UNIVERSITY OF WYOMING
DEPARTMENT OF GEOLOGY & GEOPHYSICS

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PROFILE

Inside

GEOLOGY
GEOPHYSICS

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FROM THE DEPARTMENT HEAD

The end of spring semester brings snow as well as a flurry of activity in the Department and University. As of this summer, the University has both a new President as well as a new Dean of Arts & Sciences. The former Dean, Oliver Walter, is retiring after 24 years in that position. He has been extraordinarily supportive of the Department during his tenure. The new Dean, Paula Lutz, comes from a background in biologic sciences and we are hopeful for her continued support. The new President, Robert Sternberg, has a background in psychology and is well known for his theories of both intelligence and love. We look forward to testing the limits of both theories once he steps aboard.

As with all states, Wyoming has seen a financial pinch that has trickled down to the University's budget. The state's fortunes rise and fall on the price of natural gas and low prices have had a major impact. Despite these financial woes, we have managed to eke out parts of three faculty positions during this academic year. This past January we hired Dr. Brad Carr (UW, 1995) as a new academic professional researcher who specializes in geophysical applications to image the shallow subsurface. His position is funded by the University's recent NSF EPSCoR grant and is part of the newly established Wyoming Center of Environmental Hydrology and Geophysics. Brad has an extensive background in near-surface geophysics and should be a tremendous asset in starting up this center. In parallel with that position, we are also in the throes of hiring a new assistant professor in the field of hydrogeophysics, also funded as part of the EPSCoR grant. This faculty member will be split with the Civil & Architectural Engineering Department. Lastly, the Department of Botany has hired Dr. Ellen Currano, who splits her position with us. Ellen specializes in plant-insect interactions, using feeding traces on fossilized leaves to infer how these ecological associations responded to short and long term climate change in Earth's past. Ellen has spent many summers doing fieldwork in the Bighorn Basin and is eager to continue promoting the paleontological wealth of our state.

This past January we reopened the Geology Museum with much fanfare. We have managed to increase the exhibit space of the museum by converting its storage area into a viewable preparation lab and a new space for traveling exhibits. In the main room of the museum, new displays have been added, which are beautifully done and arranged in geologic order. If you are in the region it is certainly worth a stop in to see just how much the facility has improved. In addition, recent generous gifts to the Department from alumni Roy Shlemon (MS, 1959) and the late John King (PhD, 1963) have benefitted, respectively, the establishment of the Center for Quaternary Studies and the optical mineralogy laboratory. Granite plaques are being placed in these rooms to honor these bequests. As always we are obliged and much appreciative of continued support from alumni.

Lastly, we are in the beginning stages of planning an alumni event to be held next spring in Houston, around the time of the AAPG annual convention in early April of 2014. If you are in that area, or will be there for the meeting, please drop me an email (heller@uwyo.edu) so that we are sure to have you on our invite list. ❖

Paul L. Heller

UW GEOLOGIST: MOUNTAINS ARE MINOR CONTRIBUTORS TO GLOBAL SEDIMENT, CARBON BUDGETS

For centuries, people thought the world was flat until Aristotle conclusively proved that it was round. In geology circles, researchers have long contended that small mountain rivers create a major share of the sediment that is eventually deposited into the world's oceans.

Brandon McElroy, assistant professor in the University of Wyoming Department of Geology and Geophysics, is a member of a research group that has challenged those findings and proffered that the majority of sediment delivered to the oceans actually comes directly from sediment located in floodplains and other low-lying areas.

Their work, in a paper titled "Earth is (Mostly) Flat: Apportionment of the Flux of Continental Sediment Over Millennial Time Scales" was published online Jan. 4 in *Geology*, one of the flagship journals of the Geological Society of America. The print version of the paper will appear in Geology during March.

