GEOLOGY at SMU

An occasional newsletter for alumni and friends: July, 2004.

Neil Tabor studies ancient climate through paleosols

Looking for the unconformities

Deposits of ancient soil are getting new respect these days. Instead of being walked over or misinterpreted as hydrothermal alteration zones or shales, geologists such as new Assistant Professor Neil Tabor are extracting climate information about the ancient Earth. For sedimentologist, Neil Tabor, the study of paleosols, or paleopedology, is a primary research interest.

Soil is one of the most precious natural resources on Earth. In fact, soils are so important to the success, or collapse, of civilization that the study of soils has existed as a specific subject for at least 4,000 years. Paleosols are soils that have been buried and incorporated into the rock record. Paleosols provide one of the only "windows" that permits us to peer into the surficial processes and environmental conditions of an ancient world that is otherwise lost. Paleosols record how Earth's climate has changed through time and provide clues to the mechanisms of past climate change.

New Assistant Professor Neil J. Tabor Research Interests

- Permian and Triassic atmospheric circulation systems and rainfall patterns,
- Carbon budgets of Permian, Triassic and Paleocene soils
- Atmospheric carbon dioxide concentrations over the past 440 million years
- Paleotemperatures of sub-and tropical regions

Although Neil's search for paleosols spans approximately 400 million years of the geological time scale, his research has concentrated on paleoclimatic reconstructions of Permian and Triassic time; an interval represented by strata that are between 300 and 206 million years old. During the Permo-Triassic, all of Earth's major continents drifted together into one "supercontinent" called Pangea. This unique continental configuration resulted in the reorganization of Earth's atmospheric circulation and its rainfall patterns. Elevation of atmospheric green house gas concentrations accompanied the melting of the global ice caps. Catastrophically warm climates of this time may have led to one of the most devastating mass extinctions in the history of life.

Neil Tabor shows undergraduate Robert Talamantez (left) fining-upward, repetitive layering in some Quaternary gravels in the Basin and Range, west central Arizona.

Using the stable isotopic compositions of minerals and organic matter in the paleosols, Neil was able to reconstruct the history of the temperature and the partial pressure of atmospheric carbon dioxide during a transition from an ice age to a global geeenhouse. The temperature in the tropics went up at least 5 degrees centigrade. The partial pressure of carbon dioxide went up by a factor of 5, very close to the change from a Pleistocene glacial maxima (15,000 years ago) and the values that we may see later this century!

Published by Department of Geological Sciences, Dedman College, Southern Methodist University

Chairman's Report

Don't forget about Earth: More lessons from the Colorado Plateau

By Robert Gregory

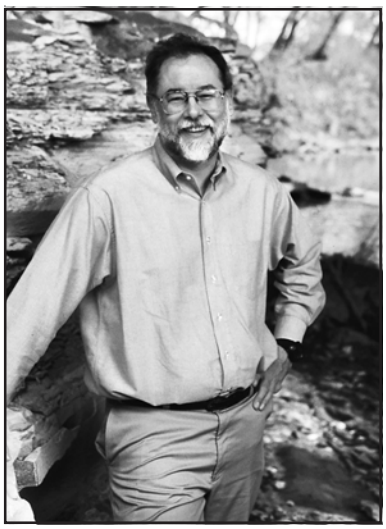


Photo by Hillsman B. Jackson

In this issue, we are pleased to introduce in the cover story our new faculty colleague, tenure-track Assistant Professor Neil Tabor. Neil comes to us from University of California, Davis, after serving as Professor Crayton Yapp's postdoctoral fellow supported by National Science Foundation funds. Neil's primary training is in sedimentology with an emphasis on ancient soils as paleoenvironmental indicators. Neil has become a player in the debate over the role of carbon dioxide in the current and ancient climate of the Earth. Neil combines classical interests with a modern analytical laboratory tool bag.

