THE OHIO STATE UNIVERSITY

SCHOOL OF
EARTHSCIENCES

January 2019 News Notes

Alumni Change Lives

Christopher Conwell is a PhD student working with Dr. Matt Saltzman. Here he describes how the Friends of Orton Hall fund helped him complete his graduate studies. If you are interested in giving to support the Friends of Orton Hall or other funds, please visit our giving page (link).

My FOH award in the Fall 2018 semester funded my trip to GSA 2018 in Indianapolis, IN where I gave a talk on the first data from my field sampling in the summer (also supported by FOH funds). The neodymium isotope measurements I presented are at higher resolution and precision than has been achieved on Ordovician rocks, and it was a profound opportunity for me to share this to a crowded room of senior scientists, many of whom wrote the papers that led me to my current work. I maintained relationships with colleagues from across the country, started relationships that could eventually lead to a postdoc fellowship, and reunited with the international community of young Ordovician researchers. I think conferences are one of the most inspiring opportunities available to a young geoscientist—thank you FOH for supporting my journey.

Thank you from the Cryolophosaurus

Once again, we want to thank all of you who donated to the Orton Geological Museum in support of Cryolophsaurus ellioti. Installation of this dinosaur has been a success in many ways from an increase in the number of visitors to recognition of the School across campus and in the community. The Museum has cooperated with Arts & Sciences IT to add augmented reality to the exhibit. First, download the "orton hall ar dinosaur exhibit" onto your iPhone or iPad. Then, either come to Orton Hall or click on the link to Cryolophosaurus on the Orton Geological Museum webpage (link). The three images on the app are triggers for the augmented reality. You can either point your iPhone/iPad to an image on your screen or you can print a pdf. In either event, each image will activate the app; and you can interact with a 3D Cryolophosaurus, see plate tectonic movements from the Jurassic to the present and back, and listen to David Elliot discuss finding the dinosaur.

Cryolophosaurus, Photographed by Jo McCulty

Hypersaline Brine Waves Induced By Submarine Landslides

A new study led by Dr. Derek Sawyer published in *Nature Scientific Reports* describes large-amplitude hypersaline waves that can be generated in seafloor brine pools by the impact forces of submarine landslides.

Subsea hypersaline anoxic brine pools are among the most extreme habitable environments on Earth that offer clues to life on other planets. The hypersaline brine is too salty and anoxic to support all but extremophiles. The anoxic and abiotic conditions lead to outstanding preservation of sedimentary layers and organics, which makes them well-suited for paleoceanographic studies.

However, while brine pools are often assumed to be quiescent and stably stratified environments, this new work describes how the impact forces of underwater landslides can cause significant disturbances of the brine as well as inject mass gravity flows into the sedimentary basin to disrupt the otherwise simple stratigraphy.

This Orca Basin in the Gulf of Mexico hosts one of the largest known brine pools and was discovered in the mid-1970s. Since its discovery, the Orca Basin, has been the site of paleoceanographic, microbiological, geochemical, and coring studies.

In this study, we use geophysical data to document numerous landslide scarps that lie hundreds of meters above the brine pool with debris and blocky deposits lying at the bottom of the brine pool (Figure 1). We then examine the physical waves that would result from slide debris impacting the brine pool. We find waves with amplitudes on the order of 100-200 meters are easily capable, which rival the largest known ocean waves (Figure 2). In addition, the wave heights may exceed the confinement of their basins thereby spreading hypersaline brines to surrounding topographic lows. Hypersaline waves may negatively affect macrofauna. These implications are an important step forward in understanding brine pool environments and the interdisciplinary, diverse science focused on them.

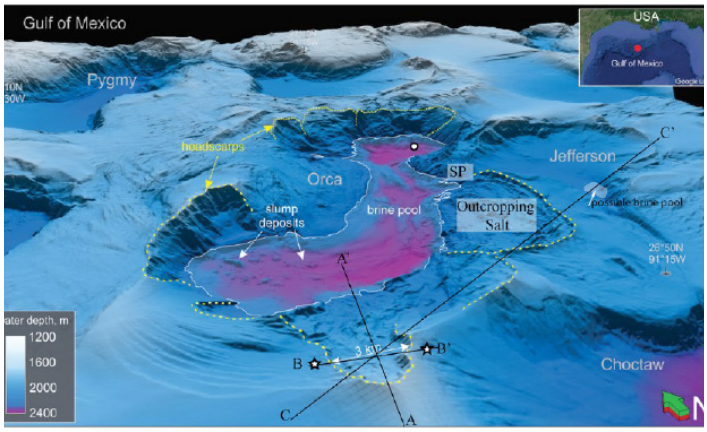


Figure 1. The Orca Basin and surrounding seafloor as seen in a perspective view looking north in the Gulf of Mexico. A hypersaline, axoxic brine pool partially fills the basin. Numerous seafloor scarps occur along the rim of the basin while their deposits lie at the bottom of the brine pool.

