GEOScape

The Alumni and Friends Newsletter of
Colorado State University's Department of Geosciences

November 2014

Colorado State University
WARNER COLLEGE OF NATURAL RESOURCES
Department of Geosciences

Dear Friends of Colorado State University Geosciences,

Rick Aster, Department Head

After almost 10 months of serving as head of CSU's Department of Geosciences, I feel that I am finally well past the most challenging part of my learning curve and am more excited than ever to have the honor of leading this remarkable organization and community.

For those of you who don't yet know me, I am a geophysicist with diverse educational and research interests ranging from earthquake and volcano seismology to glacial and river processes. I arrived at CSU in January 2014 from New Mexico Tech, where I was a professor and past department chair. In addition to serving as Department head, I currently have active research projects in Antarctica and with the U.S. Geological Survey and am co-teaching a new graduate course in geophysical inverse methods.

One of my first efforts was to coordinate a new strategic plan for the Department with the faculty, which was completed by my arrival. This plan, which lays out a broad path to a better-supported and more prominent Department, has already helped us significantly in articulating a compelling vision, both internally and externally.

This newsletter is the first of what I expect will be an annually produced showcase highlighting the accomplishments of our remarkable alumni, faculty, staff, and students. I was immediately impressed upon my arrival at CSU with the depth of commitment and pride expressed by our alumni. I want you all to know that your support is tremendously appreciated, and that I look forward to expanded and further engagement with you. Not only do I honestly enjoy getting to know our many highly accomplished and fascinating colleagues through personal interactions, but I also realize that alumni-University interactions are key to keeping this Department vibrant. This includes ensuring the relevance and attractiveness of our curriculum, providing career-building opportunities for student/faculty research and, of course, supporting our field, scholarship, infrastructure, and other financial needs.

Our Department is currently in the midst of remarkable growth (enrollment is around 180 undergraduate and 65 graduate majors this semester) driven partially by unprecedented career opportunities in the energy, water, and civil sectors. However, I strongly believe that there is another underlying factor in our growth; students at large are increasingly aware that geosciences careers are highly relevant, professionally satisfying, diverse, and high paying. The fact that many of these jobs are located in the booming Front Range region of colorful Colorado provides unique and significant opportunities for us to raise the quality and enhance the regional, national, and international profile of our Department. This growth has been a challenge to manage, as you might imagine, but I am happy to report that, with the assistance of Warner College of Natural Resources and our generous alumni, we are moving towards securing new staffing and other resources to better serve our students.

Please stay in touch with your news, stories and general engagement (*note: you can easily send updates to us as described on the contact page at the end of this newsletter).* Also, please stop by our (newly renovated) third-floor offices in the Natural Resources Building to say hello anytime you find yourself at CSU!

Rick Aster

Dear CSU Geosciences Alumni, Faculty, Staff, Students, and Friends,

I am proud to be affiliated with the prestigious geosciences program at Colorado State University and to be serving as dean of Warner College of Natural Resources.

One of the real strengths of Warner College is its combination of biological, social, and physical sciences that allows us to address natural resources issues and opportunities from a comprehensive perspective. The College's strength in physical science brought by the Department of Geosciences makes us uniquely poised for tremendous impact.

The Department is at the forefront of some of the most critical issues facing our society – spanning from issues related to water quality to sustainable energy needs to disaster recovery and beyond. Geoscientists are advancing the knowledge of the world we live in, and the Department is pioneering new research and innovative applications that are helping to create solutions to complex challenges, such as training nanoparticles to trace oil and chemical trails beneath Earth's surface.

The Department's leadership, faculty, staff, and students are among the best in the nation. Our students are winning prestigious national awards for their academic achievements, and many of them are traveling the world, learning from professors who are leaders in the field. The Department is also enriched by its strong community of alumni who are making tremendous impacts across the industry and on the lives of students who are eager to follow in their footsteps. Many of those alumni have built strong partnerships with the College, creating a legacy of impact that will persist for decades.

I am excited to celebrate with you some of the Department of Geosciences' highlights in this newsletter, and am personally committed to working with the Department to strengthen and identify new pathways for the geosciences program to reach even greater education, research, and service accomplishments in the future. I hope to have the opportunity to connect with each of you in the near future, and thank you for your continued interest in the Department of Geosciences.

