Developing novel remote-predictive geological mapping approaches to guide exploration for inactive seafloor massive sulfide deposits

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More than 300 high-temperature metal-rich hydrothermal vent sites (aka seafloor massive sulfide deposits) have been discovered in different tectonic settings, including mid-ocean ridge spreading centers, volcanic arcs, and back-arc basins. Exploration for these deposits relies on water-column surveys to detect hydrothermal plumes. These actively-venting sites are associated with unique chemosynthetic ecosystems that should be protected from seafloor mining, yet there are few tools available in the search for *inactive* sites that have lower environmental risk.

On land, a critical exploration tool is a geological map. We are developing the framework for novel remote-predictive geological mapping of the seafloor at a regional scale based primarily on interpretations of ship-based multibeam echosounder data. We compare independently-generated maps in one area in order to test the repeatability of the mapping and the bias of the researchers. We further compare maps generated from back-arc spreading centers [1] (e.g., Mariana back-arc [1]) and mid-ocean ridges (e.g., Menez Gwen, MAR [2]) in order to investigate the adapability of this approach to different tectonic settings.

Our findings indicate that there is a high degree of variability on a small scale, but this variability decreases significantly at larger scales. Furthermore, we find that the mapped units in different tectonic settings are remarkably similar, giving us confidence that this approach can be leveraged to generate remote-predicted geological maps of the entire seafloor. Importantly, our results are shedding light on the relationships between regional geodynamics, magmatism, and hydrothermal venting in each of these areas. New exploration targets for inactive deposits are being generated from this information.

[1] Anderson, et al. (2017), *Geochem Geophys Geosys* 18, 2240–2274.

[2] Klischies, et al. (2019), *Mar Geol* 412, 107–122.