Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.13235

Linking Volcanic And Hydrothermal Systems along 150 kilometers of Southern East Pacific Rise crest by AUV Sentry photo, water-column and sonar data

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Simultaneous collection of seafloor photos and high-frequency side-scan sonar, augmented by temperature, salinity, optical backscatter and redox-potential data in the water column, bridges previous gaps in spatial resolution and extent of seafloor mapping to reveal new correlations in geological features, biological communities, and hydrothermal venting. The spacing and distribution of both high and low temperature hydrothermal venting is fundamental to understanding the hydrothermal input to the oceans, the seafloor spreading volcanic system, and our understanding the ridge crest environments as ecological systems. During the October-November 2021 PLUME RAIDERS expedition, we used AUV Sentry to conduct one of the most extensive and detailed surveys ever conducted to characterize both diffuse and focused hydrothermal discharge along the Southern East Pacific Rise from ~16.5°-18°S. Sentry was programmed to fly photo runs at ~15m altitude above seafloor to maximize side-scan swath width and photo field-of-view and collected hydrothermal data of abundance and type not previously ever seen. This 150-km long transect crosses ridge-axis terrain of increasing magma budget (broader axial high) from north to south, and a major ridge axis offset stepping the ridge left by ~1 km. In order to process and interpret the large number of photographs, we trained a machine-learning algorithm in PyTorch to classify the photos for identification of hydrothermal features. These are mapped onto the side-scan records, along with locations of hydrothermal plumes from the CTD and MAPRs, in GIS software. The collection of continuous, co-georeferenced photographs with high-frequency side-scan and near-bottom water column data allows us to compare local processes at regional (km) down to visual (cm) scales for 150 km length of ridge.