Newsletter

Center for

GeoHazards Studies

Spring 2018

Letter from the Director

The Center for Geohazards Studies (CGS) continues work towards its mission of nucleating and facilitating interdisciplinary research and training related to natural disasters. One of the ways we do this is by providing competitive grants to UB graduate students to support their research on natural hazards. Last year, awardees included Zachary Younger, who characterized a lava flow in the western USA and was able to determine many parameters related to its eruption and emplacement, and Scott Borchardt, who is studying a "super-eruption" from the Valles caldera (New Mexico) with a particular focus on the initial processes associated with deadly pyroclastic flows. Short summaries of their fieldwork are included in this newsletter.

Another way we support our mission is through sponsoring/co-sponsoring, and organizing workshops and conferences related to natural hazards. We are very excited about two events that will be taking place this summer of 2018. First, the International Glaciological Society 2018 Symposium, for which CGS is a cosponsor, will bring together the world's top researchers on glaciers and ice sheets. At first glance, this may not seem like a natural hazard in the same way that, for example, an earthquake or volcanic eruption might be considered, since glaciers are relatively slow moving. The link lies in climate change, which is raising concern that accelerated melting of ice sheets and glaciers will contribute to rising sea levels, which in turn result in catastrophic storm surges and flooding in heavily populated coastal areas. This workshop follows on last year's CGS-cosponsored International Arctic Workshop. The Center for Geohazards Studies is expanding its links to climate change-related hazards, as part of its overall focus on resilience and sustainability of human populations in the face of disasters.

The second event this summer is Multidisciplinary Volcano Hazards Experiments at the Geohazards Field Station. This workshop is funded by the National Science Foundation, and organized by the Center for Geohazards Studies. It is aimed at promoting the development of a community-driven, shared-infrastructure approach to experiments on volcanic processes. The four-day workshop will feature a series of experiments using sequences of timed, buried explosives that will generate shock waves, debris clouds, and ejecta similar to what might occur at a volcanic eruption. To date, about 40 researchers and students from around the world have registered to participate.

Information on the Glaciological Society Symposium and on the experimental volcanology workshop can be found at:

http://geohazards.buffalo.edu/conferences-and-workshops/igs-2018

Finally, development of the Geohazards Field Station continues. Ingo Sonder conducted a series of experiments at the "Magma Shack" before winter set in, and observed important behaviors caused by interaction of magma with liquid water (see photo on next page). These experiments are resuming now. In addition, we'll be conducting experiments on the formation of pyroclastic flows during the coming months. Pyroclastic flows are devastating, rapid gas-particle flows that occur during explosive eruptions, and improving our understanding is key to mitigating associated hazards.

As always, we welcome new ideas and can provide assistance in developing new, interdisciplinary projects and proposals. Please do not hesitate to contact me if there is something along these lines that you would like to pursue.

Have a nice summer! - Greg Valentine, Director

Special points of interest:

STUDENTS:

Interested in becoming more involved?

E-mail Kailey DiemKaye at kaileydi@buffalo.edu to learn about the student committee.

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The Center for Geohazards is jointy sponsored at UB by the College of Arts and Sciences and by the School of Engineering and Applied Sciences.

Geohazards Field Station



What happens when you mix liquid water into molten magma? Boom! This snapshot shows an experimental eruption produced during one of Dr. Ingo Sonder's experiments at the Geohazards Field Station. The metal box holds about 25 liters of magma (molten rock) at a temperature of about 1300 °C. Water is injected into the magma via portals near the bottom of one of the sidewalls. Rapid boiling and expansion drive ejection of magma out of the box in a way that is similar to many volcanic eruptions. Understanding these processes will greatly aid in forecast-ing conditions that might lead to explosions at populated volcanoes.

Research Update: Geotechnical Lab and Earthquake Engineering

Dr. Anthony Tessari, Assistant Professor

Civil, Structural, and Environmental Engineering Department

Earthquakes release significant energy through seismic waves, which travel through the earth and interact with the built environment. The response of infrastructure to seismic events depends on the interaction between the naturally-occurring soils and the engineered foundation superstructure system. Laboratory testing of soil-foundation-structure interaction (SFSI) has proven to be challenging and expensive. Small-scale (1:50 to 1:70) testing employing geotechnical centrifuges is limited by scale effects and an inability to control dynamic properties of the structure(s). Much larger scale testing is possible with 1D geotechnical laminar boxes at a small number of laboratories worldwide. Deployment and operation of such boxes is complex.

