THE OHIO STATE UNIVERSITY

SCHOOL OF
EARTHSCIENCES

December 2016 News Notes

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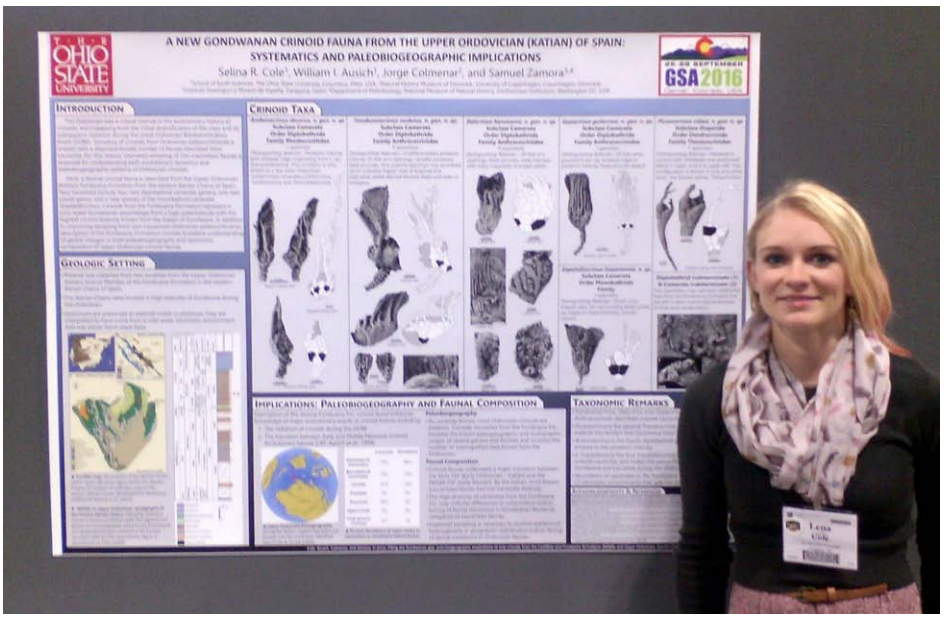
Alumni Change Lives

Selina Cole is a graduate student working with Prof. Emeritus Bill Ausich. Here she describes how Friends of Orton Hall helped further her studies. If you are interested in giving to support the Friends of Orton Hall or other funds, please visit our giving page (link).

My dissertation research broadly addresses the effect of biotic and abiotic drivers on macroevolutionary patterns through deep time. Using Paleozoic crinoids as a model group because of their exceptional fossil record, I integrate alpha taxonomy, phylogeny reconstruction, and comparative methods to explore evolutionary patterns within a phylogenetic framework. This approach allows me to incorporate the effect of organismal relationships into my studies by taking into account the amount of evolutionary history shared between species.

With a generous grant from FOH, I presented three different aspects of my research at the recent Geological Society of America annual meeting held in Denver, CO. The first presentation was a first-authored poster summarizing a new crinoid fauna that my co-authors and I described from Spain (Cole et al., in press, *Journal of Paleontology*). This fauna includes the most diverse collection of crinoids known from the Katian (Upper Ordovician) of Gondwana. This was an important interval of crinoid diversification, but few crinoids of this age had been previously recovered from the paleocontinent of Gondwana. This new fauna provides important insight into the composition of high-latitude, cool-water crinoid assemblages from the Katian and suggests heterogeneity in the timing of faunal transitions between paleocontinents.



I also delivered a sole-authored oral presentation on the effect of ecology on morphological convergence versus conservatism. Using a crinoid phylogeny I constructed as a framework, I employed a combination of parsimony, maximum likelihood, and Bayesian approaches to compare the frequency with which morphological characters change across the tree. I found that non-ecologically significant characters, such as those relating the crinoid body plan, were highly

conserved whereas ecologically significant characters, such as those relating to feeding structures, underwent significantly more convergence. These results provide important insight into the effect of ecology on morphological plasticity and rates of evolution and will also inform future phylogenetic and systematic studies. Finally, I was co-author on a poster with David Wright (SES PhD 2016) and Bill Ausich that summarized a newly-proposed classification of all crinoids, living and extinct (Wright et al., in press, *Journal of Paleontology*). This classification is the culmination of many years of both joint and individual research on the phylogeny of crinoids.

