UNIVERSITY OF WYOMING
Department of Geology and Geophysics

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PROFILE

Inside

GEOLOGY / GEOPHYSICS

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FROM THE DEPARTMENT HEAD

The past academic year has proven to be a tempestuous one at UW. We began last summer with a new University president, but by mid-fall we had an even newer president. Happily since that time, relative calm has returned to campus. By January a new faculty member, **Andrew Parsekian**, (see profile on p. 10) joined the department albeit split with the Department of Civil Engineering. His arrival represents the second hire in the Department as part of the newly established Wyoming Center for Environmental Hydrology and Geophysics (www.uwyo.edu/epscor/wycehg). Additionally we have hired a new manager of the Geology Museum and the Department sample collections, **Laura Vietti**. Laura is a Wyoming native and Department alumna (B.S., 2006) who is receiving her Ph.D. at the University of Minnesota.

This past April, we hosted an alumni evening in Houston the night before the national AAPG convention. In planning this event, we came to the realization that our alumni contact list has become somewhat out of date. Since we intend to continue occasionally hosting alumni events in Denver and Houston, we need to update our contact list. Therefore, if you have contact with any other alumni, please forward that information to **Deborah Prusia** in our front office (dprusia@uwyo.edu). In fact, even though you have received this newsletter, it might be good idea to send your present email address to Deborah as well, just to be sure our records are up to date. This will be especially important as we may be moving our newsletter to digital distribution in the future. In the next issue we will be polling you all about moving to an electronic format.

As part of our increased alumni outreach we have recently formed an Alumni Council, who will help us develop stronger ties with alumni through various events and venues. The present members of the council include **Mary Kraus** ('79), **Mark Shuster** ('86), **Andy Finley** ('92), **Mark Olsen** ('99) and **Donna Shillington** ('04). Thus far we have only met once, but in the next year we hope to develop plans to keep building alumni connections. In fact, if you have any ideas on what types of events you think would be of interest, feel free to contact me (heller@uwyo.edu).

A few of our alumni may remember the UW Recreational Camp, built by Sam Knight in 1947 and, at one point, home to our summer field camp for many years. The camp was built with much geology student labor. I am sad to report that the university has decided to dismantle the facility (as opposed to spending $1.4 million to repair it). While we have not used the camp for many years, it is still sad to see one of Sam's signature landmarks gone forever.

Lastly, several of you informed me that you enjoyed accessing the Sam Knight chalk talk on line. I recently discovered there are other Sam Knight talks available for viewing on the American Heritage Center web site. For access, go to: http://www.uwyo.edu/ahc, there click on "digital collections" on right side, and then in the search box type in "Knight talk." ❖

Paul L. Heller

UW RESEARCHER DISCOVERS SMALLER SALMON SPAWN BETTER IN RIVERBEDS THAN LARGER COUNTERPARTS

For salmon, being bigger isn't always better. Being a little smaller — at least intermediate size — is more advantageous for maximum spawning in riverbeds, a University of Wyoming researcher recently discovered.

While bigger salmon can carry more eggs and move larger sediment than smaller salmon, the larger fish also take up more space in a riverbed when they build their spawning nests, or redds, in stream gravel. Hence, bigger salmon can fit fewer redds into a particular riverbed area than their intermediate-sized counterparts, which can maximize the number of eggs they can place in a riverbed.

Simply put, smaller salmon take up less space when they nest and don't have to move as many grains to lay their eggs, says **Clifford Riebe**, a UW assistant professor in the Department of Geology and Geophysics.

"No one has recognized this trade-off before. The trade-off has some pretty big implications for how river managers restore rivers," Riebe says. "There's a 'sweet spot' where intermediate-sized fish can install the maximum number of eggs in the riverbed."

"Our work provides these managers with a tool for making restoration projects more cost-effective," he continues. "The trade-off may also help explain why different rivers support fish of different sizes. It has long been recognized that different-sized fish spawn in different reaches of river, but there has never been a very good explanation for this."

Riebe's research, which he says will benefit the multimillion-dollar fish management industry, was published earlier this month in *Water Resources Research*, an interdisciplinary journal that publishes original research in the natural and social sciences of water. Riebe was among four writers of the paper, titled "Optimal Reproduction in Salmon Spawning Substrates Linked to Grain Size and Fish Length."

Leonard Sklar, an associate professor of earth and climate service at San Francisco State University; Brandon Overstreet, a UW doctoral student in water resources/environmental science and engineering, from Laramie; and John Wooster, a geomorphologist/hydrologist with the National Oceanic and Atmospheric Administration (NOAA) Fisheries, were the other contributing writers.

"Though our study focused on California, Washington and British Columbia, our results should ultimately apply more generally to understanding spawning by cutthroat trout and

Salmon spawn in South Park Creek near Tacoma, Wash. Cliff Riebe, a UW assistant professor in the Department of Geology and Geophysics, and three other researchers, discovered that intermediate-size salmon have an advantage over their larger counterparts for maximum spawning in riverbeds. (Cliff Riebe Photo)

rainbow trout in Wyoming," Riebe says. "Managers can design their restoration projects to maximize the spawning benefit."

The study focused on pink, sockeye and Chinook salmon — which span a range of sizes from small to large — and took place in rivers and creeks in California (Shasta River) and the Pacific Northwest (South Prairie Creek in Washington state and Scotch Creek in British Columbia, Canada) during 2009 and 2010. The research goal was to understand how grain size influences spawning because conditions necessary for productive spawning were unclear. Riebe's analysis reveals that coarse substrates have been substantially undervalued as spawning habitat in previous research work.

Grain size is a fundamental regulator of the quality of salmon spawning habitat. To be suitable for spawning, substrates need to be coarse enough to prevent scouring and allow the flow of oxygen-rich water to the eggs. At the same time, substrates need to be fine enough that female salmon can move sediment to build redds and deposit their eggs within the riverbeds, Riebe says.

To create a redd, female salmon use their tails to dig a small area of gravel on the bottom of a stream or shore. They create several depressions in the gravel, which form pockets into which salmon deposit their eggs. The size of a redd depends on the size of the fish making it.