This brings to mind the recent passing of geologist and former chairman of Caltech, Professor Robert P. Sharp. Sharp, the classically-trained geomorphologist, had the wisdom to move Caltech's department in the direction of isotope geochemistry in the early fifties and planetary science in the sixties. While recognizing that geology must expand into new areas to remain intellectually stimulating, he never forgot about field work.

In the early days of planetary exploration, Sharp admonished the new scientists not to forget about the Earth. Following Sharp's advice, it is interesting to think about the formation of the Grand Canyon (a place where Sharp took many generations of geologists, just like we do here at SMU) and what it might tell us about the history of the surface of Mars.

Mars is one of the big stories and the object of a major portion of NASA's planetary exploration program. Two landers and multiple orbiters are currently active on Mars sending back volumes of data. One of the primary aims of the program is to find evidence for the former existence of abundant water on Mars. Did Mars ever have an ocean? If so, did it persist for enough time for primitive life to evolve?

Perhaps the answer may be found instead in thinking about the Earth and the global mosaics, now almost thirty years old, returned by the NASA's *Viking* program and improved upon by the Mars Global Surveyor program (Fig. 1). Martian geology is striking for its dichotomy of "old" heavily-cratered terrain of the southern hemisphere, left over from the solar system's era of heavy bombardment and the flat, virtually-featureless northern plains, the presumed site of a potential ancient Martian ocean. Valles Marineris strikes east-west and dwarfs Earth's largest canyons, such as the Grand Canyon, in comparison being over 7 km deep and 4,000 kilometers long and 100's of kilometers wide. Its canyons generally empty into the northern hemisphere or form closed depressions.

Valles Marineris seems to share a common characteristic with the Earth's Grand Canyon, in that they both appear to form by sapping. The canyon grows largely by mass wasting of the walls followed by removal of material by ephemeral debris flows in the bottoms of the canyons. The questions are: how long did it take to cut the Grand Canyon and what are the implications of the denudation rates for existence of oceans on Mars? The preservation of the >4 billion year old heavily-cratered terrain on Mars becomes the critical relationship.

The ability to obtain high precision radiometric dates on the many lava flows associated with the uplift of the Colorado Plateau and downcutting of the Grand Canyon now constrain the formation time to be on the order of millions of years and not ten's of millions of years. This is the conclusion of geologists Ivo Lucchitta (U.S. Geological Survey) and Kenneth Hamblin (B.Y.U.).

Lucchitta's analysis of a fragmentary record of gravels and lava flows, many of which now cap mesas, indicates that the ancestral Colorado River followed paths similar to that of the Little Colorado River (Fig.2), that now flows to the northwest. This trend follows that of several scarps east of the Kaibab Plateau indicating a northeastward retreat of west-facing scarps that now frame the Painted Desert to the east. To the west of the Kaibab Plateau, the

