an extremely important role in creating one of the best petroleum geology schools in the world. Your contributions are largely responsible for the scholarships, endowed chairs and professorships, computer labs, mineral exhibits, and world-class library that support the excellent programs we are able to offer our students.

To accomplish our vision of contemporary excellence, critical private investments are needed to build upon areas of historical excellence, as well as to foster emerging ideas, create new programs, and provide incentives to students, faculty, and staff.

*T*here are four important ways alumni and friends can support our school. You may:

(1) designate your gift as unrestricted, so that it may be used in an area where it is needed most;

(2) designate a gift to benefit one of the major five-year endowment priorities;

(3) participate in the annual support group, the Mohs Club, named after the Mohs Scale of Hardness; or

(4) through a planned or deferred gift, reach across the generations to touch the future of our G&G students.

SG&G's Endowment Priorities for the Current Five-Year Plan

Ö Endow graduate fellowships.

Ö Endow a full-time recruiter.

Ö Endow the Charles W. Harper Jr. [redacted]

Ö Purchase a new next-level visualization laboratory.

Ö Endow, build, and maintain state-of-the-art classrooms and laboratories.

Ö Endow two "super chairs" in strategic areas of excellence.

Ö Endow two faculty lectureships for outstanding junior faculty.

Ö Endow the Laurence S. Youngblood Energy Library fund.

Mohs Club Annual Donation for Three-Year Commitment

The Mohs Club establishes levels for annual financial contributions to the School of Geology and Geophysics Director's Discretionary Fund. The first 10 donors in each category who make a three-year commitment will be identified as charter members and will receive a mineral specimen matching their donation level (*see photos on pages 16-17*).

$0 – $99	**Talc**
$100 – $499	**Gypsum**
$500 – $999	**Calcite**
$1,000 – $1,999	**Fluorite**
$2,000 – $4,999	**Apatite**
$5,000 – $9,999	**Orthoclase**
$10,000 – $24,999	**Quartz**
$25,000 – $49,999	**Topaz**
$50,000 – $99,999	**Corundum**
$100,000 and over	**Diamond**

For additional naming opportunities available for programs, scholarships, and faculty support, please contact:

Dr. Roger M. Slatt, Director
[redacted]
E-mail: rslatt@ou.edu

John W. Ritz
[redacted]

[redacted]

EARTHSCIENTIST
2003 Edition

Dr. Roger M. Slatt
[redacted]

Sue Britton Crites
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MAKING YOUR GIFT

❑ Yes, I would like to help the School of Geology and Geophysics accomplish its VISION OF EXCELLENCE with an unrestricted gift of $_____________________.

❑ I would like to contribute to the following five-year-plan priorities:

___ Endow graduate fellowships
___ Endow full-time recruiter
___ Purchase new next-level visualization laboratory
___ Endow two faculty lectureships for outstanding junior faculty
___ Endow, build, and maintain state-of-the-art classrooms and labs
___ Endow two "super chairs" in strategic areas of excellence
___ Endow the Charles W. Harper Jr. field camp for students and faculty
___ Endow Laurence S. Youngblood Energy Library fund

❑ I would like to make a three-year commitment to the MOHS Club at $_______________per year.

❑ My check, made payable to the OU Foundation, is enclosed.

❑ Please bill my credit card: ❑ MasterCard ❑ VISA ❑ AmExpress ❑ Discover
Card no. ___________________________ Exp. date _______ Signature _______________________________

❑ My employer ____ will match my gift. Form is enclosed.

❑ I would like to discuss a possible gift of stock or a planned or deferred gift. Please contact me with further information.

TELL US MORE . . . **Help keep us up to date on our friends and alumni.**

Company name ____ Your title_______________________________________

Preferred phone________________________ E-mail address ____

OU alum? ___ Degrees?_____________________ Other info ____

____

$_________/____________/ 936 / C /

Do you recognize any of these people? *Please let us hear from you if you do. Also, share your favorite memories/stories about your experiences here at the University of Oklahoma School of Geology & Geophysics. Photos are also most welcome (and will be returned to you upon request).*

Please take a moment to let us know about your current activities, news about your family, and interesting and important things you've done.

Return your information to us at the address listed below and we'll share your memories and news with other alumni and friends of the School by including them in the next issue of the Earth Scientist.

We look forward to hearing from you. . .

Sue Britton Crites
Editor

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