Because a redd area increases with fish length, the number of eggs a substrate can accommodate is maximized for moderate-sized fish. The previously unrecognized trade-off raises the possibility that differences in grain size help regulate river-to-river differences in salmon size, Riebe says.

"Our research suggests that the factors that influence grain size in rivers also influence fish size," he says. "And those factors are climate, geology and erosional processes."

For example, a wet climate produces finer grains while a dry climate results in coarser sediment, Riebe says.

The approach provides a tool for managing grain-size distributions to support optimal reproductive potential of fish and species resilience, Riebe says. This is valuable as millions of dollars are spent annually In the United States to revitalize salmon spawning in riverbeds. Riebe adds that the research can be useful for managing any fish that uses rivers, in the same way as salmon, for spawning.

"What our method does is give managers a method to determine what size grains are needed to bring back fish of a certain size," Riebe says. ❖

UW RESEARCHERS CONTRIBUTE TO NATURE ARTICLE THAT EXAMINES DEEP OCEAN ROCK RECOVERY

A University of Wyoming husband-and-wife research team was part of a larger group that has made the first significant recovery of layered igneous rocks from the Earth's lowest ocean crust.

The discovery—found in the "Hess Deep Rift" in the Pacific Ocean—confirms a long-held belief among geologists that such rocks are a key part of the lower ocean crust formed at fast-spreading ridges.

Michael Cheadle, an associate professor, and Professor **Barbara John**, both in UW's Department of Geology and Geophysics, are two co-writers (30 in all) of a research paper, titled "Primitive Layered Gabbros from Fast-Spreading Lower Oceanic Crust," published in a recent issue of *Nature*. *Nature* is an international weekly journal of science that publishes the finest peer-reviewed research in all fields of science and technology.

The two were part of a 26-member international research team that sailed to the Hess Deep, a deep scar in the Pacific Ocean's sea floor, between December 2012 and January 2013. Their mission was to study rocks sampled about 3-4 kilometers below the sea floor in an effort to better understand how the Earth's crust is formed.

"To me, the key thing for the public is that, for the first time ever, we recovered rocks from the lower-most part of the ocean's crust. This hasn't been accomplished before," Cheadle says. "For 50 years, people have tried to drill to this depth or deeper, but have been unsuccessful."

"The rocks were in situ, or in place," John adds. "This is not rock exposed at the surface because the tectonic plates collided and formed mountains, but were recovered beneath the seafloor where they were formed."

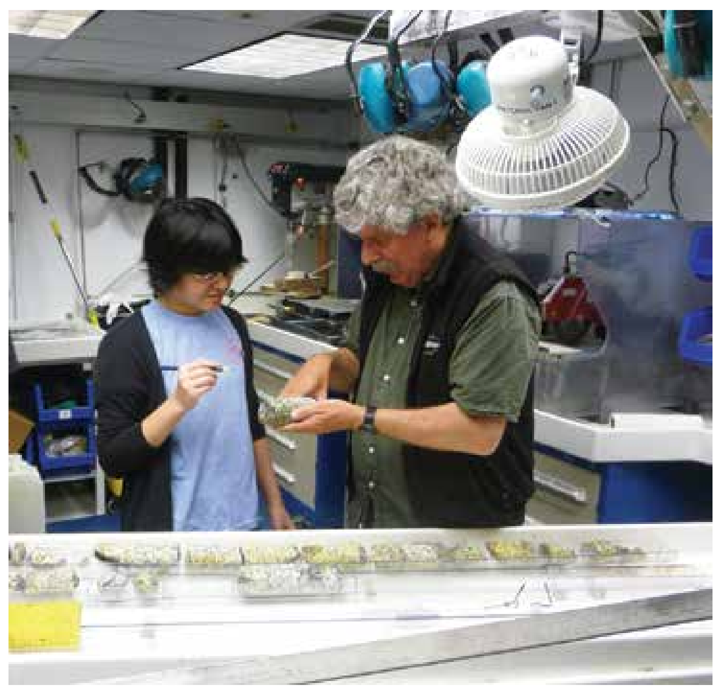
The world's oceanic crust—which makes up 70 percent of the Earth's surface—is formed at mid-ocean ridges. At these ridges, volcanoes sit above magma chambers, much like volcanoes one would see in Hawaii, John says. These magma chambers are fed from below by the melting mantle. Oceanic crust is made when this magma freezes.

"What we were drilling was the frozen remains of what once was a magma chamber," Cheadle says.

The cruise was part of the Integrated Ocean Drilling Program (IODP), a multinational research project that operates up to three research vessels that sail the world's oceans. The ships drill bore holes to collect samples of rock and sediment from below the sea floor to address questions about geology, climate, oceanography and natural hazards, including earthquakes. The U.S., Japan, Europe and several other countries were involved in the 50-day, multimillion-dollar operation, funded, in part, by the U.S. National Science Foundation's (NSF) Division of Ocean Sciences.

During their voyage, Cheadle and John studied the geology of the recovered core samples. They measured rock fractures and faults, and examined the crystals that made up the rock.

And they found something that really surprised them. Crystals of olivine, a common mineral in ocean crust, had a tree-like branch pattern on the core samples. Cheadle used the term "skeletal" and likened its growth to ice crystals on a car



Michael Cheadle, a UW associate professor of geology and geophysics, examines rocks from the lower ocean crust of the Pacific Ocean with Yumiko Harigane, a researcher from the National Institute of Advanced Industrial Science and Technology in Japan. (Susan Gebbels Photo)

windshield. John described it as similar to the ice that forms on a frozen puddle: large crystals with a delicate branching structure, unlike any seen before in the lower crust.

Because the rocks were found 3-4 kilometers (1.8-2.5 miles) beneath the ocean floor, the rocks should have cooled much more slowly and not left such a dramatic pattern, the two say.

"That was totally unexpected," Cheadle says. "That (tree branch crystal) shape indicates the mineral grew very quickly."