Sincerely,

Dean John P. Hayes

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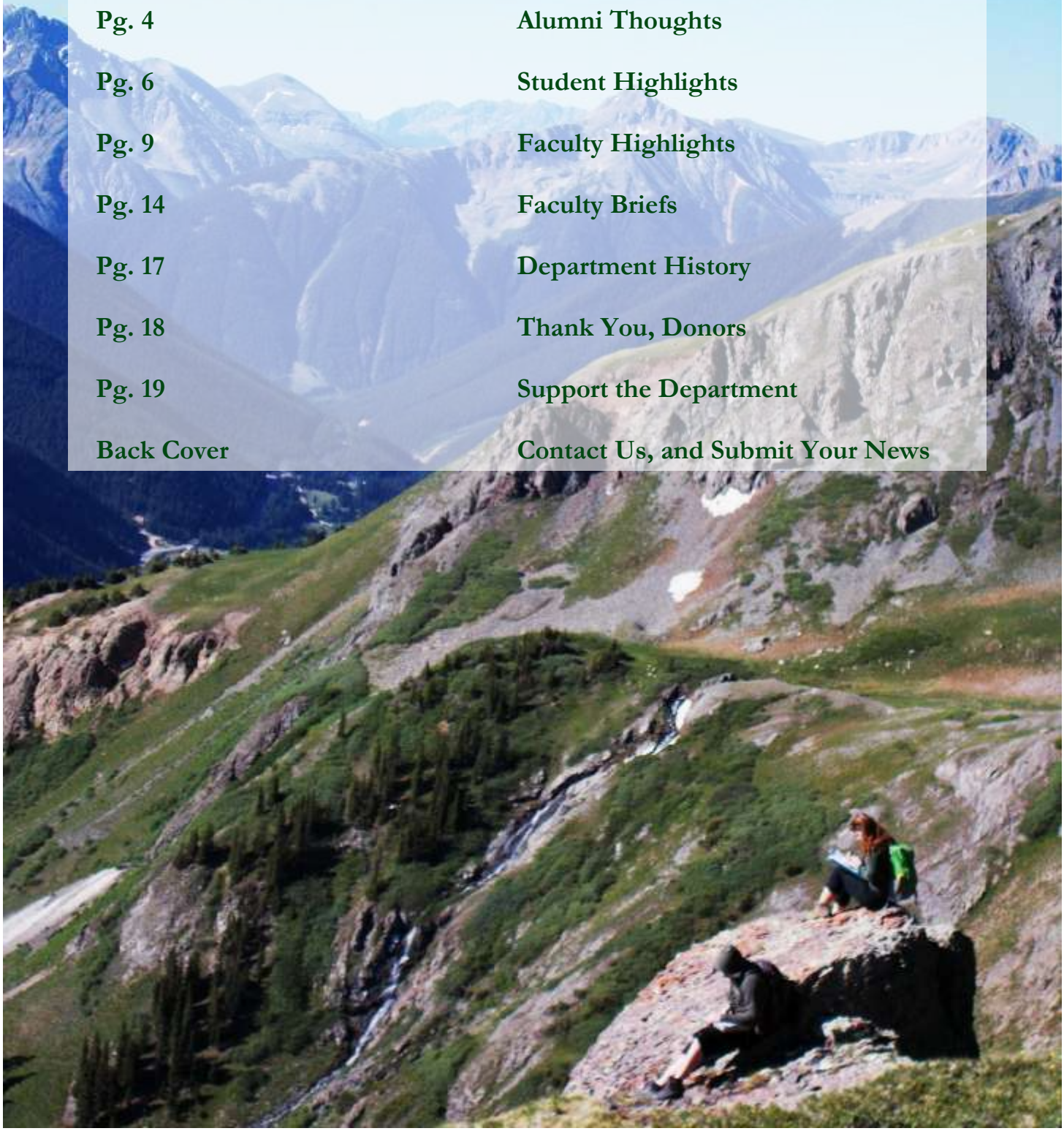

Alumni Thoughts

Chris Lidstone (M.S., '81)

President and owner of Lidstone Associates

Chris Lidstone

As owner of an environmental consulting firm, I see the need and demand for broad-based education and professional flexibility. When I graduated with a geology degree in 1977, gold was $150 per ounce. While in graduate school and working on my thesis, the hydraulic transport of placer gold, the price of gold rose to $880 per ounce. When I was looking for work in precious metals (1984), the price of gold had descended to $300 per ounce. With a background in hydraulics and fluvial geomorphology and with the mining industry depressed, I soon became employed in the environmental field, rather than the exploration of precious metals.

Commodities rise and fall, and a geologist is traditionally tied to commodities – be it base metals, precious metals, uranium, industrial minerals, coal, and/or oil and gas. Maintaining flexibility as a geologist is key, and such flexibility should not be confined simply to the mineral commodities but, more importantly, to ancillary fields such as hydrogeology, geomorphology, reclamation, and watershed sciences.

In the last several decades, mining and environmental awareness have operated on parallel tracks. Mining and mineral extraction for the public's benefit has been going on for centuries, but environmental awareness of the impacts of mining is relatively new. For 3,000 years, mining has produced raw material for art; jewelry; construction of buildings, roads, and religious temples; weapons of war; barter; and farming among thousands of other uses. But only in the last 150 years have environmental impacts of mining been seriously considered, and only in the last 40 years have they been seriously regulated and treated as a science.

Colorado State University continues to lead the country in environmental building (LEED technology), environmental resource management, and natural resources development. The Department of Geosciences has the opportunity to address not only the exploration, mining, and processing of mineral resources, but equally important the protection of adjacent resources and the final reclamation of the land surface. Mining and oil and gas companies are expected to be good stewards of the land, to not pollute, to return the land to an equal or higher land use, to invest locally, and to be good neighbors. Such expectations of stewardship originate not only from the general public and governing bodies, but also from the shareholders, financiers, and employees of the mining company. Environmental awareness by all layers of the corporate structure is an essential element of a mine's success.

The geoscientist's role in this is critical. The technical staff must identify the resource for extraction, must plan out the development of the resource with minimal impact on adjacent lands, and – most importantly – must ensure that operations are conducted in accordance with environmental requirements. In general, the geoscientist is the lead credible person who can assure the regulators and the public that the operation is in compliance. We are clearly living in a fast-paced environment, and misinformation is quickly placed in front of the public. As students, educators, and future employees and employers, it is our responsibility to use our technical knowledge and understanding to combat this misinformation. I continue to argue that good science can trump misinformation and overzealous regulation. I look to the CSU Department of Geosciences to continue to produce high-quality scientists who can balance the pendulum between development and environmental protection.

Scott Larson (M.S., '09)

Petroleum geologist with Dorado E&P Partners in Denver

Scott Larson in Utah

Since starting my career with El Paso E&P in 2007, I have researched the Cretaceous and Paleogene petroleum systems of the Uinta, Raton, South Park, North Park, and Washakie basins. I am currently working the greater Anadarko Basin and am challenged by the numerous and complex petroleum systems found within one of the thickest successions of Paleozoic strata in North America. While operational duties like well planning, permitting, and geosteering horizontal wells are my principal tasks, I still find time to map unconventional and thin, conventional petroleum reservoirs.

