Geologic mapping reveals structural limitations on hydrothermal vent locations

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Multi-beam echo-sounding and bathymetric mapping have greatly enhanced our image of the seafloor; however, the typical resolution of ship-based bathymetry data is too low to locate hydrothermal vent sites. Exploration for active and inactive vent sites therefore remains time consuming and cost intensive.

Slow- to intermediate-spreading mid-ocean ridges host the majority of known vent sites and show highly variable seafloor morphologies. We have developed a classification scheme for the geological interpretation of bathymetry data, allowing us to create geological maps of the seafloor at segment-scales for the first time. These maps provide geological context so that the controls on hydrothermal venting at known sites can be determined. This includes analysis of nearby volcanic features and structural lineament analyses. These maps can also be used to narrow exploration targets for undiscovered active and inactive deposits. Additional uses include: spatial and temporal analysis of mid-ocean ridge accretion mechanisms, habitat mapping, and application of comprehensive datasets, such as petrology, or magnetic data to understand submarine magmatic and volcanic processes.

In this study, we present regional geological maps along sections of the slow-spreading Mid-Atlantic Ridge (MAR) that also have been investigated for hydrothermal activity. Preliminary results show a distinct pattern in the regional fault density, where venting is associated to segment-centered axial highs. This pattern is absent at axial highs without indications for hydrothermal activity.