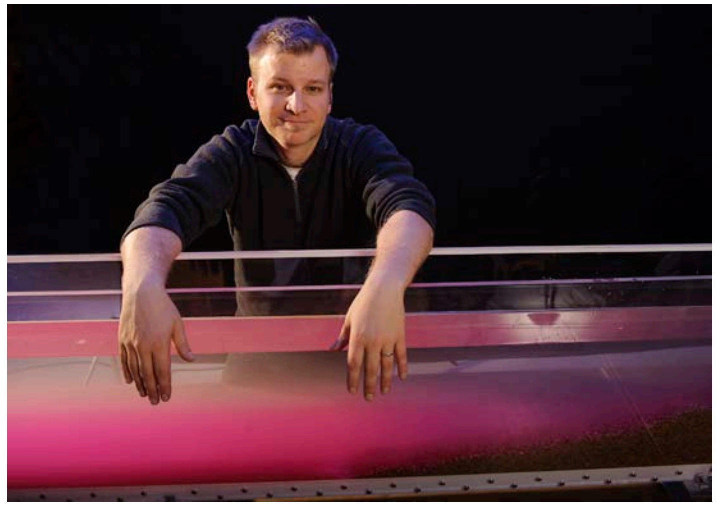
The group compiled data from erosion rate studies of 990 river basins. These included some of the world's largest, including the Amazon and the Ganges, as well as smaller river basins that drain Utah's Wasatch Mountains and the Great Smoky Mountains in North Carolina, McElroy says.

From that information, the group created a dataset they say contends that an abundance of lowland areas, including flood plains, creates far more sediment than even the steepest and most erosion-prone mountain slopes. While mountain slopes have a higher rate of carbon absorption compared to gently sloping land and flood plains, the latter far exceeds the former in terms of the world's land surface, McElroy says.

"If there is more mass loss, including chemical weathering (when rocks turn to soil) in lowland areas rather than mountains, then the potential carbon sink of lowland areas is large and should be investigated," McElroy says.

A carbon sink is a natural or artificial reservoir that accumulates and stores some carbon-containing chemicals for an indefinite period.

McElroy collaborated with Jane Willenbring, a University of Pennsylvania associate professor of earth and environmental science; and Alexandru Codilean, a geoscientist at the GFZ German Research Center for Geosciences in Potsdam, Germany. McElroy previously collaborated with Willenbring on research projects as part of the National Center for Earth-Surface Dynamics, which is a National Science Foundation Science and Technology Center.



Brandon McElroy, assistant professor in the University of Wyoming Department of Geology and Geophysics, contributed to a paper about sediment research that was published online this month in Geology.

The technique used in the compiled studies of erosion is based on the production of cosmogenic nuclides in sediment. "Cosmogenic radiation causes changes in the atomic makeup of sediment," McElroy says. "The rate at which this occurs can be used to determine the rate of mass loss from an eroding surface."

Their study, funded by NSF and the GFZ Research Center, challenges previous studies that suggest small mountain rivers contributed most of the sediment.

"High mountains have been the go-to field area for people interested in studying how much sediment goes into the ocean and how tectonics perturb global climate," Willenbring says. "But what we found was that mountains contribute only a small amount of the total sediment produced on Earth."

"I have thought, for a long time, that lowlands were a poorly understood contributor to the global sediment budget," says McElroy. He suggests other geologists should study low-lying areas to better understand the carbon cycle and the effect on climate.

To read the paper, go to http://geology.gsapubs.org/content/early/2013/01/04/G33918.1.abstract. ❖

UW PROFESSOR'S COMPUTER MODELS DESIGNED TO ENHANCE, OPTIMIZE CARBON SEQUESTRATION

To **Ye Zhang**, sequestering and storing carbon dioxide in deep subsurface reservoirs offers potential environmental benefits. But she also knows the process is primarily a "cost center," meaning there is no money to be made from such ventures.

Zhang, an assistant professor of hydrogeology in the University of Wyoming Department of Geology and Geophysics, hopes to reduce such project costs by developing computer models of subsurface reservoirs that could help determine how to store carbon dioxide more efficiently.

"How fast carbon dioxide flows depends on the characteristics of subsurface reservoirs," Zhang says. "With a realistic subsurface model, parallel computing can provide us with a lot of details of where/how much carbon dioxide is coming through, where carbon dioxide is stored, or whether we have a problem with carbon dioxide leakage."