One of my proudest accomplishments since graduating is establishing the Salonee Kharkar Memorial Scholarship, with the assistance and support of Rahul and Sulan Kharkar, Warner College of Natural Resources, and the Department of Geosciences, to honor the memory of Salonee Kharkar. I would like to remind alumni of the great financial pressures that students experience while pursuing degrees and encourage alumni to support our students and universities both financially and in the voting booth.

Ron Millikan (M.S., '14)

Left a 15-year software engineering career in 2010 to study geology. He chose Colorado State University because of its geology department and the kindness of the people he met while visiting campus. He now lives in Houston and is a geophysicist for Chevron.

Ron Millikan

It feels very good to have graduated from CSU. And looking back, I have a couple of thoughts to share with other alumni.

Take time to realize what you have done: It's easy to work through a graduate degree and emerge on the other side, diploma in hand, and not realize all you've accomplished. But it's worthwhile to spend some time remembering who you were before you began your graduate school journey. A lot has happened; you worked very hard and achieved something very impressive. You now have knowledge and skills that most people are not even aware exist.

Remember where you came from and who helped you: It's important to remember where we have come from and those who dedicated a substantial portion of their lives to helping people like us achieve our goals. Don't forget them! Keep in touch, and share the stories of your successes. And, when you find yourself able, consider giving something back. Ed Warner did! As our government and society continue to chip away at higher education funding, our gifts will become ever more important to future graduate school candidates.

My perspective of my CSU education as a new hire: What I have found during my first two months on the job is a training schedule that extends for the next several years. The initial classes I must take are a reflection of classes I took at CSU, and one even uses a book that Dr. Dennis Harry teaches with. Of course, these classes are intended to level-set and refresh graduates from a wide variety of universities, but having seen much of their content, I can see how well the Department prepared me for where I am now. I'm happy, I'm confident and I'm very grateful!

Student Highlights

Seismology in Antarctica

Rob Anthony (Ph.D. Program)

As a fifth-year Ph.D. geophysics student working with Rick Aster, I joined the Colorado State community last winter after making the 600-mile move north with my wife, Christina, from New Mexico Tech in Socorro, N.M.. Escaping the desert took about a dozen trips up and down I-25 (including an all-out final push with the help of family on Thanksgiving Day), completely renovating a (vandalized and foreclosed) condo in Windsor, and finding a new job for Christina in the College of Business. But we're now settled and are taking full advantage of life and opportunities in Northern Colorado.

As you are reading this, Rick and I are likely at the bottom of the planet deploying seismic stations on the Ross Ice Shelf. Why? The Ross Ice Shelf floats over the West Antarctic Rift System, one of the largest and most poorly understood continental rifts on Earth. Perpetual cover by ocean and ice sheets has thwarted geologists from placing hammer to rock and obtaining samples to help constrain key questions such as the extensional history, the tectonic underpinnings of recent and continuing volcanism in the area, the viscosity of the mantle and its response to ice sheet loading, and robust estimates of heat flow.

Part of my research focuses on using seismology to investigate ice-sea interactions, which, combined with refined heat flow estimates, should help illuminate the mechanisms driving ice sheet and ice shelf changes throughout West Antarctica.

As a tangent to my climate change-related research, I am also interested in the acquisition of geophysical data and assessing the performance and pitfalls of various types of seismographic instrumentation to increase its utility for science and for industry. In addition to my work in the Antarctic, I have been fortunate enough to be involved on various field campaigns, including the deployment of seismo-acoustic arrays on Tungurahua volcano in Ecuador, ocean-bottom seismometers off the Oregon coast, and an active-source marine survey of the Cascadia subduction zone.

Rob Anthony deploying ocean bottom seismometers off the coast of Oregon.

Hunting Carbon Clues in the Last Frontier

Katherine Lininger (Ph.D. Program)

Successfully navigating stretches of the longest river in Alaska in a kayak laden with soil samples and gear was only one of many achievements by geosciences graduate student Katherine Lininger this year.

After a field season of research in Alaska's wilderness, Lininger found out that she had been awarded the prestigious Horton Research Grant from the American Geophysical Union Hydrology section. She will use the $10,000 grant to fund her next season of research in Alaska. The award comes on the heels of her also being selected for two other awards: the Morisawa Award for student research from the Geological Society of America's Quaternary Geology and Geomorphology division and the Wolman research grant from the Association of American Geographers' Geomorphology specialty group.

Lininger is a National Science Foundation Graduate Research Fellowship recipient and came to Colorado State University to pursue her Ph.D. in fluvial geomorphology in the Warner College of Natural Resources. CSU's Department of Geosciences is ranked among the top programs in the nation for earth sciences. Lininger chose CSU in part because of the opportunity to work with renowned geomorphologist Ellen Wohl and because of support opportunities made possible by our generous donors; Lininger received the Edward M. Warner Graduate Research Assistantship made possible by donations from philanthropist, geologist, and CSU natural resources college namesake Ed Warner.

Lininger floated more than 180 miles of river in the rugged and remote terrain of central Alaska to better understand river-floodplain systems. She spent five weeks in the Yukon Flats National Wildlife Refuge to study how much carbon is stored in subarctic floodplain ecosystems. The remote location is accessible only by a 150-mile trip by boat, plane, or helicopter and is inhabited by bears and swarming mosquitos. The days were mentally and physically challenging, including hiking and paddling sometimes until midnight before finding a camp.

Katherine Lininger and field associate Micah Nelson in Alaska.