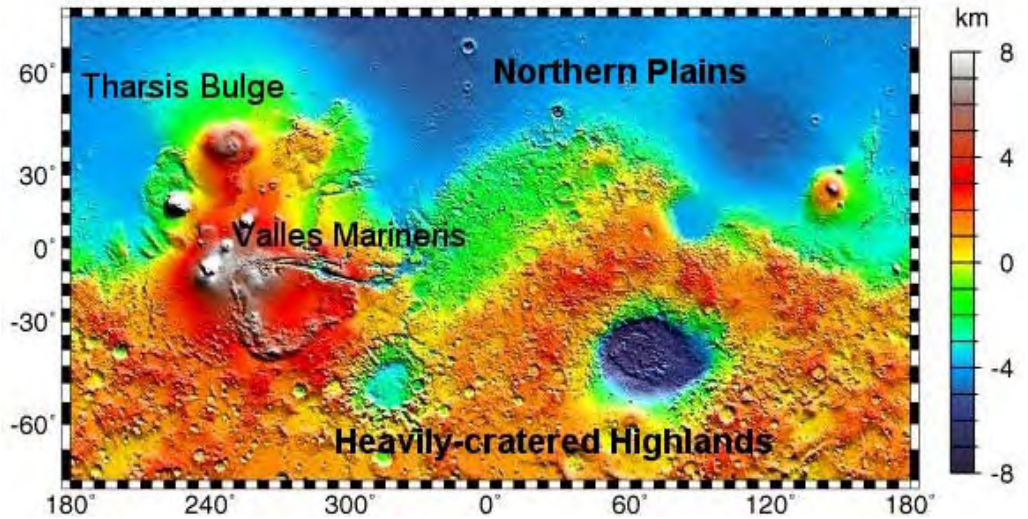


Figure 1: NASA's Mars Global Surveyor elevation data for the surface of Mars showing the dichotomy between the heavily-cratered southern hemisphere highlands and the flat lowlands of the northern hemisphere.

Department of Geological Sciences
Southern Methodist University
P.O. Box 750395
Dallas, Texas 75275
Lisa Halliburton, editor
214 768-2770; Fax 214 768-2701
E-mail: geol@.smu.edu
http://www.smu.edu/geology

Continued from Page 2

Triassic also crops out so that the Moenkopi surface was once much higher, above the present position of the Grand Canyon whose rims expose Permian Kaibab. Red Mountain, 20 miles south of the Grand Canyon, stands 1000 feet higher than the surrounding plateau and is capped by Miocene basalt underlain by Triassic Shinarump and Moenkopi formations. Tertiary (Miocene) uplift changed a meandering river on the broad Moenkopi surface into an entrenched river cutting the Grand Canyon.

Kenneth Hamblin reports on the interplay between lava flows and the cutting of the Grand Canyon by examining the partial record of 13 lava dams. He concludes that a thickness of 3.4 km of lava accumulated in the 13 dams; it took no more than 200,000 years for the river to cut through the resistant basalt! With the topographic driving force, the canyon walls have the capacity to retreat at rates exceeding 1.5- 3 km per million years! Placing this in perspective, consider a Martian surface with a northern hemisphere ocean and southern hemisphere seas filling craters. With 10's of kilometers of topographic relief and atmospheric circulation, erosion would have obliterated the record of the heavily-cratered southern hemisphere, just as erosion has done the same on Earth. It did not happen, suggesting that instead there was no ocean under an atmosphere capable of sustaining running water at the surface within a few hundred million years of the end of the era of major bombardment, 4 Gyr.

For more information see articles by I. Lucchitta and W.K. Hamblin,respectively, in S.S. Buess and M. Morales (eds.) Grand Canyon Geology, 2nd Edition, Oxford University Press (2003).

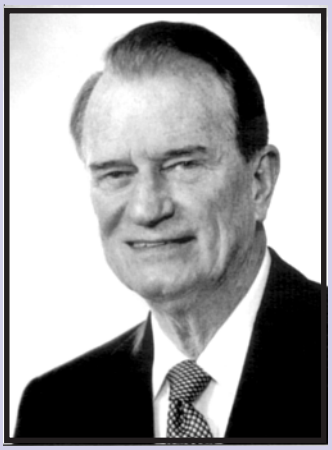
Figure 2: The 2004 SMU Field Studies students examine the Grand Falls, Little Colorado River, looking south (top) and north (bottom). Young Pleistocene lava flows filled a gorge cut (top) into the Kaibab Limestone as the Little Colorado became trapped as it cut down through the resistant limestone. The river quickly cut through the basalt to re-establish its course (bottom), a pattern also seen numerous times in the Grand Canyon itself.