To store carbon dioxide in the deep subsurface, the gas is compressed under high pressure to form a liquid-like fluid before being injected into a geological formation.
"When we simulate carbon dioxide storage, we need to solve equations," Zhang says. "When the subsurface model is large, there are many unknowns in the equations that cannot be solved using a traditional PC. These models require parallel computing."

Ye Zhang, a UW professor of hydrogeology, stands near a rock outcropping along Rogers Canyon Road in Laramie. While her actual research takes place in Wyoming's subsurface, Zhang says the various layers of outcropping materials are similar to those found in the subsurface of reservoirs. Zhang creates and simulates computer models of subsurface reservoirs that could enhance or optimize carbon dioxide storage efforts while potentially saving millions of dollars.

A closer look underground

To obtain the required parallel computing, Zhang will use the National Center for Atmospheric Research (NCAR)-Wyoming Supercomputing Center (NWSC) in Cheyenne this winter to conduct her research. She will use the supercomputer to model underground injection of carbon dioxide into deep subsurface rock formations for long-term storage in a variety of sedimentary environments. Subsurface conditions in these settings determine the movement and possible leakage pathways of the injected carbon dioxide. Her primary goal is to develop cost-effective simulation models to represent complex subsurface conditions.

"I'm trying to find out how much detail a model must have to safely store carbon dioxide," she says. "It's fundamentally important. We don't have a good handle on it."

How fast carbon dioxide can be injected and how much of it can be stored in the subsurface is determined by the porosity and permeability of the subsurface, Zhang explains. Porosity of a rock or sediment consists of the spaces between the grains. Permeability determines the speed at which fluid, such as carbon dioxide, can move through the pore space.

Using gravel or clay in separate tubes to represent potential subsurface rock strata, Zhang demonstrated how much easier it is to inject carbon dioxide into a gravelly rock—which is more porous—than clay, which is less so because it consists of tightly packed, fine-grained particles.

Subsurface rock porosity and permeability, however, are highly heterogeneous, which is defined as variability or lack of uniformity in the material. Subsurface reservoirs often consist of highly porous and permeable rock strata among various other strata that are lower in porosity and permeability.

Carbon dioxide flow and storage is strongly influenced by this variability, as it flows more easily in the high porosity and permeability zones, while low porosity and low permeability zones create barriers to flow, Zhang says.

"Heterogeneity is a main issue in the oil industry, too," says Zhang, who in 2004 worked as a research intern for Chevron in San Ramon, Calif. "A better model of reservoir heterogeneity will help us make better drilling and reservoir management decisions."

But detailed heterogeneity can only be obtained at great cost, as most of the subsurface is inaccessible, she says. In the real world, obtaining more reservoir details requires more drilling. And that requires more investment, Zhang says.

"We wish to spend a moderate amount of money to characterize and build reservoir models with a sufficient level of detail to capture the real world, while making accurate predictions of the reservoir performance," she says.

Injecting technology for assistance

That's where Zhang's computer models can help. With the supercomputer, Zhang says she can test various scaling methods by building a high-resolution synthetic model and increasingly simplified application models with fewer details.

"For a given performance goal, such as injecting 10 million tons of carbon dioxide into a proposed deep reservoir, what detail do we need to build these application models to capture the behavior of the (true) high-resolution model?" Zhang asks.

"A computer model helps us predict what is going to happen," she says. "This project is about how we, as reservoir engineers, can build these models efficiently and cost-effectively."

NWSC is the result of a partnership among the University Corporation for Atmospheric Research (UCAR), the operating entity for NCAR; the University of Wyoming; the state of Wyoming; Cheyenne LEADS; the Wyoming Business Council; and Cheyenne Light, Fuel & Power. The NWSC is operated by NCAR under sponsorship of the National Science Foundation (NSF).

The NWSC contains one of the world's most powerful supercomputers (1.5 petaflops, which is equal to 1.5 quadrillion mathematical operations per second) dedicated to improving scientific understanding of climate change, severe weather, air quality and other vital atmospheric science and geo-science topics. The center also houses a premier data storage (11 petabytes) and archival facility that holds historical climate records and other information. ❖

UW PROFESSOR'S DELAYED GREENLAND ICE MELT RESEARCH PUBLISHED IN NATURE

Neil Humphrey, a UW professor of geology & geophysics, stands next to a temperature sensor instrument in Greenland. He co-wrote a research paper that appears in the Nov. 8 issue of *Nature*.