Quantifying carbon storage in the Yukon Basin floodplains can help scientists understand the carbon cycle and how carbon moves between the land, ocean, and atmosphere. Lininger and her colleagues collected floodplain soil samples to determine the organic carbon content of the active layer, which is the top-most part of the soil that thaws out in the summer.

Knowing how much carbon is stored in the active layer could also give clues about how much carbon is in the permafrost beneath, which is continuously frozen soil. Melting permafrost due to climate change could release stored carbon into the atmosphere. The research conducted by Lininger, Wohl, and their collaborators will not only inform carbon studies but will also generate much-needed information about the physical characteristics of river systems in an under-studied region of Alaska.

Professor Ellen Wohl and student Katherine Lininger conducting fieldwork in Alaska.

Yukon Flats National Wildlife Refuge

Returning to School, Giving Back to the Community

Scott Walker (Undergraduate Program)

Scott Walker

As an adult learner and Navy veteran, the prospect of returning to school after a six-year absence was a bit daunting. I had forgotten much of the knowledge I gained in high school and was unprepared for the type of academic rigors college posed. I spent the first year at Colorado State University alone and struggling through basic algebra and chemistry, failing my Calculus I class, and doing my best to convince myself that leaving the military had been a good idea.

The one saving grace in all of this mess was my introductory geology class with Professor Dennis Harry. I hadn't been exposed to geosciences in high school, and I had no idea that the geological world we lived in was so fascinating, or that the field had such important applications to nearly everything in our daily lives. I knew then that pursuing a degree in geology was the right move.

In 2013, I decided I wanted to take my passion for geosciences to a new level, so I helped create an outreach program through the Department's Geology Club. The CSU GEO (Geoscience Exploration Outreach) Program was designed to bring Earth's story, the marvels of the geologic world, and an understanding about the people who study them to junior high and high school students in Fort Collins.

CSU GEO is a mixture of math and science tutoring and hands-on, lab-based geosciences instruction. The ultimate goal was to instill a passion for learning about the Earth and inspire students to pursue geosciences careers. The tutoring portion was an important part of the program, as I knew firsthand how tough it was to struggle in math and science, and wanted younger students not to feel discouraged. With once-a-week, two-hour long, after-school meetings at Lab/Polaris K-12 schools in Fort Collins, an outstanding troop of geosciences student volunteers and I launched the program.

The tutoring and geosciences sessions were attended by mostly seventh- and eigth-graders after school. The kids learned how the Earth was formed, how it is continuously being shaped and changed, and what sort of forces are in action to make these changes occur. They learned about numerous careers in geosciences, as well as what type of classes they should expect to take in college to pursue those paths. Many of the sessions were devoted to hands-on activities, including mineral identification games where students wound up going home with backpacks full of cool specimens to identify with their parents as well as dry ice volcano simulations, crystal growth experiments, and fossil hunts.

The program was exciting and formed a positive bond with the Department of Geosciences and the Fort Collins community. Running the program, buying the materials, creating the lessons, scheduling conflicts, and managing hyperactive teenagers soon took its toll, however. With the added responsibilities of being a new father and maintaining a strenuous course load, I have had to put the CSU GEO Program on the back burner, for now. However, I look forward to this coming spring, when I will have more time to devote to these activities. In the meantime, I've helped Boy Scouts earn their geology badges, volunteered to help out professors in geology classes, and have stayed busy with being a dad, husband, naval reservist, and full-time student. (My special thanks to Francesca Valencia for helping out as VP of the program, and to Garth Hesseltine, Abbey Vogler, Erinn Johnson, and Chris Zink for volunteering with CSU GEO!)

Faculty Highlights

Mike Ronayne – Hydrogeology and Management of Water Resources

Mike Ronayne

Mike Ronayne joined the Department of Geosciences as an assistant professor in 2008 after completing a Ph.D. at Stanford University. He was promoted to associate professor in July 2014. Trained as a hydrogeologist, he collaborates with a number of Colorado State University and external colleagues to study a broad range of water resources problems.

Since 2012, Ronayne and his graduate students have been active members of a multidepartment CSU effort focused on the sustainable use of groundwater in the Denver Basin. Working with municipal partners in the basin, they have developed new groundwater modeling tools to evaluate well field performance, infer aquifer properties from long-term water level datasets, and identify efficient management scenarios that reduce energy costs during groundwater production.

Other recent projects have investigated the hydrodynamics of karst aquifers and the hydrogeoecology of mountain wetlands. In 2013, Ronayne collaborated on a study that analyzed the sensitivity of wetland vegetation to groundwater pumping in an area of Yosemite National Park, and he is currently working with students to determine the hydrogeologic controls on water table position in climate-sensitive, groundwater-supported wetlands in Rocky Mountain National Park.

Ronayne has taught a variety of water-related courses since joining the Department. He teaches introductory environmental geology, a 100-level course that draws more than 150 students. At the advanced undergraduate and graduate levels, he has taught hydrogeology and contaminant hydrogeology, and he offers a groundwater modeling course every spring where students learn to develop and apply groundwater simulation models. During the Fall 2014 semester, he is teaching a geostatistics seminar that focuses on spatial data analysis, spatial modeling and interpolation methods.

Graduate students from Ronayne's hydrogeology group have gone on to pursue careers in the environmental consulting industry. Recent graduates currently hold positions at water resources firms in Fort Collins, Lakewood, and Denver, Colo., and Baton Rouge, La.

