THE OHIO STATE UNIVERSITY

SCHOOL OF
EARTHSCIENCES

October 2016 News Notes

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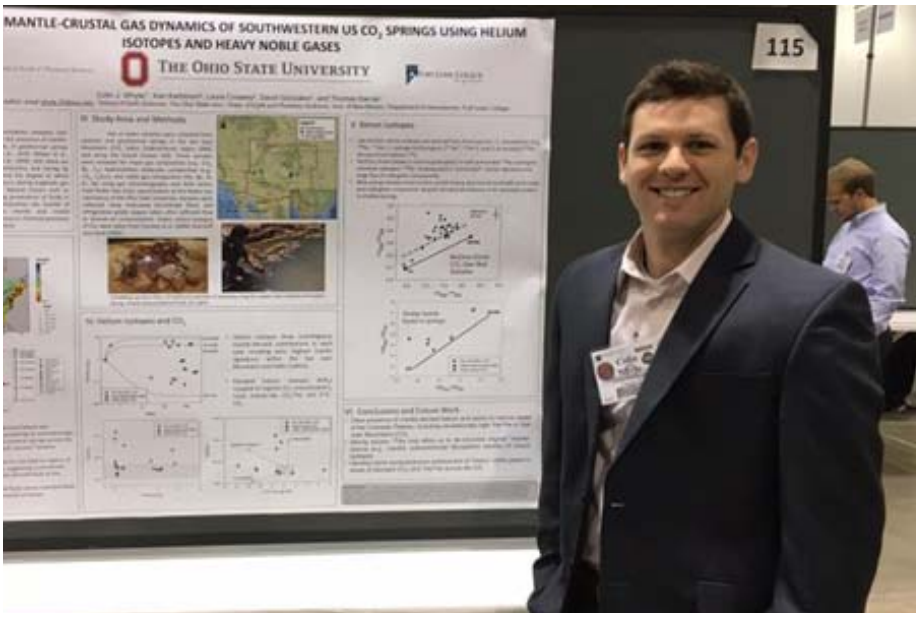
Alumni Change Lives

Colin Whyte is a graduate student working with Prof Tom Darrah. Here he describes how Friends of Orton Hall helped further his studies. If you are interested in giving to support the Friends of Orton Hall or other funds, please visit our giving page (link).



I received funds from Friends of Orton Hall to attend the Geological Society of America annual meeting in Denver, Colorado, in September of 2016. This grant paid for my conference registration fee, as well as travel expenses for the week. In Denver, I presented a poster titled "Evaluating mantle-crustal gas dynamics of southwestern US CO_2 springs using helium isotopes and heavy noble gases," which illustrated some of my more recent research that involved analyzing the dissolved gases in CO_2 springs from the San Juan Mountains of Colorado, the Valles Caldera and Jemez Springs region of New Mexico, and along the Grand Canyon in Arizona to identify the source of the CO_2 and these fluids. Dissolved noble gases, particularly helium isotopes, have the ability to separate mantle from crustal-derived fluids. My research couples the conventional helium isotopes with xenon, which has similar radiogenic and primordial (i.e., mantle-derived) isotopes, and through this technique we hypothesize that we can discern the relative depths within the mantle for fluids that have a mantle component. All of the springs sampled during this research displayed some percentage of mantle gas, but this technique led us to the hypothesis that these fluids were derived from the subcontinental lithospheric mantle and not the asthenosphere due to the presence of primordial xenon and an enrichment in the radiogenic xenon isotopes. I was able to discuss these ideas with researchers from around the nation at my poster session and after oral presentations and it led to potential collaborations with the United States Geological Survey, which conducts similar research tracing fluids in hot springs. Friends of Orton Hall helped me reach my goals of presenting at GSA and further improving my skills as a research presenter, as well as enhancing my professional network of research collaborators.

Prof Cook Awarded National Academies Early-Career Research Fellowship

Earth Sciences' own Professor Ann Cook is one of the 10 outstanding junior scientists around the country recognized by the National Academies for exceptional leadership, past performance and potential for future contributions to improving oil system safety, human health and well-being, or environmental protection. To foster their development as leaders, fellows will receive professional guidance from a senior faculty mentor at their home institution. Earth Sciences Professor Steven K. Lower is Cook's mentor. Fellows receive $76,000, paid to their institution in the form of a two-year grant, for research expenses and professional development. For more information, check out the National Academies press release here. Congratulations, Ann!