Neil Humphrey agrees there's no denying that the Greenland Ice Sheet is melting. But he and other scientists who have recently documented surface melt of the country contend Greenland is melting at a slower rate than the current world consensus of scientific thought.

Humphrey, a University of Wyoming professor of geology & geophysics, co-wrote a paper with four other researchers that contends this point. The paper, titled "Greenland Ice Sheet Contribution to Sea Level Rise Buffered by Meltwater Storage in Firn," appeared in a November issue of *Nature*.

"We're not saying Greenland is not melting," Humphrey says. "What we're saying is it will be one to two decades longer before we start seeing the melt."

That's because Humphrey and other researchers' data—collected on the western flank of the Greenland Ice Sheet from 2007–2009—shows that the water generated by repeated recent melt events penetrates deeply into the snow and firn (partially compact snow). This fills the pore space and diminishes the amount of meltwater that actually runs off into the ocean.

As future surface melt intensifies due to Arctic warming, a fraction of meltwater—that would otherwise add to the rise in sea levels—fills tens of meters of existing pore space of the percolation zone. The percolation zone is a region of the accumulation area that is perennially covered by snow and firn, Humphrey says.

"The snow is so deep and so cold that, even though it's melting, the melt infiltrates into the lower, colder snow and refreezes," Humphrey says. "We calculate there is one to two decades of pore space within the snowpack. You get denser snowpack. After 10 or 20 years, it (the pore space) fills up."

Thus, the routing of surface meltwater—that fills the pore space of the partially compacted snow—acts as a buffer between climate warning and sea-level response. As a result, this delays expansion of the ice sheet area contributing to sea-level rise.

"While other people (scientists) are predicting up to a one-half foot sea rise by 2050, we're actually saying our data shows that any rise that will occur will be delayed by one or two decades," says Humphrey of the paper he termed as "controversial." "A half-foot rise is significant. Half of Florida would be under water. New Orleans would be gone."

If the entire Greenland Ice Sheet—which is about 660,000 square miles or nearly three times the size of Texas—were to melt, that would add approximately 20 feet of water above the current sea level worldwide and would be catastrophic, Humphrey says.

To obtain their research data, Humphrey and his research group traversed a roughly 100-kilometer area in the western interior of the Greenland Ice Sheet. The group drilled holes in the snow and ice, and installed temperature sensing strings 30 feet down into the snowpack. Each string included 32 sensors that recorded temperatures at five-minute intervals over a three-year period.

The core of the firn should be approximately 15 degrees, which is the temperature at which snow falls in Greenland, Humphrey says. Data logged by the sensors revealed the core's temperature was much warmer than that, meaning water was infiltrating the firn, he says.

The available pore space in the partially compacted snow showed strong elevation dependency. Infiltration of meltwater and refreezing events filled available pore space in the firn column with ice, and reduced remaining pore space. This 2,000-meter height represents the lowest elevation at which partial snowpack was not reduced by prior meltwater infiltration and refreezing, Humphrey says.

With decreased elevation, where it is warmer, meltwater infiltration events were of greater magnitude and increase in number, Humphrey says.

"There's been a lot of media hype about the melting of Greenland. It's caught the public's imagination," he says. "Other than the media, scientists have been predicting significant amounts of snowmelt will occur quickly in Greenland."

However, despite the snowmelt, the meltwater runoff will not be so fast, according to Humphrey's research. ❖

UW PROFESSORS EXPLORE CLIMATE IMPACTS ON BIGHORN BASIN POPULATIONS OVER THE LAST 13,000 YEARS

During the past 13,000 years, Wyoming's Bighorn Basin has experienced significant increases in population growth—due primarily to periods of high effective moisture and moderate temperatures—according to three University of Wyoming professors. By contrast, when water levels were lower and temperatures higher, the state's populations of hunter-gatherers decreased or may have even disappeared altogether, they concur.