"There's something going on there that we don't understand," John says.

During their research expedition, Cheadle and John, like the other researchers aboard, took turns communicating to classrooms around the globe via Skype.

"We'd tell a little story of what we were working on," says John, who mentioned speaking to a group of middle school students from France. "They had excellent questions asked in English—something I wish our system could do better with here in the United States."

Cheadle conversed with **Craig Grimes**, a professor of geology at Ohio University, and his students. Grimes is a former UW doctoral student whom Cheadle and John supervised during 2007. ❖

UW STUDY: BEDROCK INFLUENCES FORESTS MORE THAN PREVIOUSLY BELIEVED

Bedrock influences forests and landscape evolution much more than was previously thought, according to a study by University of Wyoming scientists published this week in the *Proceedings of the National Academy of Sciences (PNAS)*.

When investigating factors that influence forest cover in California's Sierra Nevada, the UW researchers determined that bedrock may be just as important as temperature and moisture in regulating the distribution of vegetation across mountain slopes.

Jesse Hahm, who recently received a master's degree from the UW Department of Geology and Geophysics, is the lead author of the study, "Bedrock composition regulates mountain ecosystems and landscape evolution." Other contributors are Assistant Professor **Cliff Riebe**, doctoral candidate Claire Lukens and research scientist Sayaka Araki, all from UW.

Their investigations took place at the Southern Sierra Critical Zone Observatory, one of the National Science Foundation's 10 observatories used to study the Earth's "critical zone." Critical zone research examines how water, life, rock and air interact from the base of soil to the top of the vegetation canopy.

University of Wyoming researcher Jesse Hahm used a gas-powered drill to sample cores of fresh bedrock for geochemical analysis. He is the lead author of a study that shows how bedrock influences forests and landscape evolution much more than was previously thought. (Claire Lukens Photo)

The western Sierra Nevada is home to highly productive forests and large exposures of beautiful granitic bedrock, Hahm says.

"We were puzzled by the patchiness of vegetation on mountain slopes. There are densely forested areas right next to areas with little or no vegetation and soil," he says. "Strikingly, these bare areas sometimes occur side by side with groves of the largest trees on Earth, Giant Sequoia."

The researchers determined that bedrock composition acts to limit plant growth, Riebe says.

"Unexpectedly, we found that differences in bedrock composition are just as important as climate," he says. "This is hard to see without spatial analysis tools and integrated datasets on how vegetation and bedrock vary across the landscape."

The scientists demonstrated that differences in forest cover can be explained by variations in geochemical composition of underlying bedrock. Noting that plants get some of their nutrients from weathering of minerals as bedrock is turned into soil, the UW researchers found that some of the granitic bedrock contains extremely low amounts of plant-essential nutrients such as phosphorus.

"These results are important because they demonstrate that bedrock geochemistry is on par with climate as a regulator of vegetation in the Sierra Nevada and likely in other granitic mountain ranges around the world," Riebe says.

"The astonishing thing is that subtle differences in the cooling history of granite 100 million years ago can give rise to biogeochemical interactions today that produce vegetation patterns visible from outer space," says Gordon Grant, a USDA Forest Service research hydrologist and professor in the Departments of Geosciences, Forest Engineering and Resources and Management at Oregon State University. "Understanding these subtle yet profound linkages is at the heart of critical zone science."

The findings also show that differences in forest cover correspond with significant differences in erosion rates. The differences in forest and soil cover appear to affect the rate at which the Sierra Nevada is wearing down due to the action of water, wind and life, Hahm says.

"Where soil is present, the landscape is lowering at a faster rate, suggesting that soil helps accelerate the processes that weather the underlying bedrock," he says.

"The authors have convincingly shown that the bedrock is talking to the trees, and the resulting distribution of trees, in turn, dictates the rate at which the landscape itself is evolving," Grant says.

Additionally, Riebe says, the findings will augment efforts to understand how mountain forests will respond to inevitable changes in temperature and precipitation.

"Most of these studies point to an upward shift in vegetation toward higher, cooler elevations," he says. "But changes in climate may be only part of the story as forests evolve. Our results suggest that any upward shift in vegetation will occur with the consent of the underlying bedrock."

The work was supported by National Science Foundation grants to Riebe through the Critical Zone Observatory Program.

Riebe praises Hahm's contributions, noting that it is rare for someone at the master's degree level to publish as a lead author in a prestigious journal such as the PNAS.

"I had a fantastic experience doing fieldwork, and had tremendous support from the geology department at the university, including funding support from the Shlemon Center for Quaternary Studies," Hahm says. "It became a cross-disciplinary experience, integrating ideas from landscape ecology, geomorphology and petrology." ❖

UW GRADUATE STUDENT PARTICIPATES IN CHIEF SCIENTIST TRAINING PROGRAM

Will Fortin finds time on the ocean peaceful, a place where he can block out daily diversions and focus squarely on the seismic marine research project of the moment.

"What I like best about being at sea is time to be totally focused on research," says the University of Wyoming doctoral candidate in the Department of Geology and Geophysics. "It's a time when you're with a bunch of other people who are motivated. You work 15-16 hours a day with no distractions. That's what I like best."

Fortin, of Avon Lake, Ohio, was one of 14 graduate students or early-career oceanographers nationwide who participated in a recent Chief Scientist Training workshop funded by the National Science Foundation and the Office of Naval Research.

The training program, coordinated by the University-National Oceanographic Laboratory System (UNOLS), took place Oct. 19-28 at the University of Rhode Island (URI) Graduate School of Oceanography and aboard the RV Endeavor, URI's research ship. The research cruise, which spent a week at specific locations in the middle Atlantic Ocean, began and ended at URI's Marine Operation Facilities in Narragansett, R.I.

"I'm looking at ocean turbulence, and how it can be meaningful to the world's climate," Fortin says. "It's (turbulence) a small specific part of it."

In addition to previous research cruise experience, Fortin believes he was chosen, in part, due to his background in marine geology and geophysics. Most of the other applicants, and those chosen, had traditional backgrounds in biological, chemical and physical oceanography, he says.