SES at Arts and Sciences Alumni Event in Oklahoma City

At the College of Arts and Sciences alumni event in Oklahoma City on September 16, 2016, prior to the Buckeyes' football game versus Oklahoma on September 17, Geology alumnus Mike Morgan (BS 1969) met Earth Sciences undergraduate Tess Green (BA expected, December 2016). Tess was at the ASC event in her role as administrative coordinator with the marching band which performed for the crowd of 200 Ohio State alums and friends. Mike and Cindy Morgan attended the ASC event and the football game in Norman with ASC Executive Dean David Manderscheid. Mike and Cindy are pictured below with Professor Anne Carey and Tess Green. Mike claims that the Geological Sciences tee-shirt he wore to the alumni event at Rocky's Bricktown in Oklahoma City is 50 years old.

Prof Panero Elected Fellow, Minerological Society of America

Earth Sciences' Professor Wendy Panero is one of the 10 newly elected 2017 fellows of Mineralogical Society of America. Panero is part of Ohio State's Mineral Physics Research Group studying material behavior under the high-pressure, high-temperature conditions of the Earth's interior. Panero received a 2016 Distinguished Undergraduate Research Mentor Award at the Denman Undergraduate Research Forum, and teaches the very popular course for non-majors EARTHSC 2205 "The Planets."

Faculty Profile: Wendy Panero

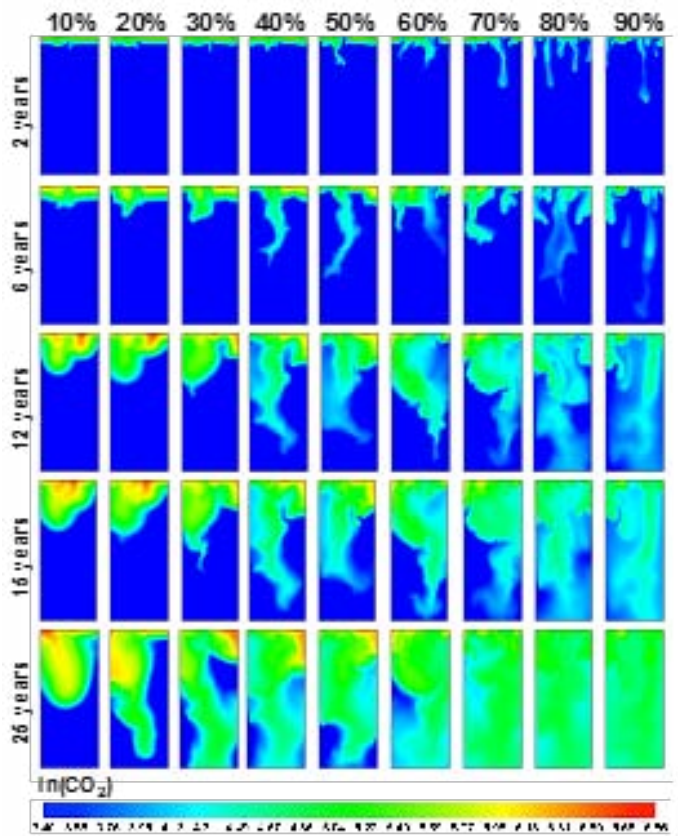
I am an Associate Professor in the School of Earth Sciences at Ohio State University, where I study the behavior of materials at the high-pressure and high-temperature conditions of planetary interiors. I've been involved in geology and geophysics work since I was 15 years old. As a high school student, I had a summer job at the USGS working for the Circum-Pacific Map Project where I transferred ocean floor maps from one projection to another on some of the first versions of ARC/INFO (now ArcGIS) and Photoshop. As a college student at Harvey Mudd College, I majored in physics while conducting undergraduate research measuring and modeling post-seismic deformation after the Northridge earthquake. I went to graduate school seeking more work to combine my physics, geological, modeling and experimental abilities.