3rd SMU alumnus to be chosen

Roy M. Huffington is the 50th recipient of the API Gold Medal for Distinguished Achievement

Roy M. Huffington (B.S., 1938) is the 2003 recipient of the American Petroleum Institute's highest honor. Huffington has served on API's Board of Directors for over 16 years. The API citation states:

"With a career in the petroleum industry spanning more than half a century, Huffington has been a pioneer in the domestic petroleum exploration and production business and an innovative leader in the international oil and natural gas industry. A nationally acclaimed geologist, Huffington has served as a distinguished diplomat and provided leadership to a host of professional, educational, cultural and other institutions both in the U.S. and abroad."



Huffington is the third SMU alumnus to receive this lifetime achievement award! The late Robert G. Dunlap (B.S. 1933) and H. Leighton Steward (B.S. 1957, M.S., 1959) were previous recipients of the award in 1975 and 2001, respectively. For more about Roy Huffington see *Geology at SMU*, December, 2002.

For the full API press release see http://api-ec.api.org/media/index.cfm.

Top left: Confluence of several glaciers on the flight into Anchorage. See also p.7. Center left: Photograph shot into the Turnagain Heights landslide, a result of the great magnitude 8 earthquake that devastated Anchorage on Good Friday, 1964. The chaotic terrain results from the rotation of large blocks of clay moving seaward in the slide.

SMU Golden Mustang takes

For SMU alumnus, Starkey Wilson (B.S., 1951), Alaska represents a land of great potential. Starkey has been involved in Alaska for over 40 years and currently maintains a home on Bell Island, southeastern Alaska. Starkey's current business interests involve coal and gold and perhaps most importantly, his dream of harnessing Alaska's geothermal energy to move us towards the future hydrogen economy.

On the last weekend in April, Professors David Blackwell, Bob Gregory, Louis Jacobs, and Brian Stump met Starkey at a hotel overlooking the Alaskan Railroad Train Station on the shore of Cook Inlet in Anchorage, Alaska. The purpose of the trip was to make some contacts with the University of Alaska in order to foster exchanges between the group in Fairbanks and SMU.

While in Anchorage, we met with its former mayor, Jack Roderick, who now serves on a Presidential commision that promotes Arctic Research. Jack also authored the book, *Crude Dreams*, that describes the history of oil exploration in Alaska. Over lunch, we received a quick tutorial on the structure of the University of Alaska system and the setup of the state and local government. The afternoon was set aside for geology.

Anchorage was devastated in the great 1964 earthquake; the Turnagain Heights landslide was initiated by the ground motion that liquified the underlying Bootlegger Cove Clay generating a slump some 8000 ft by 1200 ft. The landslide moved a subdivision of homes some 500 feet towards Cook Inlet killing 4 and destroying 75 homes. The area is now a nature reserve and the boundary of the slide is marked by a scarp that gives way to a humicky and jumbled landscape.

Portage Glacier is a short drive down the Kenai Peninsula from Anchorage and provides the opportunity to see an active glacier and chevron-folded metasedimentary rocks of Cretaceous age. Most striking is the obvious retreat of all of the glaciers in this area, most of which occurred within the 20th century. The entire field of view of the lake was originally under the glacier well into the 20th century. The retreat of ice has been spectacular.

Portage Lake at the foot of Portage Glacier, southeast of Anchorage, marks the limit of the glacier in the 20th Century. The lake empties via a creek into Turnagain Arm that marks the advance of ice during glacial maxima. Just as in many other parts of the world, the last hundred years has been a time of major retreat of glaciers. Portage Glacier is no exception. The foot of the glacier lies in the valley at left hand side of the mosaic. In 1915, glacial ice covered the entire area of lake visible in the photo. This suggests that a major change in climate is underway. Whether or not this is the result of human activity, high latitudes will be affected most strongly, seeing the biggest temperature effects.