"I applied to work with acoustic instruments on board. Seismology is acoustics," Fortin says.

Toys and turbulence

During the cruise, Fortin used various high-tech instruments to study the interaction of ocean currents and the sea floor. He used an Acoustic Doppler Current Profiler (ADCP) that makes an acoustic sound and records a reflection back from suspended sediment.

"It's similar to when the sound of a siren is coming toward you and then away," Fortin says. "This instrument works on the same principle. If the current is moving toward you, it becomes a higher frequency. The frequency becomes lower when it moves away from you."

He also used an echo sounder that works much like a fish finder. The instrument emits a "ping" sound, and measures water depth by sending pressure waves down from the surface and recording the time until the echo returns from the bottom.

Additionally, an Underway Conductivity, Temperature and Depth Instrument, or uCTD that is shaped like a small torpedo, can provide salinity, temperature and depth readings. The instrument can be towed along while the ship is moving.

"In seismic oceanography, the way we image the ocean relies on small changes in temperature and salinity," Fortin says. "With data from the uCTD, I can get similar information and calculate approximate levels of turbulence."

An old hand on deck

The training cruise and workshops were designed to help younger scientists understand the process of requesting ship time and the complicated logistics involved in planning an expedition; ensuring proper equipment is aboard; allocating space for scientists; and numerous other details necessary to make a research cruise run smoothly.

"Early career scientists often find it challenging to get access to research vessels and, sometimes on their first cruise, they have to serve as chief scientist," says Annette DeSilva, assistant executive secretary of UNOLS. "There is a lot of responsibility that comes with being chief scientist, so this cruise gives them hands-on practice that will help them for the rest of their career."

Fortin is no stranger to research cruises. During graduate school, he has been part of two cruises off Nicaragua and Costa Rica; two more in the Cascadia region near Oregon and Washington; and one in the Adriatic Sea off of Italy's coast.

As Fortin has learned, no cruise goes smoothly. Having accompanied his adviser, **Steve Holbrook**, a UW professor of geology and geophysics, on three previous research trips, Fortin learned a lesson early on.

"Steve says, 'Do what you can to get the core of your science accomplished,'" Fortin recalls.

During one research cruise in 2012, the science had to be shut down for a spell due to whales in the area. Rather than panic, Fortin says Holbrook just waited for the whales to move on before ramping up the expedition again.

That experience helped Fortin keep his cool when inclement weather at sea forced the RV Endeavor to reverse its original plan of going out to the deep ocean first before moving in toward the shallows. Instead, the vessel started in the shallow water before moving out to sea as the weather improved.

"The weather was pretty rough. We had to change our schedule before we even left," Fortin says. "If you had never been on a cruise before, that would crush you right off the bat."

"The oceanography community needs to train not only the next generation of sea-going scientists, but also the next generation of those who will step up and take charge to organize cruises," says David Smith, associate dean of URI's Graduate School of Oceanography. "That's what this program is all about."

Bridging his science

Fortin plans to use data gathered from this most recent cruise to help him answer questions to research he conducted off Costa Rica. There, he studied lee waves, which are vertical underwater waves that are stationary. Lee waves are formed when underwater currents make contact with rough topography, such as hills or ridges on the seafloor.

Will Fortin, a UW doctoral student in geology and geophysics, participated in a Chief Scientist Training workshop funded by the National Science Foundation and the Office of Naval Research. Here, he holds an instrument called a uCTD that can provide salinity, temperature and depth readings of the ocean. (Gordy Stephenson Photo)

"Unlike a surface wave, it doesn't move. It's an underwater column," Fortin says.

His research there focuses on how much turbulence the lee waves create.

"I want to bridge the two data sets," says Fortin, who had to rely more on existing literature than direct measurements during his work in Costa Rica. "I will know more of how currents interact with the sea floor on this cruise. With that knowledge, I can better inform my work with lee waves off Costa Rica."

Areas of increased turbulence are important because of the "mixing problem" being studied in oceanography circles, he says. At the Earth's poles, water sinks in the oceans because of the cold temperatures. In the rest of the world, water must rise and mix with warmer waters. However, when open-ocean upwelling is measured, it accounts for only 10 percent of what it should be, Fortin says.

"In order to understand how our climate works, oceans are a major driver," Fortin says. "The ocean is what helps us regulate our planet's climate."

He adds, "If this turns out to be an analogous study, this will go in my dissertation."

To view the research cruise blogs, including one by Fortin, go to http://csw.unols.org. ❖

UW PROFESSOR CONTRIBUTES TO ROCK PHYSICS HANDBOOK

A University of Wyoming faculty member is among three authors of a rock physics handbook that was released in April.

Dario Grana, a UW assistant professor in the Department of Geology and Geophysics, co-wrote "Seismic Reflections of Rock Properties." The book is described as being accessible for researchers and petroleum geologists, both in industry and academia.

"This book is about rock physics, the discipline that links the properties of porous rocks to their seismic response," says Grana, who wrote his section in 2013 while a doctoral student at Stanford University. "The main application is for oil and gas reservoirs for the petroleum industry."

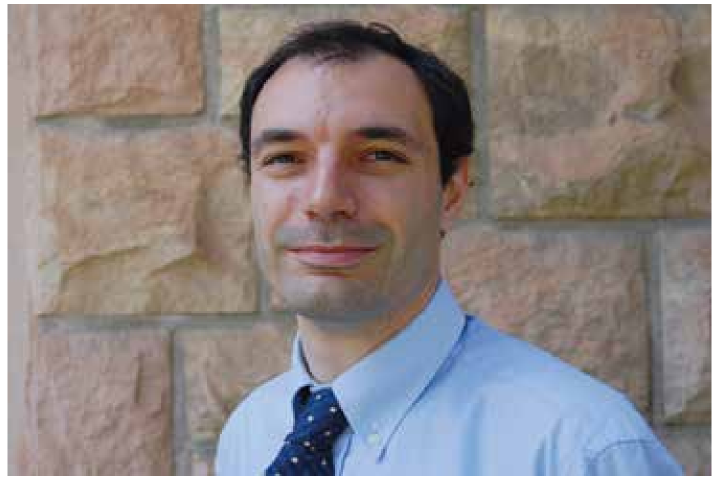
The book, published by Cambridge Press, provides a practical workflow guide on how to implement rock physics theory to reveal the underlying rock properties behind the seismic data; presents detailed descriptions of rock physics models and their relation to the geological conditions, giving readers a wealth of comparative data; and includes case studies based on real well data from oil and gas fields, which demonstrates the application of the theory in real-world situations.

