THE OHIO STATE UNIVERSITY

SCHOOL OF

EARTHSCIENCES

May 2018 News Notes

Alumni Change Lives

Devin Smith is a graduate student working with Dr. Anne Carey. Here she describes how the Friends of Orton Hall fund helped further her graduate studies. If you are interested in giving to support the Friends of Orton Hall or other funds, please visit our giving page (link).

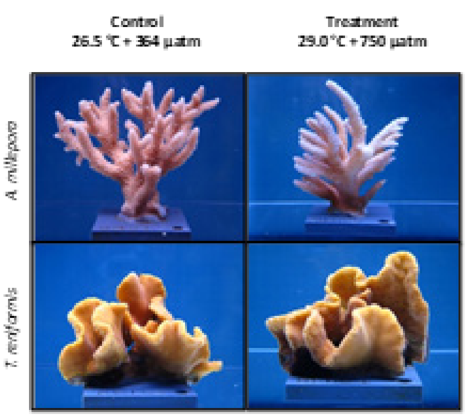
My name is Devin Smith and I am a first-year master's student working with Dr. Anne Carey. My research incorporates hydrology, environmental geochemistry, and soil science to understand small-scale water cycling on an agricultural landscape. With the assistance from the Friends of Orton Hall Fund I attended a workshop titled Field Experiences in Microwave Remote Sensing for Agricultural Hydrology at the University of Florida this past April. This week-long workshop was facilitated by the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI). The course was a combination of lecture, field work, and mathematical modeling. Students from universities around the world came together to learn about active and passive microwave remote sensing technology and to become acquainted with field sampling techniques that support the development of model inputs. At the end of the week students had the opportunity to use skills gained from the workshop to generate model outputs of varying backscatter results based on previously collected data.

In all, this workshop advanced my knowledge of field sampling and introduced me to remote sensing technology and modeling theory. The skills and knowledge that I took away from my week at the University of Florida will support my current research project and generate opportunities for future work. I would like to greatly thank the Friends of Orton Hall for the financial support to attend this workshop.

New Paper from Dr. Andréa Grottoli's Group

Coral with a stable microbiome are also more physiologically resilient and more likely to persist in the future

Rising seawater temperature and ocean acidification – both a product of increases in atmospheric CO_2 – threaten the survival of coral reefs. Coral are symbiotic organisms comprised of an animal host that contain endosymbiotic algae that live inside the animal cells. Corals get food from eating zooplankton and from photosynthetically fixed carbon that is made by the endosymbiotic algae and shared with the host. However when heat stressed, corals expel their algae and turn white; a physiological response known as coral bleaching, which leads to coral starvation, disease, and mortality. As seawater temperatures continue to rise, coral bleaching is increasing in frequency and intensity leading to massive coral losses globally. Ocean acidification can slow or stop coral calcification, which slows reef accretion. It is predicted that around mid-century, reefs may start to dissolve. Like humans, the microbiome associated with corals is thought to play a role in their immune function and ability to cope with stress. Earth Sciences Professors Andréa Grottoli and Michael Wilkins and their teams recently published the first experiment to simultaneously investigate changes in the coral microbiome and coral health in response to the dual stress of elevated seawater temperature and ocean acidification expected by the end of this century in the journal PLoS ONE. Two species of corals, *Acropora millepora* and *Turbinaria reniformis*, were exposed to control (26.5°C and pCO_2 of 364 µatm) and end-of-century mimicking treatment (29.0°C and pCO_2 of 750 µatm) conditions for 24 days, after which they measured the coral microbiome and compared it to the health status of the corals. Overall, dually stressed *A. millepora* bleached, had reduced microbial diversity, experienced increases in disease-associated microbes, and experienced dramatic physiological declines in calcification and algal health (Fig 1). In contrast, the dually stressed coral *T. reniformis* maintained their color, had a stable and more diverse microbiome community with minimal physiological decline, and very high total energy reserves (Fig 1). Thus, the microbiome changed for the worse in the physiologically sensitive coral but not in the physiologically tolerant one. Professors Grottoli and Wilkins results confirm recent findings that temperature-stress tolerant corals have a more stable microbiome, and demonstrate for the first time that this is also the case under the dual stresses of ocean warming and acidification. They propose that coral with a stable microbiome are also more physiologically resilient and thus more likely to persist in the future, shape the coral species diversity of future reef ecosystems, and should be targeted for coral conservation and management.