The ability to attend this meeting was a valuable opportunity. In addition to presenting three different portions of my dissertation research, I was able to discuss my work with many other researches in my field, initiate several new collaborations, and explore future avenues of research. I am very grateful for the generous support of FOH which helped to fund my participation in this conference.

Seismometers Measure "Fan Quakes" During the 2016 Ohio State Football Season

SES professors Derek Sawyer, Ann Cook, and Wendy Panero are using seismometers in Ohio Stadium to measure the shaking that occurs during Ohio State football games. As fans jump up and down, the vibrations are measured by seismometers and can be used as a teaching tool for students and the public about earthquake science. The team also includes collaborators from Miami University, the Ohio Department of Natural Resources, and Ohio Stadium facilities.

The hazard potential of earthquakes and the science behind using seismic waves to understand Earth's interior are core subjects taught across all levels of earth science from elementary school through higher-level graduate classes. Often though, very few students have experienced a real earthquake. This lack of intuition for the underlying physics is often a major barrier to students who might otherwise be curious.

"We'll feature the measurements in classes, so that students can engage with real-world data and connect it to an experience many of them have had in person," said project leader Derek Sawyer, assistant professor of earth sciences at Ohio State, who brainstormed the project with Wendy Panero, associate professor, and Ann Cook, assistant professor. "At a more advanced level, we'll use the data to teach data reduction and collection as well as wave propagation, earthquakes and the local geology. We've already achieved some exciting preliminary results."

The Seattle Seahawks measured fan quakes first, inspired by the "Beast Quake" in a 2011 playoff game during which running back Marshawn Lynch scored on a touchdown run, and the resulting celebration registered on seismographs outside Century Link Field. Sawyer and his team wanted to adopt this approach to the collegiate level. Ohio Stadium is one of the largest in the world and seats at least 30,000 more than the Seahawks' stadium.

The Ohio Department of Natural Resources operates the Ohio seismic network (OhioSeis). In recent years, hydraulic fracturing, or 'fracking,' of Ohio's Utica shale, as well as wastewater injection has brought the issue of human-induced earthquakes to the forefront. As a result, more students and public are inquiring about earthquakes in Ohio. Team member Jeffrey Fox, a seismologist at the Ohio Department of Natural Resources and

Ohio State alumnus, said that fan quakes present a good opportunity to get people thinking about earthquake hazards in general. "As more and more people move to and live in earthquake-prone areas, they should be aware of seismic risk," Fox said. "Even in areas such as Ohio, where the risk is low, it's not zero."

The team created a "FanQuakes Magnitude Scale," which converts shaking from fans into the perceived magnitude of a naturally occurring earthquake, if one were to occur centered 10 kilometers (about 6.2 miles) below ground underneath the stadium. "We expected that the most exciting plays would make the biggest fan quakes, and that's true," explained Miami University seismologist Michael Brudzinski, "but sometimes the fan quakes grow even larger after the play is done, because the music starts. The music helps the fans to jump in unison, which leads to even stronger shaking of the stands."

