Pb Isotope Evidence for a Small but Detectable Escape of MORB Pb into the East Pacific Rise Hydrothermal Plume

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Most of the Pb in today's ocean is from human activities, but natural sources contribute small amounts of Pb that are usually masked by the massive anthropogenic input. It has been known from the study of hydrothermal solutions and sediments that there is a fairly large Pb flux from ridge crests, but most of this Pb is precipitated near the hydrothermal vents and very little if any Pb escapes into the water column. In the US GEOTRACES GP-16 East Pacific Zonal Transect (EPZT) at 10°-16°S, the hydrothermal ferromanganese oxides actually strip anthropogenic Pb from out of the water column, resulting in the lowest Pb concentrations ever observed in the ocean (a few tenths of a picomole/kilogram). So the helium-3, manganese, and iron enriched plume shows extremely low [Pb] with no indication of Pb enrichment from hydrothermal activity.

However, as known from previous studies at other sites, coretop sediments from this section show clear evidence of MORB Pb that is distinct from the crustal and anthropogenic Pb seen in non-ridge crest sediments, specifically, low values of $^{206}Pb/^{207}Pb$ (1.189), $^{208}Pb/^{207}Pb$ (2.449), and $^{206}Pb/^{204}Pb$ (18.42), compared to ~1.195, ~2.475, and ~18.75 for the non-hydrothermal sediments. Near bottom dissolved (<0.2 μm) water column Pb (with concentrations <2 pmol/kg) at the ridge crest and in the near-downstream neutrally-buoyant hydrothermal plume show $^{206}Pb/^{207}Pb$, $^{208}Pb/^{207}Pb$, and $^{206}Pb/^{204}Pb$ ratios that are lower than observed throughout the water column and fall within the mixing end-member isotope ratios of MORB and anthropogenic Pb sources. At westernmost station 36, which shows continuation of the helium-3, manganese, and iron plume from 2200m downwards, the >2200m Pb isotope ratios return to the non-hydrothermal ratios hence having no remaining detectable MORB Pb.