Derek Schutt – Illuminating the Deep Earth

Derek Schutt arrived at Colorado State University in 2008 and was previously a program officer at the National Science Foundation, a research scientist at the University of Wyoming, and a postdoc at the Carnegie Institute's Department of Terrestrial Magnetism. He earned his Ph.D. at The University of Oregon, in addition to his bachelor's degrees in math and physics. Schutt's interests span a range of topics in seismology and geophysics centered on the fundamental question of why major features are where they are and how they are connected to the deep Earth into the mantle. More specifically, he tries to understand these deep structures in the Earth using seismic and geophysical techniques that constrain and map forces, temperatures, and convective flows that produce mountain building and generate magmatism and volcanism – with a particular interest in the remarkable western U.S. Some of his recent papers have examined the cause of recent uplift in the Colorado Plateau, and the effects of mantle melting on seismic observations.

Schutt is also very interested in education and outreach, with a focus on improving teaching of quantitative concepts to students with less rigorous math and physics backgrounds. He recently received a grant to revise a sophomore-level solid earth course at CSU to improve learning outcomes. He is also chair of the Incorporated Research Institutions for Seismology Education and Public Outreach Committee, which creates museum displays, earthquake viewers, and teaching materials for undergraduate and graduate training, and engages the broad national and international educational community in these efforts.

Derek Schutt

Schutt has also worked with a number of graduate students whose hard work and insight have led to successful careers in oil and gas. Working with such motivated and intelligent students at CSU is a great enjoyment of his.

Schutt began a yearlong sabbatical in Fall 2014, during which he will be a visiting professor at Aarhus University in Denmark, part of a team working on understanding features in Greenland and Iceland. He will also spend part of this sabbatical as a Benjaman Meeker Visiting Professor at the University of Bristol in the United Kingdom, looking at processes behind ancient plate growth. In both places, he will be working on building new long-term international collaborations with CSU's Department of Geosciences.

John Singleton – Exploring the Brittle and Ductile World

John Singleton will be joining the Department in Summer 2015 as an assistant professor. He is currently an assistant professor at George Mason University, where he teaches structural geology, tectonics, and physical geology. Previously, Singleton completed postdoctoral work and his Ph.D. at the University of Texas at Austin.

John Singleton

Most of his dissertation work focused on understanding how large-magnitude continental extension is accommodated in the middle to upper crust. Singleton also has an M.S. from the University of California, Santa Barbara, and earned his B.A. in geology from Pomona College. After completing his master's degree, Singleton worked as an engineering geologist in the San Francisco Bay Area and as an exploration geologist for Rio Tinto Minerals. His work with Rio Tinto involved geologic mapping and stratigraphic analysis of folded and faulted strata in the Mojave Desert and Mongolia.

Singleton is a field-oriented structural geologist with a research focus on the brittle and ductile structural evolution of intensely deformed regions, the development of metamorphic core complexes, and structural processes active in shear zones. Many of these studies involve fieldwork in western Arizona and California. His research relies heavily on geologic mapping, field observations, and microstructural analysis to examine the geometry, kinematics, and magnitude of deformation. His research also incorporates thermochronology and geochronology to constrain the timing and rates of deformation.

"*I am thrilled to be joining the Department of Geosciences at CSU, and am really impressed with the dynamic faculty in the Department, the quality of the graduate program, and the strong field component to the undergraduate program. I look forward to expanding my research at CSU and taking advantage of the fantastic location for teaching.*" – *John Singleton*

Sven Egenhoff – Frontiers in Shale Research

Sven Egenhoff

Shales as recently as 10 years ago were mostly considered by the energy industry as important source rocks for extractable hydrocarbons. Now they have rapidly become a hot topic in research and have spurred a revolution in the petroleum industry. Although shale formations are now important producible unconventional reservoirs due to horizontal drilling and other technical innovations, we do not understand the intricacies of how many of these key units formed, such as the Barnett Shale, the Woodford Shale, or the Bakken Shales.

Why do we care? Production from these units has heavily reduced the amounts of natural gas that the U.S. needs to import from other countries, and the U.S. may become a net exporter of natural gas before long. Enormous reserves have been identified and are rapidly being developed. And they all seem to be unique in some way. Because of this, the intent to duplicate the example and exploit natural gas from shales in many parts of Europe, has not worked out as well as in the U.S.

The principal issue is that we do not understand well enough which processes play a major role in the formation of shales. However, detailed sedimentological studies, most of them being carried out here in the U.S, by me and others, are beginning to shed some light on this. First and foremost, clay particles generally clump, often incorporating organic matter, forming aggregates of "marine snow." Experiments show that these aggregates do not just sink to the bottom of the ocean but are often reworked by currents and, because of their sizes, they behave like sand particles. Shales, therefore, have structures, like ripples and erosional scours, which we would otherwise expect to find only in sandstones.

Sedimentary basins that deposit shale are also not constantly devoid of oxygen (anoxic) as many models propose; tiny burrows of unknown organisms are preserved in many places in shale units. These burrows tell us that there must have been some oxygen present either during deposition or slightly afterward for these organisms to survive. Modern models of shale deposition, therefore, propose only "intermittent" or no anoxia given that excellent reservoirs with high amounts of organic carbon also contain a wealth of these small burrows. Thus, the characterization of ocean floors during the formation of these units as dead, toxic, and isolated deserts is inaccurate.

Where are we going next? The sedimentology and stratigraphy group in the Department of Geosciences has helped in working out marine environments where shales would deposit, by which processes deposition should take place, and how the sediment would be modified by organisms after deposition. An important formation for us in this regard is the now famous Bakken Shale. We are currently focusing on the transition of shale environments to the nearshore siliciclastic and carbonate facies, in the Bakken, in the Ordovician succession in Scandinavia as well as in the Cretaceous succession here in the Front Range.