The research, presented in a paper titled "A Continuous Climatic Impact on Holocene Human Population in the Rocky Mountains," was published Dec. 24 in the *Proceedings of the National Academy of Sciences* (PNAS). The organization advises the president and Congress on scientific and technological issues that frequently affect policy decisions at the national level.

Robert Kelly, director of UW's George C. Frison Institute of Archaeology & Anthropology, and lead author of the paper; **Bryan Shuman**, a UW associate professor of geology; and Todd Surovell, a UW associate professor of anthropology; collaborated on the study by combining their individual research in the Bighorn Basin. Geoff Smith, a former UW graduate student and now a professor at the University of Nevada, also was a co-author.

Kelly and Surovell conducted research of the region's archaeology, studying existing records of radiocarbon data that offered clues as to how old humans were at various times in the Bighorn Basin's history. Shuman studied moisture and temperature levels at different points in time in the basin.

The UW faculty members compared population, moisture and temperature records (primarily using existing data) to evaluate potential linkages between changes in climate and past human populations. Low effective moisture and high temperatures that created an arid environment are both associated with lower population levels, while cooler temperatures and wetter periods led to population growth.

Many archaeological examples emphasize the impact of severe events, but have not resolved the importance of continuous climate change in shaping cultural history, according to the UW researchers.

Humans entered the Bighorn Basin around 14,000 years ago. The UW research group identified five periods of population growth—9,100 years ago, 4,500 years ago, 3,800 years ago, 2,600 years ago and 1,900 years ago. When calculating the years, the researchers started with the year 1950 (the year radiocarbon dating started) as "before present" and worked backward, Surovell says.

While the study produced no exact population numbers during the various periods, Surovell says the group could determine population increases or decreases in relative terms

Associate Professor Bryan Shuman prepares to float geophysics equipment, a ground-penetrating radar (GPR), across Lewis Lake as part of a WyCEHG study of past lake-level changes. Radar images of the lake bottom and sediments can be used to determine the past position of the lake's shoreline.

using radiocarbon dating. The dating method uses naturally occurring carbon-14 to estimate the age of carbon-bearing materials as far back as 50,000 years.

"We're just now able to reconstruct human population size in pre-history in a way that is reliable and accurate," Surovell says. "For the first time, we are able to see the population of Wyoming or at least a section of Wyoming. Perhaps, it's not surprising that there are more people living in the state when it's cool or wet than when it's hot and dry."

"What we see here is people continually adapting to their environment. But, it's clear that climate controlled how much population there was in the state," Surovell says of the study.

To understand past climate fluctuations, Shuman says he studied layers of fossilized pollen that were trapped in river beds. The pollen helps tell the story of what types of plants and trees grew at particular times, and at what temperatures.

"From the climate side, this research shows me how meaningful climate changes can be," Shuman says. "The Platte River and the Bighorn (River) may have been dry for long parts of the summer (thousands of years ago)."

Based on his findings, Shuman says the average temperature in the Bighorn Basin 7,000 years ago was approximately 1 1/2 to 2 degrees Celsius warmer than it was during the 20th century. While the average person may think a 1 1/2-degree difference in Celsius is miniscule, Shuman says to think again.

For example, if the temperature in the Platte River rises 1 degree Celsius, you would, through evaporation, remove about 230,000 acre feet of water in one year, Shuman says. Today, the Platte River stores about 300,000 acre feet of water in one year.

Without that water in the region, Surovell says that such a small rise in temperature can deplete the amount of plant life which, in turn, can reduce animal numbers. The domino effect continues to the top of the food chain. Without plentiful food to hunt or water to drink due to arid temperatures, populations either migrate or, worse, disappear, Surovell surmises.

"People move or they die," he says. "We don't know if people moved because of the climate or simply died out."

Similar radiocarbon dating studies would need to be conducted in Colorado and Montana to determine whether there were any human migration patterns, Surovell says.

He stresses their findings are relevant today.

"We may be more technologically savvy now and may be able to better adapt to climate change, but we're not immune" to its effects, Surovell says.