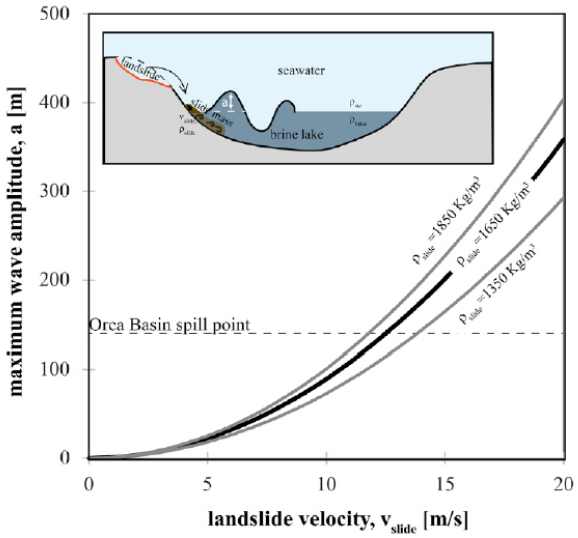


Figure 2. Maximum amplitude of slide-induced brine waves as a function of landslide velocity and density. Wave amplitudes can easily reach over 100 m with a moderately fast 10 m/s landslide.

The open-access article can be accessed here (link). An AGU Eos article has also been published about this article available here (link).

AGU Outstanding Student Presentation Awards

Emma Oti, a PhD Candidate working with Professor Cook, won the American Geophysical Union (AGU) Fall Meeting Outstanding Student Paper Award for her talk: Using X-ray computed tomography to estimate hydrate saturation in sediment cores from Green Canyon 955 Gulf of Mexico. This prestigious award is only granted to the top 5% of student participants at the conference.

(Above) Michalea King, PhD. Candidate and second consecutive OSPA winner

In addition, SES/Byrd Center PhD. candidate Michalea King has won her second consecutive AGU Fall Meeting Outstanding Student Presentation Award for her talk: "Greenland-wide Glacier Response to Runoff and Retreat: Evaluating Outlet Glacier Changes on Monthly to Multi-year Scales" in Washington DC last December. Winning two of these awards in a row is an extremely rare accomplishment.

The third and final OSPA winner was MS student Amelia Nelson, for her poster "Heterogeneity in River-Groundwater Mixing, Microbiology, and Geochemistry in an Alpine Riverbed during Baseflow."

Congratulations to Emma, Michalea, and Amelia!

(Right) Amelia Nelson, MS Student and OSPA Winner

(Above) Emma Oti, PhD Candidate and OSPA Winner

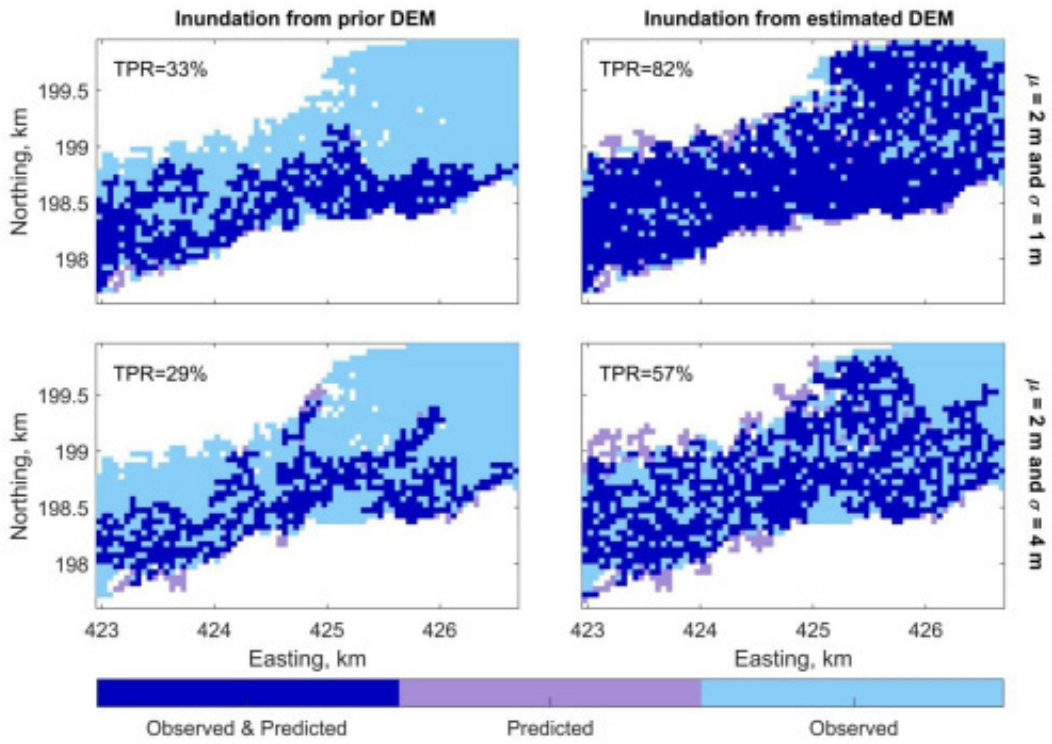
A new idea to improve global flood predictions

