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# $^{238}U$-$^{230}Th$-$^{226}Ra$ dating of Seafloor Hydrothermal Deposits

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Seafloor hydrothermal vent deposits form on timescales of minutes to thousands of years, are products of significant heat and mass transfer from the lithosphere to the oceans, and form in conjunction with activity that supports significant microbial and animal communities in the deep-sea, away from the photic zone. Understanding timescales over which the deposits form, whether they form continuously or episodically, and identifying relationships of age with geologic features (e.g., faults, fissures, lava flows, distance from neovolcanic axis) can provide important information both about energy and mass transfer and feedback within the ocean crust and lithosphere, and about environments, energy, and nutrient sources for hydrothermal biological communities. Uranium series chronometers are widely applied to age dating these deposits. However, there are unresolved questions about the accuracy of the dates of older material, and the assumptions (e.g., of closed system behavior) made when calculating the dates using single proxies.

In this study, we test the assumptions made in previous age dating of hydrothermal deposits by examining $^{238}U$, $^{230}Th$, and $^{226}Ra$. Samples were taken from the TAG, Lau Basin, and PACMANUS relict hydrothermal fields located across mid-ocean ridge and back-arc basin tectonic settings. To further investigate the extent of open system behavior, we examine U-series isotopes in co-precipitated anhydrite and pyrite from massive anhydrite and anhydrite vein samples. Additional radioisotopes, Sr and Pb, were measured to interpret water-rock interaction and identify the sources of hydrothermal fluids.

Our results demonstrate that U-series isotopes can remain in a closed system regardless of precipitation in anhydrite or pyrite; multiple proxies can evaluate if samples have met the necessary assumptions for application; result in concordant ages; and episodic formation of seafloor hydrothermal vent deposits. Water-rock interaction does not appear to vary across tectonic settings indicated by Sr isotopes reflecting a seawater origin whereas Pb isotopes are sourced from rock. Pb isotopes reveal hydrothermal fluids in each field studied interact solely with the basaltic substrate.