Several of our papers in this fast-moving area of research are submitted and in press, and another study on the Alum Shale Formation in Scandinavia will soon appear in a GSA Special Paper that I am editing with the help of colleagues. My research with my students will continue to push this topic forward and to keep the scientific community and the petroleum companies updated on our latest findings; it is important for all of our daily energy needs.

Sara Rathburn – Studying the Effects of the Historic 2013 Colorado Floods

Sara Rathburn

Heavy rains in September 2013 resulted in widespread and historic levels of flooding within many of the rivers that drain in the Colorado Front Range. Although our local river, the Cache la Poudre, was in flood stage during the storm, with road and bridge closures limiting travel within Fort Collins, damage to property and infrastructure was minimal. The largest geomorphological effect of this flooding was abundant transport and deposition of High Park Fire-related sediment and wood within Poudre Canyon, with flood-related erosion within the 2012 burn areas causing extensive deposition within tributary drainages and producing debris fans within the main stem of the Poudre River. To the south, the North St. Vrain drainage basin experienced vastly different flood effects. Extreme damage to homes, buildings, roads, and water supply structures along North St. Vrain Creek drastically impacted communities.

Geomorphology students examining flood damage

Colorado State Univrsity and University of Wyoming secured collaborative research funding from National Science Foundation to study the effects of this rare and significant event. The objectives were to assess the effects of a very high magnitude, infrequent flood and associated extreme sedimentation in Ralph Price Reservoir (a municipal water supply for the city of Longmont), relative to longer-term sediment and carbon fluxes. The reservoir history and setting provided a unique research opportunity because: (1) no intentional flushing events have been conducted by the reservoir operators since construction of the dam; (2) the reservoir stratigraphy chronicles uninterrupted delta deposition. and (3) this is the only on-channel reservoir with unimpeded, natural sediment flux from the Continental Divide to the mountain front in a basin that has been unaffected by significant timber harvests, flow regulation, or general land-use impacts.

Our assessment of flood-related sedimentation prior to any dredging activities included coring and bathymetric surveying of the reservoir delta, resistivity and ground-penetrating radar surveys of the sub aerial inlet deposit, and surveying of tributary deposits. Findings to date indicate that, over the 44-year life of the reservoir, approximately *two-thirds* of the delta sedimentation is associated with extreme discharges solely from the September 2013 storm. Total storm-derived reservoir sedimentation is a remarkable approximately 275,000 m^3, with 81 percent of that occurring within the gravel-dominated inlet and 17 percent in the delta. Grain size distributions and volumes of the delta sediment have helped the city of Longmont obtain accurate removal estimates, a prerequisite for FEMA funding for flood recovery efforts. Core samples of pre-2013 reservoir are currently undergoing ^{210}Pb and total organic carbon analysis for age determination and carbon flux into the reservoir, respectively. The success of our efforts has led to the application of similar techniques to be planned for two older Front Range reservoirs affected by the September flooding to fill knowledge gaps about sedimentation history and to expand these rates to annual and decadal scales more broadly. We are excited to be presenting the results of this project at the American Geophysical Union Meeting in San Francisco in December 2014!

Holly Stein – Rhenium and Osmium – a Very Special Couple

Holly Stein

The AIRIE Program is a self-supporting research unit in Colorado State University's Department of Geosciences that is engaged in pushing the frontiers of science in Re-Os (rhenium-osmium) geochronology and isotope geochemistry.

AIRIE's initial work was the development of a new chronometer to date ore deposits by directly dating the constituent minerals (e.g., molybdenite, pyrite, arsenopyrite). Current work focuses increasingly on shales and hydrocarbons. The ability to chemically extract and directly date ancient organic matter provides time pins for Earth's sedimentary record, which is useful for correlation across basins and globally. Particularly when biostratigraphy cannot be used, Re-Os dating of shales fills a unique and valuable niche.

Recently, AIRIE scientists have derived precise Re-Os ages for Permian-Triassic shales in the Arctic to correlate with global climate crises in the equatorial geologic record. The Re-Os age, and trace metal chemistry of Neoproterozoic shale and associated glacial deposits draw links between "snowball earth" events, rising oxygen levels, and the explosion of multicellular life. These results help us understand climate changes and illuminate conditions during key points in the evolution of life.

The osmium isotopic composition of dated organic material, trace metal, and stable isotope data allow us to reconstruct and correlate environmental conditions in ancient seas and lakes. More recently, Re-Os dating of oil maturation and migration has opened still more opportunities, and we have spurred new ways of thinking about how oil migrates. The Norwegian petroleum industry likes the way we think, and is providing financial backing for these efforts through a new long-vision grant, CHRONOS (with Judy Hannah and me as the PIs). The AIRIE Program has a second residence at the Centre for Earth Evolution and Dynamics, University of Oslo, that brings new collaborative opportunities to CSU. Last year, we graduated an M.S. geosciences student whose thesis and field area were in the Neoproterozoic formations of southern Norway. He loved being there! A short media piece with further information about the AIRIE Program can be found at airieprogram.org/ReOsStein2014.pdf.

Sean Bryan – New Directions in Introductory Geology

Sean Bryan

I am a full-time instructor in my second year in the Department of Geosciences with long-term professional interests in undergraduate education. Part of my responsibility this year entails coordinating, teaching, and advancing our large-enrollment undergraduate offerings. Interest and enrollments in our course offerings continue to grow - this fall we have 680 students in the Introductory Geology GEOL 120 and 122, and our Introductory Laboratory (GEOL 121) has 450 students. We are excited to be reaching so many students; showing them the wonders of the geosciences, and helping them to gain the scientific knowledge and skills to be informed citizens. As our enrollments grow, we are continuing to seek ways to improve our introductory curriculum.