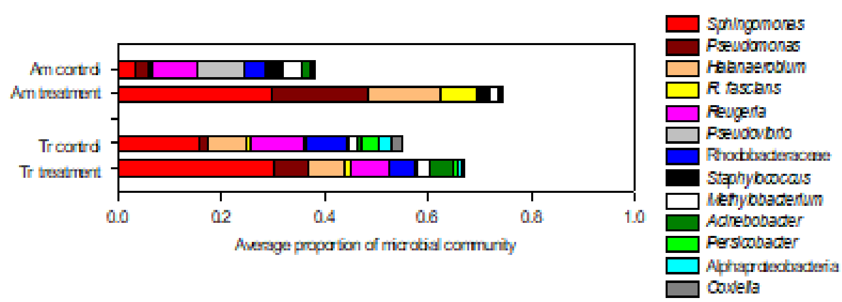


Fig 1: Left) Photographs of representative Acropora millepora and Turbinaria reniformis coral fragments at the end of the 24-day experiment. Note the pale appearance of the treatment A. millepora. Right) Average relative abundance of the nine microbial taxa contributing the most to the dissimilarity between the treatment and control corals. Note the significant increases in the disease-causing microbes Sphingomonas, Pseudomonas, and R. fascians in A. millepora (Am). No statistically significant differences were detected between treatment and control T. reniformis (Tr).

The full article is available with open access at https://doi.org/10.1371/journal.pone.0191156.
Grottoli AG, Dalcin Martins P, Wilkins MJ, Johnston MD, Warner ME, Cai W-J, Melman TF, Hoadley KD, Pettay DT, Levas S, Schoepf V (2018) Coral physiology and microbiome dynamics under combined warming and ocean acidification. PLoS ONE 13(1): e0191156.

Faculty Profile: W. Ashley Griffith

I was born out west and spent my early childhood years split between Colorado, Idaho, California, Ohio, and Australia. Both of my grandfathers worked in the silver mining industry in the Belt Supergroup in northern Idaho, which, looking back, I suppose was foreshadowing. Oddly though, after spending my high school years in North Canton, Ohio, I headed off to college at the College of William and Mary in Williamsburg, Virginia with a clear vision of a history major, law school, and a future in Washington, D.C. Anxious to get my science and math curriculum requirements wrapped up quickly, I tried to sign up for a computer science class my first semester, but it was full, so I ended up stuck in Physical Geology at 8AM MWF. A few dynamic professors and field trips later, I had a BS in Geology.

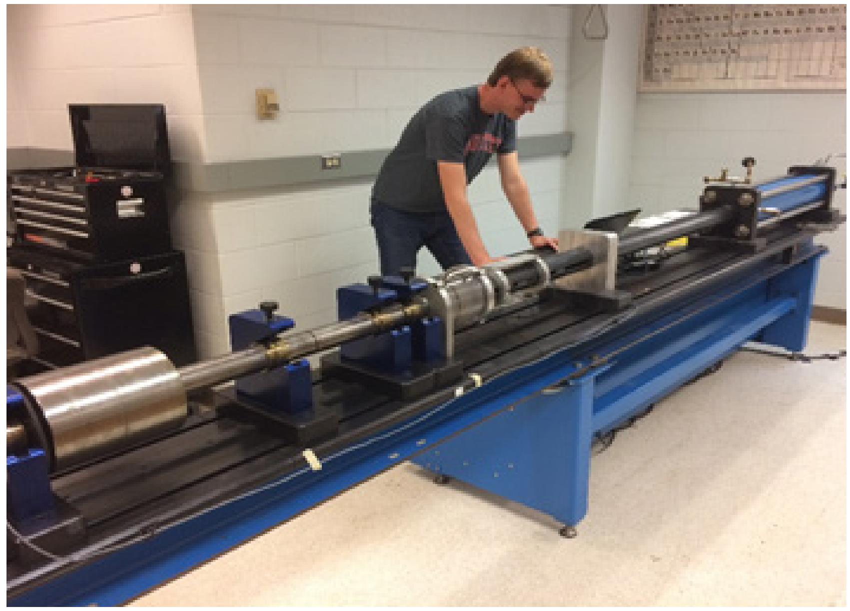
While I loved my major, I didn't really have a good understanding of real world applications of the Earth Sciences by the time I was a senior (this is kind of ironic in and of itself), so I wasn't ready to jump head-first into graduate school. Instead, immediately after college, I spent two years teaching middle school science in Houston, TX, as a Teach for America corps member. It was as a teacher that I finally discovered my inner nerd, and I looked for ways to marry physics, engineering, and geology. I went to the University of Massachusetts Amherst to study earthquake hazards in the Los Angeles Basin through numerical modeling, and soon I was hooked. I went on to Stanford University for my PhD to study structural geology and fracture mechanics, followed by a postdoctoral stint in 2009 studying earthquake mechanics through fieldwork and laboratory experiments at the Istituto Nazionale di Geofisica e Vulcanologia in Rome, Italy. Before coming to Ohio State a year ago, I previously held faculty positions at the University of Akron and the University of Texas at Arlington.

