

2021 Near Surface Research Award Winner

Stephen Slivicki, Boise State University

Bio

During my undergraduate at University of Wisconsin-River Falls, I had the pleasure of having a few different summer internship experiences before graduating with a Bachelor of Science in geology in 2020. The first research internship was at the Lunar Planetary Institute, where I conducted geochemical research on the hydrothermally altered impact melts from the Chicxulub crater. The following year I would shift my focus from geochemistry to geophysics having been accepted as a summer intern for the Incorporated Research Institutions for Seismology (IRIS). I worked at Boise State University (BSU) that summer assisting in a multi-channel analysis of surface waves (MASW) for data that was gathered in the Seattle area. The concluding fall semester I spent abroad in Italy at the University of Bologna as an undergraduate research assistant assisting with gravity and horizontal-to-vertical spectral ratio (HVSR) surveys in Bolzano and HVSR and MASW surveys in Irpinia. After I graduated in the spring of 2020, the following fall semester I became a graduate student at BSU where I am currently pursuing my Masters in geophysics.

My current research here at BSU involves examining the Crystal Geyser in southeast Utah and the CO₂ charged aquifers the geyser draws from. I am interested in using time lapse active source seismics to understand the cycling of CO₂ content in the reservoirs as the Crystal Geyser progresses through its eruption cycles. Time lapse active source is the ideal tool for tackling this problem since the seismic properties of the reservoir rock should change through time as the gas content changes. In addition to the time-lapse component of this research, a deployed 200 seismic nodal array captures passive signals in the area. I will also be studying this data set to determine if there are passive signals associated with the geyser eruptions or the phase change of CO₂ from supercritical to gas phase as it migrates from depth.

Abstract

Time-lapse active source seismic response of natural CO₂ gas migration through a shallow reservoir

I propose to monitor natural CO₂ gas migration within shallow reservoirs near the Little Grand Wash fault in east-central Utah using time-lapse active source surface seismic data. CO₂-charged eruptions from the Crystal Geyser, and CO₂ flux measurements along a two-km length of the fault, show near-continuous outgassing from three or more shallow and independent sandstone reservoirs. Previous pressure, temperature, and microbial borehole studies suggest each reservoir produces a unique set of eruption characteristics, with cycles that repeat every

two to four days. The presumed source reservoirs range from 100 to 600 m depth, and large impedance reservoir boundaries have been seismically imaged in high resolution. Results from a 12-hour pilot study show multi-hour-scale amplitude and travel time changes of first arrival and reflection signals through portions of a geyser eruption cycle. I hypothesize that the first arrival travel time differences resulted from changes in water table elevation within the fault zone. These water elevation changes are likely driven by hydrostatic pressure changes. Furthermore, I hypothesize that reflection amplitude changes at reservoir depths have resulted from migrating CO₂. I suggest that these amplitude changes will influence different reflectors as gas migrates through different reservoirs. Integrated with pressure and temperature measurements in the nearby boreholes, I propose a 6-day active source time-lapse field campaign to deploy geophones across the Little Grand Wash fault to systematically test these hypotheses. This field campaign can be carried out with a small field crew and equipment housed at Boise State University.



Stephen J. Slivicki

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RESEARCH INTERESTS

Primary: Geophysics, reflection/refraction seismology, MASW, HVSr, Carbon sequestration and gas fluid substitution.

Secondary: Geochemistry, Petrology, Impact structure mineralogy

EDUCATION

Masters of Geophysics, Boise State University	2020-present
Bachelors of Geology, University of Wisconsin-River Falls	2013-2020
Welding certification program, Wisconsin Indianhead Technical College	2010-2011
High school degree, River Falls High school	2006-2010

Programming Languages and Software

Matlab – semi proficient
Linux Based Seismic Unix
MS Office Suite - Excel, Word, PowerPoint
Adobe suite - Illustrator, After Effects, Distiller, Media Encoder\
ArcGIS

PROFESSIONAL HISTORY

Undergraduate Research Assistant, University of Bologna, Italy **Fall 2019**

- Field work: Gravity and HVSr surveys in Bolzano Italy and Seismic station geophysical characterization using MASW and HVSr in southern Italy.
- Learned to use Grilla and Soil Spy Software to process HVSr and MASW Measurements respectively.

IRIS Research Intern, Boise State University, ID. **Summer 2019**

- Research topic: Mapping Seattle area site response using MASW
- Fieldwork: Utah, Colorado and Seattle using resistivity and active seismic arrays
- Learned basic MATLAB scripting and file processing in addition to the use of SurfSeis for Vs30 inversion and to create figures for publication.

Research Intern, Lunar Planetary Institute Houston, TX **Summer 2018**

- Research topic: Chicxulub impact crater melt alteration mineralogy
- Trained in the use of SEM and electron microprobe at Johnson Space Center
- Extensive use of excel to create geochemical ternary diagrams and calculate mineral percentages

Teaching Assistant, UWRF Department of Plant and Earth Science **Sept 2018- May 2019**

- Subjects: Structural geology, petrology, Introduction to geophysics

Geology Intern, Superior Silica Sands in Barro, WI **Summer 2017**

- Enter data from sieve analysis into Excel to calculate ore and waste percentages.
- Preparing sand sample mixtures for crush analysis and performing initial crush test.
- Measuring groundwater depth, purging wells, collecting groundwater samples for analysis.

Academic Success Center Tutor, UWRF Academic Success Center **Sept 2017-May 2019**

- Subjects: Intro geology, Structural geology, Global change, Geophysics, Mineralogy, Petrology.

Backup Shift Lead for Fabrication Department, Trinity Meyer Utility Structures **2015-2016**

- Assisting employees in addressing manufacturing process issues (repair).
- Training new employees how to do different jobs in the department and provide ongoing training.
- Organize and prioritize employee work assignments based on workflow requirements
- Promote “Safety First” and “Team Player” attitudes in the workplace.
- Team leader of “Kaizen” process improvement that resulted in increased efficiency and safety in Long Seam workstation.

Long Seam Operator/ Fabrication Department, Trinity Meyer Utility Structures
2013-2016

- Operating controlled cutting operations via a plasma arc process.
- Running specialized equipment for welding steel with submerged arc process, and hand assembly of large Utility structures.
- Shifting workload to different cells to maintain schedule adherence with minimal downtime and ensuring throughput.
- Communicate effectively with other employees in the department, and across departments, to facilitate optimal workflow.
- Operating several different types of cranes and rigging methods to move large loads.

Circumference Welder, Thomas and Betts (*Business Sold to Trinity Meyer Utility Structures*) **2011-2013**

- Attaching base plates to base of utility structures
- Perform full penetration weld around the circumference to combine structure sections and baseplates.
- Utilizing manlifts & cranes to perform welding work on > 10FT diameter power structures.
- Reading Blueprints and coordinate logistics for material flow of parts to work cell.
- Imperial to metric conversions for accurate fabrication of parts and assemblies.
- Maintain safety standards for working at increased elevations.

RESEARCH

Petrologic Analysis of Green-Black Impact Melt Breccia with a History of Hydrothermal Alteration at Chicxulub. Poster presentation at LPSC 2019.

Seismic characterization of the Seattle fault deformation front: hazard implications for downtown Seattle, Washington. Upcoming poster presentation at AGU 2019

HONORS / AWARDS

UWRF Dean's list 2016-2020

MEMBERSHIPS / AFFILIATIONS

American Geophysical Union Member 2019

University of Wisconsin River Falls Geologic Society Treasurer 2016- Spring 2019

2014-2015 Tabletop Gaming Club President

2010-2011 WITC Welding club Secretary