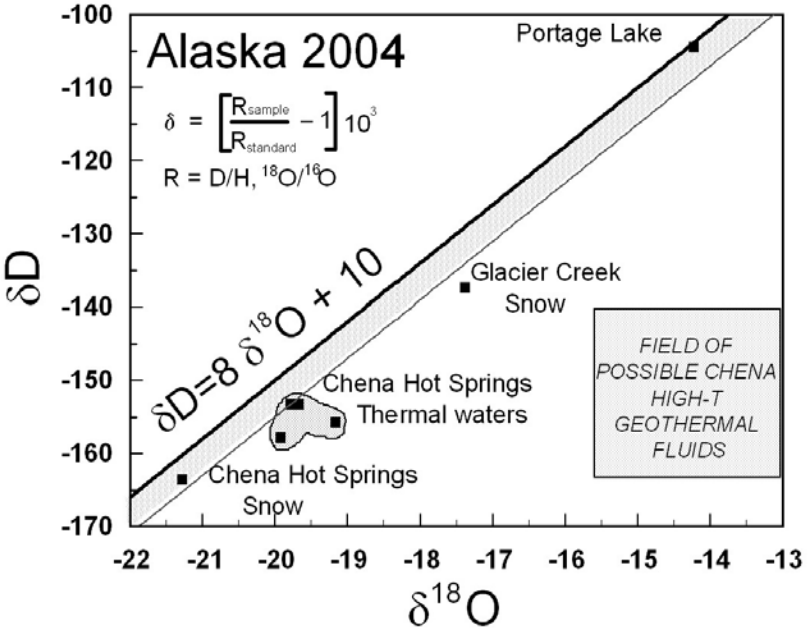
faculty to a frontier geologic wonderland, Alaska

In Fairbanks, the SMU group met with faculty members from the University of Alaska. Professor John Eichelberger, head of Alaska Volcano Observatory (AVO), a collaboration between the U.S. Geological Survey, the State of Alaska, and the University of Alaska, noted the importance of connecting Alaska to the mainland by increasing the interaction with scientists and students from the lower 48. Through AVO, Alaska is also looking across the ocean to the west fostering links with Kamchatkan scientists who share a common interest in volcanology.

The theme of the need for understanding of the unique situation of Alaska was repeated at the luncheon with Governor Murkowski hosted by University President Mark Hamilton. The Governor spoke on the sustainability of the economy of Alaska. The state has abundant resources, but a small population and a low property tax base because of federal ownership of most of the land. Exchanges between universities like SMU and University of Alaska help get the word out about Alaska.

Chena Hot Springs, known to westerners for almost 100 years, are reputed to have "curative" powers. The current resort operators are attempting to develop the springs for geothermal energy; although at this time, only the existence of thermal waters has been proved. Isotopic analyses performed on Chena waters, as well as other samples collected on the trip, confirm that the springs are largely sampling meteoric waters, little evolved from the present day precipitation. As a result of the visit, Blackwell and Gregory may work with the operators on this interesting geothermal exploration problem.

Also resulting from the trip are potential cross listing of field courses and opportunities for future exchanges between the departments. Special thanks for the persistence of Starkey Wilson that made it all possible.



Top right: Chena Hot Springs main pool first developed in 1905. Center right: δD-δ^{18}O diagram showing the position of Alaskan water samples collected in April, 2004, with respect to the global meteoric water line (shaded area with slope 8). The springs are thermal waters only slightly modified from local meteroic waters.

Hamilton Visiting Scholar: Dr. Robert Blanford speaks on array design for the detection of seismic signals

Robert Blanford, Senior Scientist with the TreatyMonitoring Directorate, Air Force Technical Applications Center (AFTAC) presented three lectures on the general topic of array design with application to detection, azimuth estimation, and discrimination of sources for seismic signals.

After a short stint in the field of oceanography, Blanford has spent nearly 40 years as a research scientist working on the general problem of seismic detection of nuclear blasts. He was a U.S. delegate to the negotiations on the proposed Comprehensive Test Ban Treaty and has served on many National Academy of Science seismic panels.