As a part of this effort, Sara Rathburn and I recently were awarded a grant from Colorado State University's Provost's Course Redesign Competition that will support our work with The Institute for Teaching and Learning to update and improve the Introductory Geology Lab course. A major goal of this effort is to revise and update the in-house GEOL 121 Lab Manual, taking advantage of recent "teachable moment" events and opportunities, such as

the Fall 2013 Front Range floods and the upcoming centennial anniversary of Rocky Mountain National Park, to engage students and enrich their learning experience. We will also be coordinating with Professor Jerry Magloughlin to incorporate new materials on geology of our national parks.

We are lucky in Fort Collins to have such a wonderful natural geological laboratory in our backyard, and hope to take full advantage of these splendid surroundings to make our introductory courses both relevant and engaging for students as well as for the broader CSU community.

Faculty Briefs

Dennis Harry

Dennis Harry: I continue to teach Physical Geology for Scientists and Engineers and Applied Geophysics on a yearly basis. The demand for subsurface mapping is growing, with this course being offered in consecutive spring semesters for the first time. I continue to work primarily on understanding the opening of the Gulf of Mexico and the West Antarctica Rift System, with funding from the National Science Foundation and American Chemical Society. Our work was presented at the 2013 GSA and AGU meetings and the 2014 AAPG meeting, co-authored with undergraduate students Derek Witt and Jace Koger, and graduate students Sumant Jha and Chris Wenman.

Bill Sanford

Bill Sanford: This year I have been involved in teaching two senior-level courses – hydrogeology and environmental geology – and a graduate-level course on estimating groundwater recharge. In addition, I taught a section of the Geosciences Field Camp and co-led the fall semester field trip to the Black Hills with Jamie Kirkpatrick. I have been fortunate this past year to be a co-PI on an innovative seed grant for conducting research on the transport of nanoparticles through the subsurface. This work could lead to improving remediation of contaminated sites, understanding geochemical processes within porous media, and potentially tracing fracking and other geological fluids.

Sally Sutton

Sally Sutton: I spent the 2013-2014 academic year on sabbatical in Krakow, Poland, where I taught courses at the Academy of Mining and at Jagiellonian University and worked on unraveling the complicated diagenetic history of the Kupferschiefer, a Permian copper-bearing shale that has attracted economic and scientific interest for many hundreds of years. Now back at Colorado State University, I am continuing to collaborate with colleagues in civil and environmental engineering and we'll be teaching our new course, Modern Gas and Oil, in the spring to a diverse student audience. Other ongoing research includes tracking paleofluid pathways in sandstones and shales using alterations, and then using that information to identify controls on fluid pathways.

John Ridley

John Ridley: There have been long-term highs of enrollment in my courses, Mineral Deposits and Field Methods. In collaboration with Al Hofstra from the Denver office of the U.S. Geological Survey, I convened the biennial PACROFI (Pan-American Current Research on Fluid Inclusion) meeting at the Pingree Park Campus in June. Cambridge University Press published my textbook *Ore Deposit Geology* late last year. Also this year, the multiauthor special publication of the Geological Society, *Gold Transporting Hydrothermal Fluids in the Earth's Crust*, that I edited with Paolo Garofalo of the University of Bologna, was published.

Judy Hannah

Judy Hannah: A recent highlight for me was Nathan Marolf's M.S. thesis on the geochemistry of late Precambrian shales from Norway, a step toward understanding glaciation and the explosion of multicellular life. Marolf now works for PDC Energy in Denver.

I am spending fall terms in Norway, now at the Centre for Earth Evolution and Dynamics at the University of Oslo. Interaction with sponsors from the Norwegian petroleum industry is invaluable as we explore the behavior of rhenium and osmium in organic matter. Next goal – date hydrocarbon expulsion!

Jerry Magloughlin

Jerry Magloughlin: This past academic year (Fall 2013) kicked off with enrollments in Mineralogy and Optical Mineralogy the biggest in around 30 years. Those of you who recall taking Mineralogy in Room 301 might be surprised to learn that we outgrew that room several years ago, so yes, crystal models (etc.) now need to be schlepped to another building with a classroom big enough for us. Recently, a 5-year-old boy I passed on my way back to the Natural Resources Building pointed at my base-centered monoclinic Bravais lattice model and loudly proclaimed, "I could make something like that!" We started Fall 2013's class with 71 students, and then topped that with 72 this (2014) fall semester.

In January 2014, as chair of the Faculty Council Committee on Libraries, I attended a meeting in Houston where the future of university libraries was discussed. I visited the Spindletop area, where the Texas oil boom originated in 1901 with a gusher that gave rise to Gulf Oil and Texaco. The Ocean Star Drilling Museum is a must-see if you are in Galveston.

Spring semester, I taught two graduate-level courses and, in March, a group of photographers I've been involved with got picked for the opportunity to visit "The Wave," near the Utah-Arizona border. It is a famous location in large-scale crossbedded Navajo Sandstone. (Do an Internet search if you're not familiar with it; you've probably seen a picture.) This past summer started with field camp in May and June (36 students this year), and then fieldwork in the North Cascades with graduate students Adrian Kahn and Russell Thomas, in the Glacier Peak Wilderness area. It was spectacular, including great wildlife and the most flowers I've ever seen in the Cascades. A highlight was testing out a hand-held X-ray fluorescence "gun," that enables one to obtain chemical analyses on specimens in the field and *in situ*. It's reasonably new technology, enabling the addressing of research questions never before possible, and we will have one of these full time in the Department this coming year.

My research continues to be on the nature of fault rocks accompanying earthquakes in fast-slip fault zones, along with some work on weird nearly pure garnet metamorphic rocks called coticules from Washington and New Zealand, and new work on ultramafic rock bodies in the North Cascades, which I will present at the AGU meeting in San Francisco in December. As always, I enjoy hearing from those of you who have graduated, so send me an email sometime with whatever you've been up to!