Shuman agrees, saying that, in the distant past, if the state's rivers dried up, it impacted Wyoming's population. Today, if the Colorado River dried up, that same scenario would affect the much denser populations of Los Angeles and Phoenix, Shuman says.

Shuman, who also serves as director of the Roy J. Shlemon Center for Quaternary Studies, says this collaboration between the geology and anthropology departments is exactly what the center works to encourage.

To view their paper, vist http://www.pnas.org/content/early/2012/12/19/1201341110.abstract. ❖

DEPARTMENT NOTES

Under the direction of **Erin Campbell-Stone** and **Brandon McElroy**, a new consortium has been formed to examine aspects of tight oil occurrence in Cretaceous sandstones. The initial project is examining the Frontier formation in the Powder River Basin. Three industry contributors are currently participating in the Cretaceous Tight Oil Consortium (KTOC), and the research group is open to other interested parties. With this funding, MS Student Rebekah Rhodes is conducting research on the Wall Creek member of the Frontier Formation, focusing on core and outcrop analysis, as well as well log interpretation.

While on sabbatical, Professor **Carrick Eggleston** has been working with the School of Green Energy Technology at Pondicherry University in India. Eggleston recently gave a presentation on "Renewable energy on campus—some examples from the USA."

More information is available at The New Indian Express website at, http://newindianexpress.com/states/tamil_nadu/article1375839.ece.

Professor **W. Steven Holbroo**k received a $50,000 contract from ExxonMobil for Marine detection of hydrocarbon seeps.

Assistant Professor **Brandon McElroy** gave three invited talks this semester at Utah State, Colorado State, and Rice University.

Alumnus **Scott Quillinan** and Professor **Carol Frost** recently published, "Spatial Variability of Coalbed Natural Gas Produced Water Quality, Powder River Basin, Wyoming: implications for future development," with the Wyoming State Geological Survey (WSGS), Report of Investigation No. 64.

The report identifies spatial variations in water:gas ratios and water quality for the five largest CBNG producing zones in the Powder River Basin. It is available at the WSGS online store at, http://sales.wsgs.uwyo.edu/catalog/product_info.php?products_id=3421&osCsid=d6fao899lhqiett0bst58vi9r4.

Associate Professor **Kenneth W. W. Sims** was recently featured in a new Discovery Channel episode titled, "Curiosity: Volcano Time Bomb." The episode highlights Sims' research in Yellowstone National Park and other research of North American volcanoes such as Mount St. Helens and Long Valley Caldera.

The video is available on YouTube at, http://www.youtube.com/watch?v=7kgPna8NvJU.

To read about recent students news, visit http://www.uwyo.edu/geolgeophys/news/grad-student-news.html. ❖

ALUMNI NEWS

Alumnus **Mark A. Bronston** (BS , 1979), alumnus **Paul J. Graff** (PhD, 1978), and former Wyoming State Geologist Dan Hausel, recount how they were all members of the mineral (gold) exploration team that was awarded the *Thayer Lindsley Award* for an International Mineral Discovery by the Prospector's and Developer's Association of Canada in 2009. They discovered the Donlin Creek gold deposit in central Alaska in the late 1980's working for WestGold, a subsidiary of Anglo-American and DeBeers. The Donlin Creek deposit is currently the largest unexploited gold deposit in the world (37 million ounces proved and probable reserves). The mine is currently in the final stages of permitting.

Alumnus **Frank Burk** (BS, 1977) is currently working as the CEO of Brigadier Oil and Gas, LLC (www.brigadieroil.com).

Alumnus **Mike Hudec** (PhD, 1990) won the Gulf Coast Association of Geologists *Levorson Award* at a section meeting held in Austin, Texas last October. He previously received AAPG's *Matson Award* for best oral presentation and the *Braunstein Award* for best poster presentation at one of AAPG's annual meetings.

Alumnus **Matthew Jones** (BS, 2010) is currently working as a Senior Geosteering Technologist for Anadarko.

Alumnus **Tom Michalek** (BS, 1991) is currently working as a Senior Research Hydrogeologist for the Montana Bureau of Mines and Geology in Butte, Mont. where he has been for five years. His work involves hydrogeologic characterization studies focused on providing solutions to water supply problems, primarily in the Gallatin Valley of Montana.