Plate tectonics are the surface manifestation of the dynamic processes in the interior of the planet that move heat to the surface. These processes are in turn controlled by the physical properties of the rocks in the interior. I both conduct experiments and perform calculations on the materials of the Earth's mantle and core with a focus on how water is stored in the mantle rocks. The magma erupted at mid-ocean ridges contain traces of water that had been stored in the mantle. As oceanic plates subduct into the interior, they carry water from reactions with the oceans while on the seafloor. Most of this water is released below arc volcanoes, but some persists to greater depths. As mantle minerals have different capacities to store water, this leads to variations in the ductile nature of the mantle, affecting how it flows to allow for internal heat to escape: the very plate tectonic process that leads to our dynamic surface. Listen to more about my work on water cycles in the Earth's deep interior in my NPR Science Friday interview (link).

(left) Diamonds in a diamond anvil cell compressing a sample to the pressures of the Earth's deep interior. (Right) Dr Panero aligning a diamond cell at the National Synchrotron Light Source beamline U2A to measure the bonding properties of water in mantle minerals.

The Earth is just one of thousands of discovered planets, of which just 8 are in our solar system. In recent years, I've been also working to apply the geophysical knowledge and intuition on modeling of terrestrial exoplanets in our Galaxy, applying knowledge of their likely composition by using measurements of their stellar host composition. Just as the Earth's composition mirrors the Sun's, these exoplanets likely have a similar composition to their star's. For instance, stars with more carbon than ours may produce planets full of diamond while stars with more heat producing elements may maintain plate tectonics on planets as small as Mars or even Mercury.

SES postdoc and FOH-supported student publish in *Nature* about geological CO_2 sequestration



Geological carbon (CO_2) sequestration in saline aquifers is a promising technology to mitigate anthropologic greenhouse gas emissions. When CO_2 is injected in an aquifer, it tends to accumulate in the top as a gas cap. If the cap rock is compromised, e.g. by fractures or abandoned wells, CO_2 may leak back into the atmosphere. However, if CO_2 is dissolved into the brine, storage is more likely to be permanent. Dissolution of CO_2 across the gas-brine interface starts through diffusion, which is a slow process. But CO_2 dissolution causes a density increase of the brine, and dense brine on top of lighter brine can be gravitationally unstable. Gravitational fingering (see Figure) then mixes dissolved CO_2 throughout an aquifer at convective time-scales, which can be very fast for high permeability aquifers. This process has been studied in detail for homogeneous porous media and under various simplifying assumptions. In this work, we create about 100 synthetic reservoirs that have realistic geological formation properties. Specifically, we distribute different volume fractions of high-permeability facies, like sandstone, and low-permeability facies like shale or clay. For each reservoir we perform high-resolution simulations to study the differences in gravity-convective mixing of dissolved CO_2 between different heterogeneities, and compare to equivalent homogeneous domains. We also propose global quantitative measures of the effective mixing rates over time. These measures provide universal scaling behavior of mixing rates that can be applied in future sequestration projects. We also find new flow regimes in the fingering process that had not been recognized before.

The citation is Soltanian M.R., Amooie, M.A., Dai, Z., Cole, D., and Moortgat, J., "Critical Dynamics of Gravito-Convective Mixing in Geological Carbon Sequestration", accepted for publication in *Nature Scientific Reports*.

Lead author Reza Soltanin is a postdoc in SES. Amin Amooie is a graduate student in SES, and has received support from Friends of Orton Hall. Congratulations, all!

Volunteering at Mershon Auditorium

PhD graduate student Myles Moore volunteered at the Mershon Auditorium for the Wexner Center for the Arts Usher Appreciation Night. This was a three hour long dinner and then social hour. The goal of the event was to celebrate and recognize the hard-work that ushers do for Wexner Center. Awards were given out to ushers that have dedicated hundreds of hours of service to the Wexner Center. The event was Old West themed with some volunteers dressed up as cowboys and a mock mineral panning area filled with labradorite, pyrite, chrysocolla, and some smoky quartz. Myles Moore volunteered by showing people how to perform panning and telling them about the different minerals they had uncovered. Myles also brought in some samples that he and his lab mates had collected from different mining areas that contained ores of copper, silver and gold. Myles informed people at the event of the depositional environment of where some of these ores had formed.

Li Wei Wins Award

Li Wei, a PhD student working with Dr. Ann Cook won best student poster at the Gas in Marine Sediments (GIMS) conference in Tromso, Norway, for her poster: A 1D mass balance model for the formation of gas hydrate in marine sequences.