Ellen Wohl: My highlights for the past year include publication of a graduate-level fluvial geomorphology textbook (*Rivers in the Landscape: Wiley-Blackwell*) and fieldwork along the Yukon River in central Alaska with graduate student Katherine Lininger. The Alaska project focused on floodplain storage of organic carbon. The role of river form and process in carbon dynamics is now a research focus for several of the fluvial geomorphology grad students. Bridget Livers is examining in-channel carbon storage in Front Range headwater rivers; Nick Sutfin is quantifying floodplain carbon storage in the Front Range; Dan Scott is measuring carbon storage in subalpine lake deltas in the Front Range and the Cascade Range of Washington; and Natalie Anderson is quantifying particulate carbon export via wood in the Mackenzie River drainage of Canada.

Ellen Wohl

Jamie Kirkpatrick

Jamie Kirkpatrick: This year started on a high for me with trips to Palm Springs, Calif. for fieldwork, and to Kochi, Japan, to visit the IODP core repository before classes started in January. I also visited Tokyo in May for an IODP workshop that I co-convened, and spent several weeks in Yosemite National Park studying ductile-brittle deformation. I taught structural geology and field camp, took a trip to the Black Hills over Labor Day weekend with Bill Sanford, and developed a new graduate-level reservoir geomechanics class for the fall. Although I am departing in January to assume a new faculty position at McGill University in Montreal, I plan to maintain affiliate research connections with the Department and am pleased that an excellent new faculty member, John Singleton, will arrive in 2015 to keep structural geology moving forward at Colorado State University!

Rick Aster: In addition to getting up to speed as Department head this year, I am teaching a new fall semester graduate course, Geophysical Inverse Theory and Practice, with Mike Ronayne (based on my 2013 textbook, *Parameter Estimation and Inverse Problems*). Publications with students this year include a study of the (dynamic) mantle beneath the Colorado Rockies (in *Earth and Planetary Science Letters*), a new model of the West Antarctic crustal thickness (*Journal of Geophysical Research*), and the discovery of a new variety of icecap "stress indicator": shallow Antarctic icequakes that are dynamically triggered from distant (as far away as Chile) large earthquakes (*Nature Geoscience*).

Rick Aster

I am also gearing up, as I write this, for a Fall 2014 trip to Antarctica with Colorado State University graduate students Rob Anthony and Michael Baker. We will be coordinating the installation of seismographs across the Ross Ice Shelf, Earth's largest floating expanse of ice, to characterize its seismic response to ocean waves and to image the underlying crust and mantle structure of the West Antarctic Rift System.

Compiling our Department History

Frank Ethridge, emeritus professor, and former department head of earth resources (1989-1990), has recently updated a compendium of the Colorado A&M and CSU geology story from 1922 through 2014. Did you know, for example, that the first geology course at the University was taught by chemistry professor Roy G. Coffin (and that the uranium mineral coffinite is named after him)? We are actively seeking new materials (and any corrections) to enhance this history. Kindly contact Department Head Rick Aster (rick.aster@colostate.edu) if you have some history and/or photographs that you'd like to share with us. You can view the history online at warnercnr.colostate.edu/docs/geo/GeoHistoryCSU2014.pdf

CSU Field Camp 1982 - Little Molas Lake, San Juan Mountains

CSU Field Camp 2014 - northern New Mexico

Special Thanks to Our Supporters

Our community of supporters around the world contributes to the Department in diverse ways each year; below are a few special highlights. Many thanks to all of you!

Thank you, **Joby Adams,** for providing annual scholarship support to be awarded to a deserving geosciences undergraduate student (Adam Yates for 2014-15). Adams also serves on the Geosciences Advisory Council, and has contributed notably this year to connecting the Department with corporations and government agencies in the Middle East focusing on several areas of water resources management and research.

Thank you to the **Kharkar family** for continuing to honor their daughter, Salonee Kharkar, by supporting the Salonee Kharkar Memorial Scholarship. This scholarship will honor a deserving undergraduate student (Jessamyn Benshoof for 2014-15) in the Department of Geosciences.

Thank you, also, to **Scott Larson** for his continued support to increase the Salonee Kharkar Memorial Scholarship. Larson continues to remember his friend and classmate, and his gift is representative of his passion and commitment to support students in the Department.

Additional thanks to faculty member **Sally Sutton** for her generous gift this year: the majority of which will also support the Salonee Kharkar scholarship.

Special thanks to alumnus **Jeff Ware** for his unwavering support of the Ethridge Sedimentology Endowment, the Lary Kent Burns Memorial Scholarship, the Schumm Graduate Fellowship, and the Ware Fellowship. Through Ware's generous continued support, his associated endowments now sit at almost $120,000 and generate approximately $5,000 for critical scholarship awards annually.

Thank you to **Chris Lidstone** and **Kate Laudon**, who established and endowed the Lidstone Scholarship in Geosciences this year. This scholarship will be awarded to a deserving student who exhibits well-rounded cultural interests and is active in extracurricular activities. In addition to employing undergraduates from the Department, Lidstone also volunteers frequently to counsel students about preparing for the workforce, something he is passionate about.

The Department also received two very large meaningful software gifts this year. The first, Kingdom Suite, has been utilized by Professor Dennis Harry for several years to train students in geophysics. IHS is committed to sustaining this license for an additional three years at a value of $1.9 million. Professor Sven Egenhoff has also shepherded a significant new software gift to train students in shale- and reservoir-related studies. Sincere thanks to Emerson Process Management for working with us to implement this industry-standard software into our curriculum.

Thank you!

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