Hybrid simulation offers an added valuable dimension to SFSI testing and is unique to the SEESL facility at the University at Buffalo. The soil-foundation-structure system is partitioned into (a) a physical subsystem: an experimental component representing the soil and foundation, and (b) a virtual subsystem: a computer model of the superstructure, interacting in real-time via actuators, sensors and control systems. Key benefits are (a) foundation models can be tested with multiple virtual superstructures; (b) physical space requirements and costs are reduced; and (c) larger foundation models can be accommodated, minimizing scaling effects. These benefits substantially expand the utility of geotechnical laminar box experiments. Recent proof-of-concept tests were performed to demonstrate viability of SFSI hybrid simulation, and present measurements that (i) elucidate the role of superstructure dynamics in foundation response, and (ii) can be used to validating computational SFSI models. The physical subsystem is a 10-ft deep pile-group foundation model in a 23-ft laminar box filled with saturated sand. One dimensional seismic excitation was applied at the base of the laminar box to represent bedrock input at depth. Interface conditions representative of different superstructures were applied to the foundation using a second shake table.



Student Research Award Recipient - Scott Borchardt

Basal deposits of the upper Bandelier Tuff ignimbrite, New Mexico

Large, explosive volcanic eruptions are generally thought to have two main phases. First, an initial Plinian phase produces a buoyant eruption column that ascends several kilometers into the atmosphere and distributes widespread, well-sorted fall deposits. After some time, the column becomes unstable and collapses, producing ground-hugging pyroclastic density currents (PDCs) that deposit thick ignimbrites. At many eruptions sites, these ignimbrites are underlain by a basal layer that is stratigraphically distinct from the fall unit below and the ignimbrite above it. This layer marks the transition between the two main phases of the eruption and can be studied to provide insight into the processes occurring at that point in time.

During the summer of 2017, I conducted a detailed field study of this type of basal layer associated with the upper Bandelier Tuff ignimbrite in northern New Mexico. This included stratigraphic and sedimentological characterization of 26 outcrops at various locations around the eruption source, Valles Caldera, as well as sampling of the basal layer and overlying ignimbrite. The goal was to use the stratigraphic characteristics, granulometry and componentry of the layer to shed light on the eruptive, transport and depositional processes that led to its emplacement. Thanks to support from the Center for Geohazards Studies Student Research Award, I was also able to examine additional deposit characteristics, including major and trace element geochemistry and ash morphology.

Data analysis and interpretations are ongoing, but initial results indicate that the basal layer was likely produced under similar eruptive conditions as the overlying ignimbrite and its stratigraphic characteristics may have been influenced by the preexisting local topography. The final results will be compiled into my master's thesis and prepared for journal publication.



Photo of Scott Borchardt at Bandelier Tuff, New Mexico

Student Research Award Recipient - Zachary Younger

Basaltic 'a'ā lava field emplacement of the intraplate Marcath volcano from field and LiDAR data



Photo of Zachary Younger taken while standing on Marcath's rubbly lava field.

Monogenetic volcanoes – which erupt once before going extinct – are often found within monogenetic volcanic fields, some of which are found near major populations around the world and are still considered active today. And despite how common these types of volcanoes are, they are poorly understood, especially in regards to their lava field emplacement, which is highly relevant to volcanic risk assessment for nearby communities. The Marcath volcano - an intraplate, monogenetic volcano in central Nevada that erupted ~35,000 years ago provides an excellent opportunity to analyze and interpret basaltic lava field emplacement for these poorly understood systems because slow erosive processes have left its lavas well-preserved.

For this project, I analyzed and interpreted the Marcath lava field in terms of: surface morphology, rafted pieces of the volcanic cone that were broken off during the eruption and ultimately deposited on the lava field, and lava parameters such as total volume, effusion rate, emplacement duration, and flow viscosity. My work shows the how lava surface features can be used to reconstruct complex flow histories, as well as the potential for rafts to greatly affect lava emplacement.

Though I mainly used high-resolution Li-DAR (Light Detection and Ranging) data, a six-day field campaign that was partly funded by the Center for Geohazards Studies made this work possible. With field assistance from Dr. Greg Valentine, Dr. Tracy Gregg, and Scott Borchardt, I was able to investigate small-scale lava features that were unclear or not visible in LiDAR imagery, as well as correlate rafted cone fragments to LiDAR data in order to thoroughly map their sizes and distributions. I am thankful to the Center for Geohazards Studies for supporting my field work that proved to be crucial to this project.