The book catalogs various cases, including clastic sediments, carbonates and gas hydrates; and discusses the effect of rock properties on seismic reflections and time-lapse sediment monitoring.

Grana wrote a chapter in which he integrates rock physics models with statistical methods. Rock physics addresses the relationship between rock properties and elastic properties. These include porosity (empty spaces in rock materials), lithology (mineral composition of the rock) and fluid saturations (volume of space fluid occupies relative to the pore space); and elastic properties, which is the measurement of a rock's tendency to deform non-permanently in various directions when stress is applied.

"The goal of this chapter is to try to quantify uncertainty that comes from different sources," Grana explains. "You use geostatistics."

For example, if a researcher knows the porosity of a rock, he can determine the seismic response of the rock. Using geostatistics, a researcher also can quantify the uncertainty of this estimate provided in the book's formulas, he says.



Dario Grana, a UW assistant professor in the Department of Geology and Geophysics, co-wrote the book "Seismic Reflections of Rock Properties." The book will be available in the U.S. in May.

"My main job was to describe the mathematical methods used in rock physics modeling," Grana says. "This is a really practical book. We have a lot of examples."

Grana wrote the textbook with Jack Dvorkin, a senior research scientist of rock physics at Stanford University, and Mario Gutierrez, a principal quality improvement geophysicist at Shell Exploration and Production Inc.

The 304-page book includes 15 color illustrations and 13 tables. Priced at $75, the book becomes available for order in April in Europe and in the United States in May.

"Cambridge has pre-orders from people working in research at oil companies," Grana says. "This book can bridge the gap between theoretical background (in academia) and research oil and gas companies do in their work."

But Grana stresses the book can be used in the college classroom. He is considering using it himself next fall in a new graduate-level course he developed called "Rock Physics and Reservoir Modeling." The class focuses on applications for oil and gas reservoirs, but could be applied to aquifer modeling in the shallow subsurface, he says.

The book has garnered some good early reviews from the business community.

"The authors superbly introduce readers to the field of rock physics and also educate practitioners on applying rock physics in seismic interpretation for hydrocarbon reservoirs," says Ivar Brevik, a project leader and specialist in geophysics at StatoilHydro, an international energy company. "Systematically designed using templates and catalogs, this guide to exploration for and production mapping of hydrocarbons is honestly explained, including warnings for interpretation pitfalls. Supported by excellent figures, it is enjoyable to read and hard to resist turning to the next page."

"This invaluable companion to Mavko's popular 'Rock Physics Handbook' describes the deterministic and stochastic forward modeling tools a geophysicist needs to find reservoir parameter combinations whose seismic responses fit the data," says Sven Treitel, president of TriDekon Inc. "The authors illustrate key concepts with simple applets, and cover the latest developments in digital rock physics and gas hydrates."

Grana describes the end product as "a great satisfaction."

"It's essentially two years of work," he says. "It took a big part of my Ph.D."

For more information or to register your interest for ordering the book, email collegesales@cambridge.org. ❖

DEPARTMENT NOTES

Undergraduate senior **Callie Berman** (Colorado) was recently elected into the Phi Beta Kappa (PBK) Society. The PBK is the oldest and most prestigious honorary academic society in the United States. Only about 10 percent of the nation's institutions of higher learning have Phi Beta Kappa chapters and only about 10 percent of the arts and sciences graduates of these distinguished institutions are selected for Phi Beta Kappa membership.

Professor **Carol Frost** recently completed a term as Science Editor for *Geosphere*, an all electronic journal published by the Geological Society of America. When she took the position in 2009, the journal received 55 submissions/year and had an impact factor of 1.63. Three years later in 2012 the journal received 116 submissions and the impact factor had risen to 2.023. The journal attracts submissions with interactive figures for which the all-electronic format is well-suited. It is also known for its themed issues to which contributions can be added over time.

Two University of Wyoming faculty members wrote a college-level geology textbook that was published by Cambridge University Press.

Ron Frost and **Carol Frost** (unrelated), both professors in UW's Department of Geology and Geophysics, recently wrote a college-level geology textbook that was published by Cambridge University Press. The book, titlted "Essentials for Igneous and Metamorphic Petrology," is an introductory textbook designed specifically for one-semester undergraduate courses. Petrology is a branch of geology that studies the composition, distribution, origin and structure of rocks.

Described as ideal for programs where petrology and mineralogy courses are separate, the publication provides the essential information to understand the origins, environments and basic processes that produce igneous and metamorphic rocks.

"The book fills a real void because it is aimed at all undergraduate geology majors, and is written for a one-semester igneous and metamorphic petrology class," says Carol Frost.

In the textbook, the authors engage students by applying petrology to real geologic environments. The textbook's content is organized around the types of rocks to expect in a given tectonic environment rather than around rock classifications.

Application boxes throughout the text encourage students to consider how petrology connects to wider aspects of geology, including economic geology, geologic hazards and geophysics. Exercises at the end of each chapter allow students to apply concepts they have learned and practice interpreting petrologic data.

The 336-page paperback contains more than 250 illustrations and photos, and is supplemented by additional color photomicrographs available online for free. Priced at $65, the book became available this month at http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/mineralogy-petrology-and-volcanology/essentials-igneous-and-metamorphic-petrology.

"At the annual Geological Society of America meeting in Denver (Oct. 27–30), Cambridge got several dozen requests for examination copies, and many professors told us they were adopting the book for use this coming spring," says Carol Frost.