Blanford's theoretical and experimental analysis of array design, much of which was accomplished while he was a program manager with Teledyne Geotech, resulted in seminal publications in the 70's and 80's. Many of the lessons learned from this research are still being exploited in modern arrays such as those operated by SMU geophysicists. Recently, he has extended his work on array design to infrasound.

Bob Blanford is the third Hamilton Scholar who is heavily involved in the applications of geophysics for the enforcement of nuclear test bans and the monitoring of nuclear explosions. Carl Romney, the first Hamilton Scholar, was an important player in the negotiations leading up to the first test ban treaty, whereas Peter Marshall was arguably one of the key scientific advisors for the proposed Comprehensive Test Ban Treaty.

Geological Sciences Hamilton Scholars

1997	Carl Romney	SAIC
1999	Peter Marshall,O.B.E.	Blacknest, U.K.
1999	James O'Brian	Florida State University
2000	Chen Yun-tai	Inst. Geophysics, China
2002	Charles "Buck" Wilson	University of Alaska
2004	Robert R. Blanford	AFTAC

The Hamilton Scholar program has provided us with the opportunity to meet with the scientists, other than our own, who helped make, "peace through seismology" an important part of nuclear containment and non-proliferation.

A physical oceanographer (O'Brian), an earthquake seismologist (Yun-tai) and an infrasound pioneer (Wilson) round out the group. Retired Teledyne executive Jack H. Hamilton gave $1 million to SMU for an endowed visiting scholars program in geophysics. Look for an expansion of the scope of the Hamilton Scholar program in the near future.

Institute for the Study of Earth & Man

Gerald Friedman: 2004 recipient of Hollis D. Hedberg Award

By Louis L. Jacobs
President of I.S.E.M.

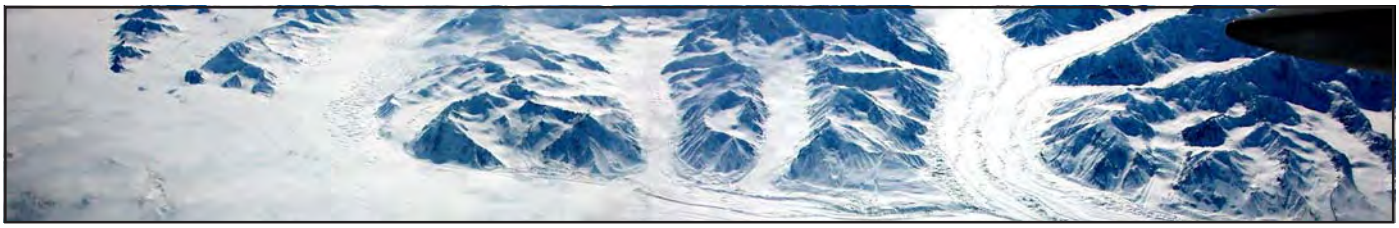
Gerald M. Friedman, was honored on April 1, 2004, at the annual Hedberg Dinner attended by more than 200 people. Dr. Friedman received the Hedberg Award for his numerous and significant contributions to research in the energy industry, and for his longtime commitment to education and academic research.

Dr. Friedman is currently Distinguished Professor at Brooklyn College, which has been his home since 1985, after a long and productive career involving appointments at Rensselaer Polytechnic Institute, the University of Cincinnati, and Amoco Petroleum Corporation. Dr. Friedman has received the highest honors in the field of sedimentary geology, including the Twenhofel Medal of the Society for Sedimentary Geology (SEPM) and the Sidney Power's Medal of the American Association of Petroleum Geologists (AAPG).

In his entertaining Hedberg Lecture on the development of the principles of stratigraphy, Dr. Friedman reminisced about his joint efforts with SMU's Claude Albritton, Jr., and Jim Brooks to start a systematic study of the history of geology, eventually resulting in the History of Geology Division of the GSA. The Institute for the Study of Earth and Man is pleased to honor Gerald Friedman with the Hollis D. Hedberg Award this year.

