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Is the Rainbow ultramafic hydrothermal system a poor source of radium isotopes to the Atlantic Ocean?

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Hydrothermal plumes play an important role in marine geochemical budgets as sources and sinks for elements in the deep ocean. While percolating through the oceanic crust, the hydrothermal fluid is enriched in a range of trace metals (TMs), gases and radionuclides before rising from the vent chimney and mixing with the overlying seawater. The Rainbow hydrothermal vent field (36°13.80’ N, 33°54.14’ W) comprises at least 13 black smokers and forms one of the most prominent and persistent metal-enriched natural plumes on the Mid-Atlantic-Ridge (MAR). We investigated the distribution and fate of hydrothermally-derived radionuclides (^{223}Ra, ^{224}Ra, ^{226}Ra, ^{228}Ra, and ^{210}Pb) in seawater and deep-sea sediments at increasing distances from the Rainbow vent sites (100 m to 60 km) and estimated hydrothermal and sedimentary fluxes to elucidate TM distributions. Ra isotopes have been applied to study the vertical and horizontal dispersion of hydrothermal plumes, and elevated Ra activities have been observed in the vicinity of hydrothermal vents on the MAR. However, in this study, Ra isotopes were probably scavenged in the first 100 m beyond the vent site, or the Rainbow vent fluid is not Ra-enriched. No short-lived Ra (^{223}Ra and ^{224}Ra) activities were detected, and background seawater activities of ^{226}Ra were observed along the plume. Radium-226 profiles in sediment cores were analysed to investigate how vent signals are imprinted on sediments accumulating with distance from the vent site, but the hydrothermal influence is only seen at the closest station to the vent. Porewater data will be analysed to better understand the Ra sedimentary and water column distributions. Our results, therefore, may shed light on the role of hydrothermal vent activities as a source of Ra and its budget in the oceans.