Alumnus **Phillip Nickerson** (BS, 2007) is currently working for Bronco Creek Exploration, a mining exploration company based out of Tucson, Arizona. He received his PhD from the University of Arizona in August 2012. He and his wife, Laura, are expecting their first child in February.

Alumnus **Ralph Risley** (MS, 1961) is currently residing in Tucson, Arizona after a wandering career in numerous locations. After getting trained in major corporations, he was involved in a number of Energy Con

Alumnus **Bo Spencer** (BS, 2006) sent in an update to tell us that he has started work on his Masters degree. We wish you luck Bo!

Obituaries:

Alumnus **John C. Gries** (MS, 1965) passed away on January 18, 2013 following a short illness. John worked as a Professor of Geology at Wichita State University (WSU) for over 40 years and was known to thousands of general studies students and many of WSU's finest athletes through his popular Introductory Geol. 300 class on Energy, Resources, and the Environment, he will be particularly remembered by the many Geology majors he mentored and encouraged in their careers.

John was born and raised in Rapid City, South Dakota where his father, Paul Gries was a long-time, highly regarded professor of geology at the South Dakota School of Mines. He was introduced to well site geology at the age of five and accompanied many of his Dad's field classes. Dr. Gries's education included a BS in Engineering and a Master's degree in Geology from the University of Wyoming and a PhD from the University of Texas. His dissertation centered on mapping portions of the northern Mexico region near Ojinaga—work which still ranks as the definitive map of that area, perhaps in part due to the fact that drug cartels and smugglers have prevented access to any other geologists.

John's work and interests have taken him at one time or another to all of the Rocky Mountain States, many of the other states, and the occasional jaunt to Morocco, Ethiopia and the East African Rift, often in the company of his long-term companion and wife of 35 years Toni Willis-Jackman, a former Diplomat and now lecturer in Environmental Geology at WSU. He had no immediate plans for retirement and was actively planning the next year's field season.

Alumnus **John S. "Jack" King** (PhD, 1963) (1927–2013) passed away on March 14, 2013. Jack lived in Tonawanda, New York and had a second home in Monticello, Utah. Jack made a gift of $350,000 from his estate to the Department. This generous gift will be used for student and research support as well as facility improvements. A plaque honoring Jack is being installed in the Department's mineralogy classroom.

Alumnus **Donald E. Lawson** (BA, 1948; MS, 1949) (1924–2012) died unexpectedly from heart failure on December 4, 2012. Don was born in Potter, Nebraska in 1924 where his father was employed as a telegrapher and depot agent for the Union Pacific Railroad. After his family moved to Medicine Bow, Wyo. and he graduated high school, Don joined the Army Air Corps within two months of the bombing of Pearl Harbor. After extensive meteorological training, he qualified as a B-17 flight engineer.

After being discharged from the Army Air Corps as a corporal in 1946, Don enrolled at UW to study geology. His interest in geology was sparked by the fascinating geological formations he had observed as a boy while riding horses and working on various ranches near Medicine Bow. After having earned his Bachelors and Masters Degree from UW, Don married his childhood friend, Marjorie Bailey of Hanna, Wyoming in 1950.

Throughout his successful career Don was active in the affairs of the Wyoming Geological Association (WGA) and was a member of WGA for over sixty years. At different times Don served as president, vice president and treasurer of the WGA. He received many awards from the WGA and cherished the Frank Morgan and honorary ones as especially important. He was also active in the American Association of Petroleum Geologists and was also certified as a Professional Geologist by the State of Wyoming. ❖

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Installation of a nebulizer and spray chamber on the new inductively-coupled plasma optical emission spectrometer (ICP-OES). The Geochemical Analytical Laboratory has acquired several new instruments through a grant from the School of Energy Resources. New equipment includes an inductively coupled plasma optical emission spectrometer (ICP-OES), a flame atomic absorption spectrometer (AA), a dual channel ion chromatograph (IC), a flow injection analyzer (FIA), and a flash combustion organic elemental analyzer (EA).