For more about the annual Hollis D. Hedberg Award, please visit http://www.smu.edu/isem/hedberg.htm

News of alumni, faculty, & friends



The **2nd Golden Mustang Geologist Dinner** was held at the SMU Faculty Club on May 13, 2004. Golden Mustang Geologists have celebrated their 50th class reunion. This year, Max Gilpin (1954) volunteered to help with the telephone solicitations. Each year, we invite all of the classes who took their degrees more than 48 years ago; the 48th and 49th year reunion classes are the proto-Golden Mustang Geologists. *We will have the 3rd Golden Mustang Dinner on Thursday night before Saturday graduation, May, 2005*.

SMU Professor Eugene T. Herrin (B.S., 1951; M.S., 1953) reports that a timing error at an Australian station eliminated the last possible epilinear source; such sources are possibly the result of the passage of strange dark matter through the Earth. A British group with special knowledge of the station responded to the Bulletin of the Seismological Society of America article published late last year. See *Geology at SMU*, October, 2002.*

Donald F. Reaser (B.S., 1953), Professor *Emeritus* at UT Arlington, has published a book on the *Geology of the Dallas-Ft. Worth Metroplex and Local Geologic/Meteorologic Hazards,* Pearson Custom Publishing. See *Geology at SMU*, Summer, 2004.

Tom Goforth (Ph.D., 1973) is stepping down after a successful 9 year run as chairman of the Baylor Geology Department. Tom guided the department through a strategic campaign and an external review process that resulted in 6 new faculty lines and the completion of a new building to house the expanded department of 18 faculty. See *Geology at SMU*, December, 2001.

Barb Dutrow (B.S., 1980, Ph.D., 1985), Adolphe Gueymard Professor of Geology, Louisiana State University has been named an Association for Women Geoscientists (AWG) Conoco Phillips Distinguished Lecturer for 2004-2005. See *Geology at SMU*, December 2001.

Dr. Roberta Hotinski (B.S., 1993), one of SMU's first Presidential Scholars, is now the Information Officer for the Carbon Mitigation Initiative funded as part of a 10 year program by Ford and B.P.; housed within the Princeton Environmental Institute, Princeton University.

Kimberly Stevens (B.S. 1994) is completing a M.S. degree program at Colorado School of Mines on the *Origin of isolated sandstone encased in marine mudstones of the Mancos Shale: …east-central Utah*. She will be joining Exxon-Mobil in the fall.

Steve Balsley (Ph.D., 1994) has been seconded from Sandia National Laboratories to work for the International Atomic Energy Agency (Austria) in its Safeguards Analytical Laboratory (SAL) leading the Chemical Analysis Unit. Balsley will be responsible for the quality of elementary assays of nuclear material. The laboratory provides basic data for nuclear inspectors under Dr. Mohamed Al Baradei. See *Geology at SMU*, October, 2001.

Jennifer (Dougherty) Pogue (B.S., 1997) is completing a law degree at Georgetown University where she is concentrating on environmental and tax law. She published a paper on tax law associated with the transport of natural gas.

Jack Rogers (M.S, 2000) completed his first year teaching at Valencia Community College in Florida. Jack is continuing his Ph.D. work on a part-time basis.

Peter Kubick (B.S., 2002) has accepted a position with Kerr-McGee beginning in September and is finishing his M.S. thesis on the sedimentology of an offshore play within the Gulf of Mexico. Peter received the 2004 Goodell-Richards Award for teaching excellence. See *Geology at SMU*, October, 2002.

Steven Burns (B.S., 2002) has accepted a position with Denver office of the Canadian oil company Encana and will join the firm this August. This month he defended his M.S. thesis *on a stratigraphic analysis of the Late Jurassic Bossier Formation of the East Texas Basin oil field*. See *Geology at SMU*, October, 2002.