Apoorva Shastry (adviser: Michael Durand) has just had a paper accepted in Frontiers. Describing it, she writes:

"According to the World Disasters Report, over 59,000 people were killed with 865 million people directly affected by floods between 2005 and 2014. The economic damages caused by these floods was over 340 billion US dollars. With growing population exposure and climate change, the number of people that are exposed to flood risks, and the frequency and magnitude of floods maybe expected to increase. There is a need for better flood forecasting, and flood inundation models play an important role here. Flood models use topographic data along with other information to predict spatial extents of floods. Quality of topographic data (generally used in the form of digital elevation models, DEMs) is paramount for flood models. Vertical inaccuracies in freely available global DEMs (like SRTM) lead to spatial inconsistencies in predicted flood extents.

In this paper, we propose a new method to infer floodplain topography using remotely sensed flood maps through data assimilation. Satellite derived flood maps provide auxiliary information about ground elevations along the flood boundary. We merge observed flood maps along with flood maps from the model output to estimate the DEM using a particle batch smoother. The synthetic implementation of this algorithm shows that we can significantly reduce bias and standard deviation of errors in the DEM, and use this to better predict flood extents. The algorithm produces promising results, and this type of analysis can be performed in data-poor floodplains where high resolution DEMs do not exist."

This graphic illustrates Apoorva's analysis: numerical simulations using synthetic observations to demonstrate algorithm feasibility. The panels on the left show typical flood inundation skill from existing DEMs: dark blue shows areas successfully predicted by flood models. Panels on the right show improved skill after incorporating flood extent observations. The "true positive rate" (TPR) is significantly improved by the algorithms.



Studies using real observations are underway.

Greendland Ice Loss Acceleration

SES geodesist Michael Bevis and a team of collaborators from the USA, Denmark, Belgium, Holland and Luxembourg recently published an article in which they argued that the Greenland ice sheet crossed a tipping point, in terms of its melting behavior, early in this century. They analyzed the space-time structure of the accelerations in ice mass changes recorded by the GRACE satellite mission and by the Greenland GPS Network (GNET). The main mechanisms of ice loss in ice sheets are glacial discharge and the runoff of melt water during summer. Net glacial discharge was accelerating in Greenland from the late 1990's to about 2006, but the new analysis shows that the main acceleration in mass loss from 2003 to 2013 was centered in SW Greenland, an area almost devoid of large outlet glaciers, and was dominated by melting and runoff. They showed that the amount of runoff was tracking the phase of the North Atlantic Oscillation (NAO), a natural cycle in the pattern of atmospheric circulation in the North Atlantic. This physical behavior was also captured by the regional climate models MAR and RACMO2. The NAO can now nudge the ice sheet into historically unprecedented levels of summertime melting, because global warming has already brought summertime temperatures close to the threshold of large-scale melting. It could not do this during the last century because the baseline summertime temperatures were too low. The implication is that within 20 years or so, continued global warming will lead to major summertime melting in central west and southwest Greenland, even without a major 'assist' from the NAO. During the last century the Greenland ice sheet was remarkably insensitive to global atmospheric warming, but now the ice sheet is very sensitive to it, and to the NAO. There is no going back. This is one of several recent scientific publications suggesting that the impacts of climate change on our ice sheets and on sea level are developing much faster than was widely assumed, even as little as five years ago.

This research was reported by dozens of news outlets worldwide, by climate bloggers, and Bevis was interviewed by the BBC, NBC, CBC, London Talk Radio and an Israeli current affairs program.

ALUMNI SPOTLIGHT

SANDRA PASSCHIER

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WHERE HAS YOUR DEGREE TAKEN YOU?

During my Ph.D. research I spent three seasons in Antarctica. My Post-Doc work in the Netherlands didn't allow for any polar work. I missed the polar work, so I came back to the U.S. for a faculty position at Montclair State University and my previous OSU experience allowed for an opportunity to spend many more seasons working on my favorite subject: Antarctica's ice sheet and climate history!

HOW DID YOUR EXPERIENCE AS AN SES STUDENT PREPARE YOU FOR THE FUTURE?

I was introduced to the polar science community and benefited from the extended professional network of my advisor Peter Webb and many others, Larry Krissek, Terry Wilson, to name a few. The faculty were also very effective role models as teachers and research advisors, and my current success as a teacher and advisor can be entirely attributed to the great examples I had at OSU.

WHAT ARE YOU CURRENTLY WORKING ON?

I am currently preparing for another cruise to Antarctica with the International Ocean Discovery Program planned for January-March 2019. The plan is to drill in the Amundsen Sea off West Antarctica to reconstruct the past dynamics of the ice-sheet under climate conditions that were warmer than present. Follow me @earthmontclair!

> *"Ask many questions and put your efforts into something that you are passionate about. Don't lose hope at any bumps in the road; you will find a way to succeed in the end!"*