The textbook already has garnered some good reviews from the academic community.

Joshua Swartz, an assistant professor of geology at California State University Northridge and UW alumnus, described the book as "an authoritative and contemporary textbook ideal for today's undergraduate student … that distills the essence of igneous and metamorphic petrology."

"Frost and Frost do a good job of linking igneous and metamorphic petrology to basic chemistry and major tectonic processes," says Aley K. El-Shazly, an associate professor of geology at Marshall University. "(It is) well illustrated with a decent set of problem sets and a nice summary of mineral properties."

For more information, email collegesales@cambridge.org.

In February and March, Associate Professor **Bob Howell** had two articles published in the journal *Icarus* respectively titled, "Io's active volcanoes during the New Horizons era: Insights from New Horizons imaging" and "Composition and location of volatiles at Loki Patera, Io."

In March, Associate Professor **John Kaszuba** was nominated for the *James C. Hurst Each Student—A Person Award*. In the spring of 1994, the Associated Parents of the University of Wyoming (APUW), now known as Cowboy Parents, established the "Each Student—A Person" award to recognize a member of UW's faculty or staff who distinguishes him or herself through leadership in creating a warm and caring attitude at the University of Wyoming and who also demonstrates a unique effort to personalize the student experience. In the spring of 2000, APUW renamed the award in honor of Dr. James C. Hurst, UW's Vice President for Student Affairs from 1981–2000, who is remembered for his warmth, wisdom, and dedication to student success.

In December, Kaszuba also lead a session of a Review in Mineralogy and Geochemistry workshop titled, "Geochemistry of Geologic CO_2 Sequestration, where his topic was "Experimental Perspectives of Mineral Dissolution and Precipitation due to Carbon Dioxide-Water-Rock Interactions." The workshop was part of a continuing series that is jointly sponsored by the Geochemical Society and the Mineralogical Society of America.

Graduate student **Robert Mahon** (Ph.D.) recently received first place in the inaugural USGS/GSA Annual Best Student Geologic Map Competition at the 125th Anniversary GSA Annual Meeting in Denver, Colo. for his map, titled, "EdMap Geologic Map of the Saddle Peak Hills 7.5' Quadrangle, Death Valley National Park, San Bernardino County, California." The award includes a plaque, a Brunton Compass, and publication in the *Journal of Maps*.

Robert is advised by Assistant Professor **Brandon McElroy**.

PhD candidate **Fred McLaughlin,** MS candidate **Davin Bagdonas**, and faculty members **Carol Frost** and **Ron Frost** recently published the Stampede Meadows 7.5 minute quadrangle map through the Wyoming Geological Survey. The rocks exposed in that quadrangle located just north of Jeffrey City in the Granite Mountains of central Wyoming record nearly a billion years of Archean history and provide insights into the early evolution of the Wyoming province. The project was funded by the USGS EDMAP program.

In February, Assistant Professor **Cliff Riebe** had an article published in Water Resources Research titled, "Optimal reproduction in salmon spawning substrates linked to grain size and fish length."

In May, Professor **Art Snoke** was honored at the GSA joint Cordilleran-Rocky Mountain sectional meeting in Bozeman, Montana, for his career contributions to the geosciences. The honoring symposium was titled, "The Eclectic Tectonic Legacy of Arthur Snoke." The symposium included two sessions: Metamorphic Core Complexes at Age 35 and Comparative Anatomy and Tectonic Evolution of Continental Margins from the Precambrian to Recent.

Graduate student **Erin Phillips Writer** (PhD) recently received the Dick and Lynne Cheney Fellowship for Excellence in Study Abroad. The $4,000 award is given to no more than six UW undergraduate and graduate students each year in support of significant contributions to their field of interest via international research or study.

Phillips Writer spent 10 weeks at the École Normale Supérieure in Lyon France during the fall of 2013 working in their geochemistry laboratories and analyzing the isotopic compositions of volcanic rocks from Antarctica and the East African Rift.

"This was a valuable international research opportunity and I appreciate the funding I received through the Cheney Fellowship. I learned much from this experience and was able to produce a data set that will form an important component of my PhD dissertation," Phillips Writer said.

Erin also recently won the best student presentation award at The Frontiers of U-series Research Symposium in Sydney, Australia. The symposium brought together scientists from around the world to discuss current research using U-series geochemistry and the future direction of the science. Erin presented a poster titled, "U-series isotopic constraints on mantle upwelling on the periphery of the Hawaiian plume; Isotope geochemistry of Haleakala crater basanites." Funding for travel was provided by a student award from Macquarie University, the University of Wyoming Geology and Geophysics Department, the Wyoming NASA Space Grant Consortium, and NSF grant funding from Erin's advisor, Associate Professor **Ken Sims**.

This Spring, Associate Professor **Ye Zhang** had three articles published in the journals *International Journal of Greenhouse Gas Control*, the *Journal of Hydrology*, and *Transport in Porous Media*.

Zhang was also recently awarded the first Nielson Fellowship from the UW School of Energy Resources for her research project titled, "The Development and Experimental Verification of a New Simulation Inversion Technology for Improved Subsurface Characterization in Environmental and Energy Application." ❖

ALUMNI NEWS

Alumnus **Kevin Adler** (MS, 1982) is currently working as a Supervisory Environmental Scientist for the U.S. Environmental Protection Agency, where he has been since 1986. He stopped by the UW Geological Museum during Summer 2013 and was impressed with the new exhibits and spaces.

Alumnus **Fred Beck** (BA 1955, MS 1959) continues to work as a self-employed geologist in Yarmouth, Maine. Although mineral exploration has been the principle focus of his working life marine geophysical surveys, sand and gravel evaluations, and an analytical lab (Maine Environmental Laboratory) seem to keep him busy these days. In between paying jobs, he enjoys playing competitive croquet, cross country skiing, and leading rafting trips through the Grand Canyon. He misses the West and hopes his old friends from UW are doing well and happy.