Dana Biasanti (M.S., 2003) has published the results of her stable isotope studies on migrating turtles in triple *Palaeo* in an article entitled, "*Stable carbon isotopic profiles of sea turtle humeri: implications for ecology and physiology.*" Dana is a Ph.D. student at Florida State University. See *Geology at SMU*, October, 2001.

Please share any career news and interesting photos with us for use in our newsletter. Contact Lisa Halliburton.
****All prior issues of Geology at SMU can be found online at http://www.smu.edu/geology..***

Geological Sciences Faculty, Southern Methodist University

David D. Blackwell, Hamilton Professor, Ph.D., Harvard. Geothermal studies and their application to plate tectonics, energy resource estimates and geothermal exploration.

Robert T. Gregory, Professor, Chair, Ph.D., California Institute of Technology. Stable isotope geology and geochemistry, evolution of earth's fluid envelope and lithosphere.

Eugene T. Herrin, Shuler-Foscue Professor, Ph.D., Harvard. Theoretical and applied seismology, solid earth properties, computer analysis of geophysical data.

Louis L. Jacobs, Professor, Ph.D., University of Arizona. President of the Institute for the Study of Earth and Man. Vertebrate paleontology, evolution.

Bonnie F. Jacobs, Assistant Professor and Chairman of the Environmental Science Program, Ph.D., University of Arizona. Paleobotany of Tertiary deposits of Africa, application of pollen analysis to Cenozoic geological and environmental problems. bjacobs@smu.edu.

A. Lee McAlester, Professor, Ph.D.,Yale University. Marine ecology-paleoecology, evolutionary theory, Paleozoic geology, petroleum geology.

Jason R. McKenna, Research Assistant Professor, Ph.D., Southern Methodist University. Thermal mechanical evolution of subduction zones.

Brian W. Stump, Albritton Professor, Ph.D., University of California, Berkeley. Seismology, seismic source theory, regional waves, seismic and infrasonic instrumentation.

Neil J. Tabor, Assistant Professor, Ph.D., University of California, Davis. Sedimentology, paleosols, stable isotopes and paleoclimate.

John V. Walther, Matthews Professor, Ph.D., University of California, Berkeley. Experimental and theoretical aqueous geochemistry, fluid-mineral interactions in the crust.

Crayton J. Yapp, Professor, Ph.D., California Institute of Technology. Stable isotope geochemistry applied to the study of paleoclimates, paleoatmospheres, and the hydrologic cycle.

Adjunct Faculty

Steve Bergman, Adjunct Assistant Professor, Ph.D., Princeton University. Tectonics, petrology & geochronology .

Anthony Fiorillo, Research Associate Professor, Ph.D., Pennsylvania. Curator of Paleontology, Dallas Museum of Natural History. Vertebrate paleontology.

Troy Stuckey, Adjunct Assistant Professor, Ph.D., University of North Texas, EPA, Environmental Science and Policy.

John Wagner, Adjunct Assistant Professor, Ph.D., University of Texas, Dallas. Chief Geologist, Nexen Petroleum, USA.

Alisa J. Winkler, Research Associate Professor, Ph.D., S .M.U. Mammalian paleontology, anatomy.

Dale A. Winkler, Adjunct Associate Professor and Director, Shuler Museum of Paleontology, Ph.D., University of Texas at Austin. Paleontology, paleoecology, stratigraphy.

GEOLOGY FACULTY EMAIL ADDRESSES

David Blackwell blackwel@smu.edu
Robert Gregory bgregory@smu.edu
Eugene Herrin gloria@smu.edu
Louis L. Jacobs jacobs@mail.smu.edu
Lee McAlester mcaleste@smu.edu
Jason McKenna jmckenna@smu.edu
Brian Stump bstump@smu.edu
Neil J. Tabor ntabor@smu.edu
John Walther walther@smu.edu
Crayton J. Yapp cjyapp@smu.edu

Southern Methodist University
Dedman College
Department of Geological Sciences
P.O. Box 750395
Dallas, Texas 75275-0395