Forty-Seventh Annual

Geoscience Day

Program and Abstracts

April 30, 2021

Indiana University of Pennsylvania
Geoscience Department

Program Schedule

10:15 Opening Remarks by Dr. Nick Deardorff

Introduction of Junior Proposal Presentations by Dr. Katie Farnsworth

10:20 Susie Adams

10:30 Christian Vizza

10:40 Caleb Cramer

10:50 Eric Reynolds

- Break -

11:10 Billy Cartwright

11:20 Molly Rabon

11:30 Gavin Vashie

- Break -

11:55 Introduction of Senior Research Presentations by Dr. Karen Rose Cercone

12:00 Garrett Strittmatter
Scotia Sea Diatoms in Relation to Climate During the Last Glacial Maximum

12:20 Jordan Kulak
Understanding Deep-Sea Sediment Property Methods and Error

12:40 Lauren Donati
Rapid Exhumation of the Taiwan Central Range: Constraints from Plastic-brittle Structures from the Mugua River

- Break -

1:10 Featured Alumni Speaker:
Gerry Hatcher ‘83 and Jonathan Warrick, USGS Santa Cruz Pacific Coastal and Marine Science Center

Rapid Exhumation of the Taiwan Central Range: Constraints from Plastic-brittle Structures from the Mugua River

Lauren Donati

Taiwan records some of the highest late Cenozoic exhumation rates in the world as a result of the collision between the Luzon volcanic arc and the passive margin of Eurasia. To understand how such rapid exhumation is accommodated, we focus on late-stage plastic and early brittle structure in an unfolded unit tentatively assigned to the Tailuko belt within the eastern Central Range.

Our goal is to document these plastic to brittle structures in an attempt to provide three dimensional geometric and kinematic constraints on the rapid exhumation of Taiwan's Eastern Central Range. We specifically focus on the youngest metamorphic fabric in these outcrops, documented as S3, syn-kinematic veins, and crosscutting well-developed joint sets. We suggest that veins document the bridge between the plastic and brittle regime, as mm-scale veins are locally cut by S3, while others cross-cut the outcrop. We suggest that S3, as the youngest plastic structure, records the most variation in geometry and reflecting post-S3 brittle processes. In typical field view the relationships between these fabrics are distorted by mm- to m-scale folding, but the unique outcrop we focus on is well preserved between two greenstone units and shows no folding at these scales. In the area surrounding this outcrop, veins are subparallel to joints striking NW-SW and dipping nearly vertically. S3 shows some variation in orientation, but is overall rather consistent striking NW-SE and shallowly dipping toward the NE.

This outcrop tentatively mapped within the Tailuko belt provides a preserved unfolded perspective of S3, the last-stage of plastic deformation during exhumation. Thus, the late-stage plastic and early brittle structures from the Mugua river outcrop provides helpful, relatively simple, constraints on the geometry and kinematics constraints of this region during exhumation.

Understanding Deep-Sea Sediment Property Methods and Error

Jordan Kulak

The composition of deep-sea sediments can provide valuable information to help understand the past climate and oceanographic environments. In this project, we report on the use of Gamma Ray Attenuation (GRA) as a proxy measure of the bulk sedimentary calcium carbonate percentage, an important indicator of biological productivity and chemical dissolution associated with in the CO2 content of deep-water masses. GRA is a quick and non-destructive measurement routinely logged on sediment cores. We have measurements with 1cm spacing, thus GRA data has the potential to provide a very high-resolution record of carbonate content. Bulk GRA data varies with the density (composition) of sediments, but it also varies with physical factors of the sediments associated with porosity and compaction. Here we compare %CaCO3 measurements determined by experimental methods and microscopic visual analysis to create comparisons with %CaCO3 predicted from GRA data to create better understanding of the relationship between bulk density and the carbonate content of a deep-sea sediment samples.

Estimates of carbonate content in marine sediments can be made by visual analysis using a microscope, but these results are susceptible to human error and generally less accurate than most other methods. Bulk carbonate content can also be measured using a calibrated volume CO2 released during the reaction of the sediment sample with hydrochloric acid but is a time-consuming process and destructive to the sediment.

We attempt to utilize GRA bulk density to predict % carbonate in a deep-sea sediment core KN223-10LC2 recovered from the western flank of the Mid Atlantic Ridge (latitude, longitude, water depth). Offsets between the measured and GRA-predicted carbonate % represent error that can be explained, in part, by the type of microfossil composition found in individual samples; ratio of coccolithophores to foraminifera. The error decreases with an increasing microfossil ratio, suggesting that samples with a more equal ratio of microfossils have a greater margin of error in predicted results. There is also an error associated with low amount of compaction in the upper portion of sediment core. The upper portion of the core has not been well compacted, leaving ample pore space that results in a lower GRA-derived bulk density.

Future work in investigating the error between predicted and experimental properties of deep-sea samples should involve more microscope visual analyses and sieving of samples to count the composition of foraminifera and non-carbonates in the sediment samples. A larger dataset of microscope visual analyses would allow for better correlations, and the sieving of samples would allow for future studies to have a more accurate understanding of how the foraminifera affects the density, carbonate percentage, and other sediment properties. Further studies on samples should also analyze the non-carbonate components for the ratios of clay, silt, volcanic glass, or silicate. The amount of latent salt and its error on sediment properties can also be researched in further studies.

Scotia Sea Diatoms in Relation to Climate During the Last Glacial Maximum

Garrett Strittmatter

The Scotia Sea is rich in diatoms that, by collecting sediment cores, allow us to analyze climate variability over time. Diatoms are primary producers that readily fossilize, making them useful in climate studies. Sediment samples were taken from the core retrieved from IODP Site U1537, representing the last ~30,000 years. The samples were then made into slides that were viewed under an oil immersion microscope, identifying species along with counting the overall density of the diatoms in the sediment.

An inverse correlation of the Absolute Diatom Abundance with the benthic oxygen □ stack, as well as some species groups was observed, implying increased productivity in cold water. This is the opposite of what would be expected of productivity, which is typically higher in warmer water in the Southern Ocean. This temperature/productivity relationship, as well as species data, can help us understand more about the climate and ecological setting of the Scotia Sea and change to the location of the polar front. The previously stated inverse correlation allow us to further our understanding of climate, how that relates to diatom production, and how Southern Ocean climate along the polar front reacts in relation to global change.

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