Alumnus **Nikolaus Gribb** (BS, 2009) is currently working as a geophysicist for Ion Geophysical. After two years of offshore seismic acquisition work, he has recently been relocated to Houston, Texas. He has been integrated into several groups including software development testing and new hire training. His son celebrated his fourth birthday in December 2013 and he and his wife are expecting their second child in August 2014.

Alumnus **Gene Kiver** (PhD, 1968), a retired geology professor, is currently on the national Ice Age Floods Institute Board. He also recently published *On the Trail of the Ice Age Floods*, through Keokee Press. He misses the Rocky Mountains, but is having "geologic" fun in the North Cascades.

Alumnus **John Morgan** (BS, 2003) has been enjoying a 10 year career in the petroleum industry doing well site work including geochemistry (XRF, pyrolosis, and chromatography) and petrophysics (LWD). He has also worked as a directional well planner designing horizontal wells in unconventional reservoirs. Since may, he has been employed by Anadarko Petroleum Corporation as a geosteering technologist, doing operations geology in the Wattenberg field. He currently lives in Littleton, Colorado, where his daughter, Ona, is graduating from Littleton High School this Spring. He was recently accepted into the master of science in geology program at the Colorado School of Mines, which he will start in the Spring 2014 semester.

Alumnus **Alfred Pekarek** (PhD, 1974) is currently developing and marketing oil exploration programs in Nevada after a career as a petroleum geologist and professor at St. Cloud State University.

Alumnus **Orion Skinner** (BS 1980, MS 1982) recently received the AAPG *Norman H. Foster Outstanding Explorer Award*. The award is presented to members in recognition of distinguished and outstanding achievement in exploration for petroleum or mineral resources, with an intended emphasis on recent discovery. Skinner currently works for Whiting Petroleum in Parker, Colo. and was responsible for Whiting's Pronghorn Field discovery and his contributions to Bakken exploration in Stark County, North Dakota. ❖

NEW FACULTY PROFILE: ANDREW PARSEKIAN

Birthplace: New Jersey

Doctorate: Rutgers University, Newark, New Jersey

What did you want to be when you were growing up? My aunt was a geologist and I thought that was cool, so I wanted a career involved with rocks in some way.

How did you get started in your field of work? After undergrad, I seemed qualified for environmental consulting so I did that for a couple of years, but eventually decided there was not enough opportunity for creative science. I applied to the closest graduate program and got lucky to work on a great doctoral research project with an inspiring graduate supervisor.

What inspires you to dedicate your life to earth sciences? Attempting to understand the complexity of our natural world is endlessly fascinating and challenging. The natural processes that I get to investigate through our research—mostly hydrology and carbon cycling—have direct impacts on modern human life, and important implications for our future. Also, my field research enables me to spend a lot of time outdoors in remote locations.

Is there someone who has inspired you during your academic or professional career? Four people inspired me significantly during my academic career: Jens Hilke (High School science teacher), Martin Helmke (Undergrad research supervisor), Lee Slater (Doctoral supervisor) and Rosemary Knight (Postdoc supervisor). The excitement about science related to our natural world that each of these mentors provided was invaluable in my academic development.

Tell us a little bit about your research. I'm interested in geophysical applications to several areas of hydrologic science research. My most enduring investigation topics are related to the coupled carbon and water cycles in boreal and arctic environments. Specifically, I aim to address the question: how is carbon stored in high-lattitude wetlands and permafrost, and what are the possible links between stored terrestrial carbon and releases to the atmosphere as methane and carbon dioxide? More recently, I've been getting involved with research into engineered hydrologic systems and how geophysical measurements may be able to help us understand how these systems function and improve the ability to meet human water demands. Since starting at the University of Wyoming, I've been involved with the WyCEHG hydrogeophysics effort where I will use geophysical measurements to understand alpine catchment hydrology.

What has been your favorite experience in the field? The most challenging? My favorite thing about the field of hydrogeophysics is the many opportunities to do field work. Just like any other field-based science, I believe it's important to get outside to truly understand the system we're studying. Perhaps the most challenging part of this field is bringing together the traditionally disparate fields of hydrology and geophysics and working with scientists from both of those fields to communicate ideas effectively.

What do you think of Laramie and Wyoming so far? Love it. Plenty in town to keep busy with during the week, and great access to the outdoors for the weekends.

What are some of your other hobbies and passions? I'm drawn to any activities that involve the snow, particularly snowboarding. When winter finally disappears, you're most likely to find me backpacking. ❖

ALUMNI PROFILE: MARK BRONSTON

Birthplace: I was born in September, 1953 in Macomb, Illinois but moved to Kansas, the ancestral home of most of my family at the age of nine months. I grew up in the suburbs of Kansas City, primarily in Leawood and Prairie Village, Kansas.

Current Location: Houston, Texas

Degree/Year at UW: BS, 1979

What did you want to be when you were growing up? I began my education at the University of Kansas as a History major but transferred to UW after a summer visit to Laramie and a change of heart regarding my major. I graduated from the University of Wyoming in December, 1979 with a B.S. in Geology (Geophysics Option). I went to work for Amoco Production Company as a Geophysicist immediately after finishing school. In 1988, while working with Western Gold Exploration and Mining Company (WestGold) in Alaska I was encouraged by my employer to return to graduate school and earn a Ph.D. I attended the University of Mississippi in Oxford, Mississippi under the direction of Dr. Robert Woolsey and received my Ph.D. in Geological Engineering in May of 1994 while continuing to work in the mining and oil industries.

When did you become interested in studying geology? Initially I thought that I would be an attorney when in high school but as I advanced through my university career I became more interested in science in general and the geosciences specifically. My arrival in Laramie cemented my decision to continue my education in the geosciences.

What memories stand out during your time at UW G&G? My experience at UW was outstanding. I feel that I received a first-class education in Geology and Geophysics in the middle of a world-class outdoor laboratory, a sentiment that is shared by many of my contemporaries at UW. I was fortunate to study under some of the great geology/geophysics professors in UW history, including Don Boyd, D.L. Blackstone, Brainerd Mears, Bob Houston, and Scott Smithson. Dr. Smithson was particularly important in my early development as a geophysicist. I worked for Scott during a few semesters of my undergraduate career and for a summer collecting and processing gravity data. Most importantly, Scott introduced me to reflection seismology, the subject that has been the focus of my professional career.