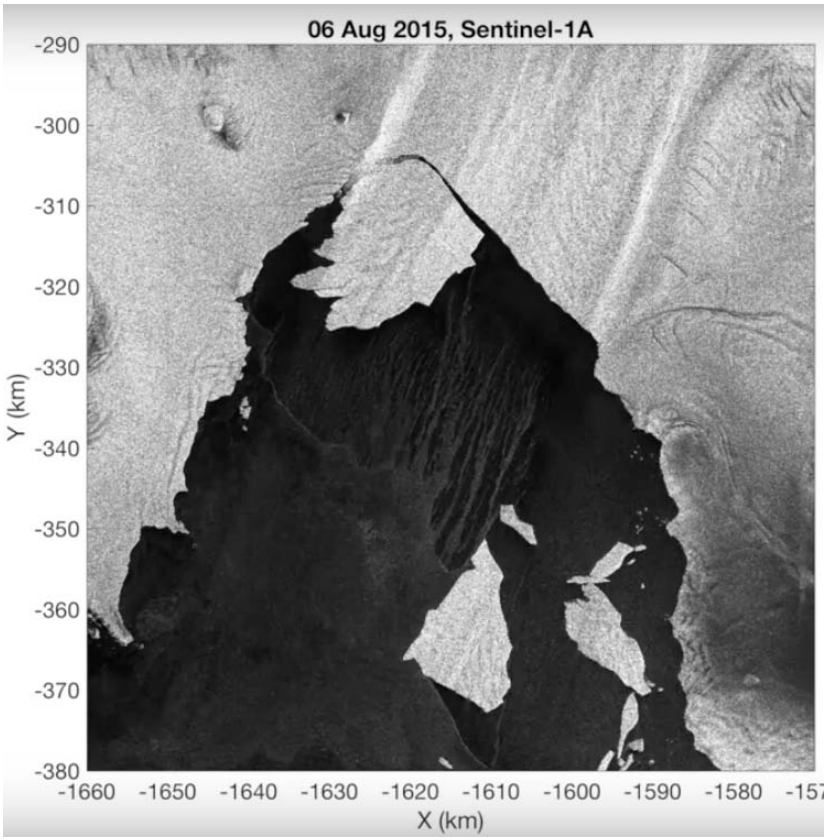
The team recorded 5 home games this season. The Buckeye fans saved their best for last during the Michigan game on November 26th with a record attendance of 110,045. After Curtis Samuel's double overtime touchdown, the stadium shook with 5.79 on the FanQuake Magnitude scale, which was the largest FanQuake recorded during the season (shown in the image, above). Other large FanQuakes during the season occurred during the Nebraska game on Nov. 5th: Damon Webb's interception and touchdown in the first quarter, generated a 5.1-magnitude quake and Curtis Samuel's touchdown catch at the beginning of the second half reached a FanQuake Magnitude of 5.2.

The project has been featured in social media and several media outlets including the Columbus Dispatch (link), local TV stations, and ESPN (link). The team plans publish their results and continue the project for the 2017 season.

West Antarctic ice shelf breaking up from the inside

Earth Sciences professor Ian Howat and postdoc Seongsu Jeong led a study in *Geophysical Research Letters* which shows part of the West Antarctic Ice Sheet breaking apart from the inside out, spelling trouble for the future of the ice sheet. In 2015 a 225 square-mile chunk of the Pine Island Glacier in West Antarctica broke off into the sea. While a calving event may not be extraordinary, this event was different.

Where most cracks form at the edges and propagate laterally across the shelf, this crack actually started at the base of the ice shelf 20 miles inland which grew for two years until breaking through the surface.



While this is the first time researchers have witnessed a deep subsurface rift opening within Antarctic ice, they have seen similar breakups in the Greenland Ice Sheet—in spots where ocean water has seeped inland along the bedrock and begun to melt the ice from underneath. This study provides the first strong evidence that these large Antarctic ice shelves respond to changes at their ocean edge in a similar way as observed in Greenland.

You can view the full study in *Geophysical Research Letters* here, and read the OSU press release here. Image credit: Seongsu Jeong, Byrd Polar & Climate Research Center.

SES Students Win Awards

Congratulations to Alan Mason (adviser: Derek Sawyer) on receiving an Undergraduate Research Scholarship by the College of Arts and Sciences Honors Program. Alan is a dual major in earth sciences and music education. His research is on the effects of underwater landslides on a sea-floor brine lake in the Orca Basin, Gulf of Mexico using 3D seismic data. Alan recently presented his work at the GSA meeting in Denver. Well done, Alan!

Congratulations to graduate student Rowan McLachlan and undergraduate student Alec Moore (adviser: Andrea Grottoli) on being awarded Sigma Xi grants (see photo at right).

Congratulations to PhD students Amin Amooie who was awarded both an OEE and an Alumni Grant, and Fengyang Xiong, who was also awarded an OEE Research Grant (adviser: Joachim Moortgat).