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Distinctive vanadium isotope compositions in seamount-hosted hydrothermal 'FeOx' deposits

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Hydrothermal venting of Fe-rich fluids into oxygenated oceans produces widespread seafloor deposits enriched in Fe oxides, hydroxides, and oxyhydroxides, (FeOx). These deposits provide archives of biogeochemically significant Fe export and can also effectively scavenge other seawater- and hydrothermal fluid-derived trace species. Scavenging of V onto FeOX at hydrothermal vents impacts the marine mass balance of this redox-sensitive element and is well understood in the plumes of high temperature black smokers [1–3]. FeOX deposits from the TAG Mound and the Southern EPR feature small V isotopic fractionations relative to seawater V compared to non-hydrothermal oxide sediments[4]. This makes hydrothermal deposits an important and distinctive lever on the marine V isotope mass balance that underpins paleoredox reconstructions and means that V isotopes could track hydrothermal plume contributions to open marine sediments [4]. FeOX deposits are also widespread at seamount-hosted low temperature hydrothermal vents, but the V isotopic ratio ($\delta^{51}V$) of these deposits is unexplored [5–7]. We conducted the first $\delta^{51}V$ analyses of seamount-hosted hydrothermal FeOx, from the young Fani Maoré submarine volcano in the Indian Ocean. Among diverse lithological types, we find that these seamount-derived FeOx materials have an identical $\delta^{51}V$ range to previously analyzed high temperature deposits that precipitated above black smokers. This suggests a uniform and distinct mechanism associated with the hydrothermal precipitation of FeOx. Despite their similar $\delta^{51}V$, overall V and P uptake into low temperature FeOx deposits is less than observed in high temperature vent plumes. Our results to date indicate that marine V isotope mass balance models can continue simplifying the impact of hydrothermal sinks with one uniform fractionation. Furthermore, $\delta^{51}V$ can potentially trace hydrothermal Fe particle export to marine sediments from diverse vent sources.

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