Is there someone who has inspired you during your academic or professional career? Like everyone I've had many people that have influenced my life and my career but three individuals stand out. I have already mentioned Scott Smithson who was instrumental in my decision to select geophysics as a career. During my tenure at Amoco Production Company I was fortunate to work with Anthony DiRenzo during my time in the Regional Tech Group. Under Tony's tutelage I was introduced to industry best practices and standards in seismic acquisition and processing. This experience provided me with a very solid background in these subjects. Also during my tenure at Amoco I was introduced to Mike Graul, an ex-Chevron geophysicist who taught many of the training classes at the Amoco Training Center in Tulsa. Mike is an expert in geophysical data processing and acquisition methods and in my view one of the foremost authorities on the application of AVO/AVA (Amplitude vs Offset/Angle) to geophysical exploration. Over the past 25 years I have leveraged this technology successfully in my exploration efforts and I have maintained a close collaboration with Mike which continues to this day.

Tell us a little bit about your career. After leaving Amoco I worked for some small independents in the Denver area and on my own generating prospects. After the 1986 crash I left Denver and went to Alaska with WestGold, a joint venture between Minorco and Inspiration Resources. With WestGold I was involved with a unique project offshore Nome, Alaska, exploring for drowned marine gold placer deposits. By 1987 I was the Alaska Exploration Manager for WestGold and we had branched out into hard rock exploration in the interior of the State. We focused our efforts at Donlin Creek, located about 20 miles north of the Kuskokwim River in central Alaska. We undertook a tremendous amount of work over the next 4 years on the Donlin Creek Project, locating an extensive area of gold mineralization. Due to the low gold price at the time Inspiration dropped the Donlin Creek Project which went through several iterations and is now owned by Barrick Gold and Nova Gold. They report that it is now considered one of the largest unexploited gold resources in the world. Our exploration team from WestGold was awarded the 2009 Thayer Lindsley Award by the Prospectors and Developers Association of Canada for our work on the Donlin Creek gold discovery. I returned to the oil and gas industry in 1990 and went to work for Lake Ronel Oil Company, a privately held company in Tyler, Texas. At Lake Ronel we successfully explored for gas-condensate reservoirs, primarily in the US Gulf Coast using advanced geophysical methods tightly integrated with subsurface information. In late 2008, I accepted an opportunity to work with Denny Bartell and John Amoruso at Legends Exploration, LP. We explore in the US Gulf Coast and East Texas for conventional oil and gas resources.

How do you think your time at UW G&G prepared you for the career challenges you have encountered? My training at the University of Wyoming was excellent preparation for my career. I received a thorough education in the fundamentals of geology and geophysics. The setting in Wyoming is unparalleled and the opportunities that I had to do field work in conjunction with UW and private employers was very beneficial.

Anything you would like to say to your fellow alumni? To my fellow alumni, I would just say that I believe that the Geology and Geophysics Department at UW provides an excellent foundation for any career in the geosciences. I would encourage everyone to give something back to the University of Wyoming, which in my case, provided a springboard to a rewarding professional career. ❖

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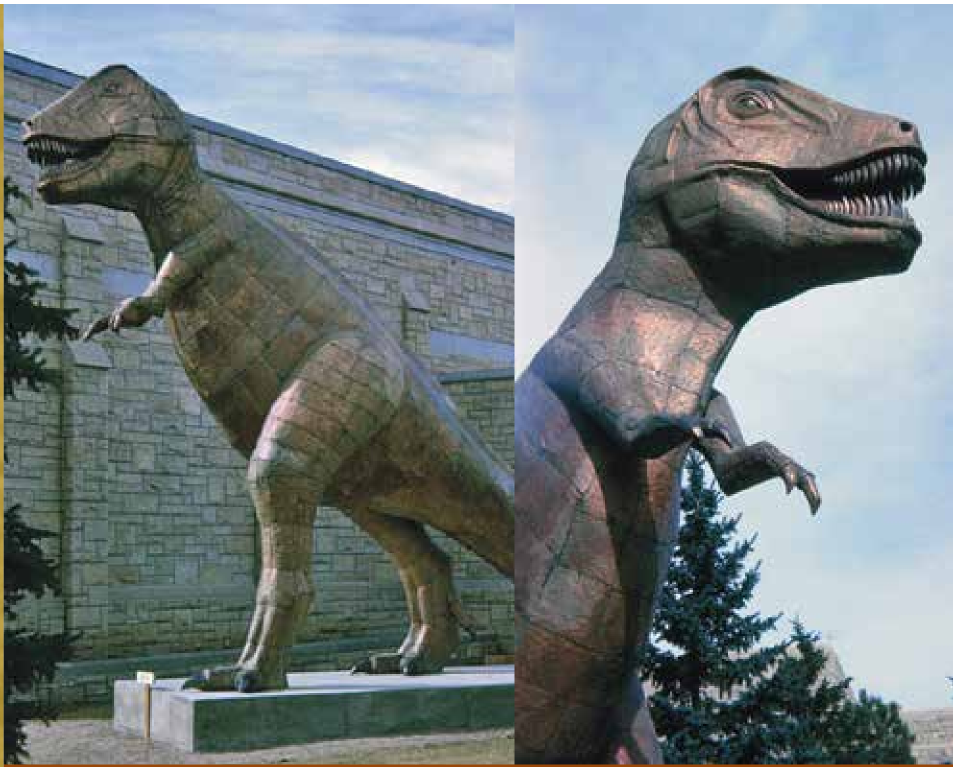

S.H. Knight's life-size statue of Tyrannosaurus rex after removal of the shed which concealed it during construction. The unweathered copper sheathing gleamed brightly in full sunlight as indicated here in the few parts of the statue not in shadow. As Knight anticipated, weathering slowly changed the bright copper color to a reptilian green.