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Upcoming events:

WORKSHOP ANNOUNCEMENT: MULTIDISCIPLINARY VOLCANO HAZARDS FIELD-SCALE EXPERIMENTS, 24-27 JULY 2018, BUFFALO, NEW YORK

The U.S. National Academy of Sciences' Committee on Improving Understanding of Volcanic Eruptions recent report (*Volcanic Eruptions and Their Repose, Unrest, Precursors, and Tim-ing, www.nap.edu/24650*) highlighted the need to develop a community-driven, shared-infrastructure user facility for large-scale, multidisciplinary experiments on volcano processes. The University at Buffalo, with support from the National Science Foundation, has established a Geohazards Field Station to help meet this need. The field station comprises an open area of several acres with supporting infrastructure.

An open workshop will be held at the field station on 24-27 July 2018. The workshop will include a day of experiments related to explosive eruptions. Preliminary plans call for four experiments, each carefully timed and spaced sequences of buried chemical explosives, generating blast waves, debris-laden jets and plumes, small-scale density currents, and resulting craters and ejecta deposits. Participants are encouraged to participate in data collection using any approach. This could include, for example: high-speed video, acoustic sensors, seismic sensors, thermal infrared video, Doppler radar, ejecta and fall-out sampling, and photogrammetry to establish quantitative morphology of explosion products. Preliminary schedule for the workshop:

 \cdot Day 1 – afternoon presentations and discussions by participants on data collection techniques to be deployed and potential integration of the techniques.

- · Day 2 setup at the field station.
- · Day 3 four experiments

 \cdot Day 4 – data archiving for shared access, working session where participants present and discuss data from the experiments and future directions for multidisciplinary experimentation, and begin development of a report on the workshop.

Participation is open to any interested researcher. There is no registration fee, however, *registration is required* (<u>http://geohazards.buffalo.edu/conferences-and-workshops/</u>). **Registration deadline is 23 May 2018**. Limited funds are available to offset travel expenses for graduate students and postdoctoral researchers (Please indicate whether you are requesting funds when you register; a more detailed request for information will be provided to requesters at a later date.). Participants will be responsible for their own travel and lodging arrangements (the hosts will provide guidance at a later date).

Hosts: Greg Valentine, Ingo Sonder (University at Buffalo)

Scientific Committee: Ben Andrews (Smithsonian Institution) Costanza Bonadonna (Université de Genève) Joe Dufek (Georgia Tech) Breg Waite (Michigan Technological University)

This workshop is sponsored by the U.S. National Science Foundation.





The Center for Geohazards Studies and the Department of Geology are honored to host the International Glaciological Society (IGS) 2018 Symposium. The event will take place the Hotel Lafayette in Buffalo, New York on 3-8 June, 2018.

The Arctic Workshop is known for fostering a relaxed and student-friendly atmosphere where professionals, graduate and undergraduate students can network and present their latest research. We are proud to announce that registration for student presenters is free this year, and registration for non-presenting students is at a discounted price. The Center for Geohazards Studies and the Department of Geology look forward to welcoming an esteemed group of climate and research scientists from around the world to the University at Buffalo!

For additional information and the conference schedule please refer to our website:

http://geohazards.buffalo.edu/conferences-and-workshops/igs-2018

The Center for GeoHazards Studies

Have changes to your employment, research interests, or contact information? Let us know at <u>geohaz@buffalo.edu.</u>

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GeoHazards Studies

The **Center for GeoHazards Studies** seeks to decrease harmful societal effects of natural phenomena such as volcanic eruptions, landslides, mudflows, and avalanches through research, service, and education. Our team of scientists and engineers works together with social scientists, urban planners and public health researchers to evaluate the broader harmful impact of hazardous natural phenomena. One of our principal goals is to integrate analyses of various hazards with predictions of their effects on human infrastructure and ecosystems in order to evaluate approaches that could lead to a reduction of injury and death. Hazards that are affected or triggered by changes in climate are included within the Center's scope.

Special thanks to:

Advisory Committee Members:

Amjad Aref, Civil, Structural and Environmental Engineering Marcus Bursik, Geology Department Estelle Chaussard, Geology Department Beata Csatho, Department of Geology Amit Goyal, Research and Economic Development Abani Patra, Mechanical And Aerospace Engineering Bruce Pitman, Materials, Design and Innovation Chris Renschler, Geography Department Michael Sheridan, Geology Department Ingo Sonder, Center for Geohazards Studies Janet Yang, Communications Department Jun Zhuang, Industrial and System Engineering

> Student Representative: Kailey DiemKaye, Geology Department

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Send your research updates to Barb Catalano (bac6@buffalo.edu) to be included in the next newsletter or eblast!

Center for GeoHazards Studies