Ashley and collaborator Jose Cembrano investigating a thrust fault near the Planchón-Peteroa stratovolcano compex in the Southern Volcanic Zone, Chile

At OSU, my group is focused on a wide variety of problems ranging from earthquake physics to reservoir geomechanics to large scale crustal deformation and volcano-tectonic hazards. In the very simplest of terms, I am interested in the science of how things break. My students and I employ a variety of tools including old-school structural mapping, 3D mapping using Global Navigation Satellite System technologies and photogrammetry using low-range UAVs, laboratory rock mechanics experiments, and numerical models.

Our laboratory experiments are non-traditional in the world of rock mechanics, as we are focused primarily on simulating rock failure processes in violently extreme environments. We are interested in extremely transient and impulsive deformation processes – processes that occur under large stresses for the upper crust over very short durations (microseconds to milliseconds). Many natural processes that pose significant risk for humans such as earthquakes, rock slides, and bolide impacts occur at rates which are hundreds to thousands of times faster than are typically simulated in the laboratory. Furthermore, the way that humans interact with and modify rocks in mining, tunneling, and military applications (think grinding, controlled explosions, and projectile penetration) similarly happen very rapidly. It turns out that rock responses to applied loads are very rate sensitive, so we have set up a lab that simulates these kinds of conditions. Instead of hydraulically-actuated rams, we load rock specimens with stress waves using a device known as a Split Hopkinson Pressure Bar, and we can monitor deformation in these rapid experiments with electrical strain gauges, acoustic emission sensors, and a camera that takes up to one millions photos per second.

We are using these laboratory experiments to understand how earthquake ruptures damage rocks adjacent to faults and the energy sink this represents in the overall earthquake energy budget. During the experiments we also create microstructures that we compare to those in rocks collected from natural sites in fault damage zones, impact sites, and ancient massive landslides. By integrating laboratory experiments and field observations this allows us to constrain the stresses, strain rates, and mechanical processes that make these processes tick. A couple of field areas we are using as natural laboratories for our experiments include the San Andreas Fault in southern California, the Arbuckle Mountains in Oklahoma, the Markagunt Gravity slide in southwest Utah, and Upheaval Dome in Canyonlands National Park.



Grad student Mike Braunagel setting up an experiment on the Split Hopkinson Pressure Bar apparatus in the OSU Structural Geology & Geomechanics Lab

Outside of the laboratory, we are also working on a project in the Southern Volcanic Zone of Chile, where we are investigating triggering of magma and hydrothermal fluid flow events in the main volcanic arc by subduction zone megathrust earthquakes. This work involves a combination of good-old-fashioned field mapping, large scale geophysical surveys to image the geometry of faults and fluids in the subsurface, and numerical crustal deformation models. Called ***S****tructural and* ***T****ectonic* ***E****volution of* ***A****ndean* ***M****agmatic* ***H****ydrothermal, and* ***E****arthquake* ***A****rchitecture through* ***T****ime (****STEAM HEAT****)*, this is a large ongoing project that involves collaborations with scientists at University College London, and the Pontifical Catholic University of Chile.

We have a very diverse set of exciting projects that are waiting for ambitious students to get involved. I am extremely excited to be at Ohio State, and I am looking forward to continued interactions with the wonderful faculty and talented students here.

ALUMNI SPOTLIGHT

ABE SPRINGER

Professor of Hydrogeology and Ecohydrology, Northern Arizona University; abe.springer@nau.edu

> *Take advantage of all of the opportunities presented to you to learn and grow as a student and a scientist while at OSU.*

WHERE HAS YOUR DEGREE TAKEN YOU?

After finishing my graduate work at OSU, I came directly to NAU and started my faculty career. I served as the Inaugural Director of our School of Earth Sciences and Environmental Sustainability and created our new interdisciplinary Ph.D. program. My research on spring ecosystems and karst hydrogeology, and interests in international research has led me to establish a study abroad course in Bosnia & Herzegovina, Croatia, and Montenegro. Also, this led to a number of years of field research in Western Canada.

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

The many years I spent studying under the mentorship of Dr. Scott Bair and the other hydrogeologists at OSU prepared to not only successfully conduct hydrogeology research as a professor, but also dedicate myself to the education of our graduate students and undergraduate majors.

MOST MEMORABLE EXPERIENCE AS AN SES STUDENT?

Like any geology student, the best memories I hold are of field trips and field work. My fondest memories in particular are of trips to Mammoth Caves, Kelly's Island, and all kinds of groundwater wells and streams around Ohio.

HOW HAVE YOU GIVEN BACK TO OSU?

It was very special to advise another OSU graduate, Elizabeth Schaller Boldt (B.Sc. OSU 2010) on her M.Sc. (2013) thesis at NAU.