Cadmium and lead isotopes in high temperature hydrothermal vents on the Mid-Atlantic Ridge

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Deep-sea hydrothermal vents act as sources, as well as significant sinks, for trace metals in the oceans. Vents are also important ecological niches, and a possible setting for the ”cradle of life“ on the early Earth. Recent Cd isotope studies indicate that Cd depletion in O_2-deficient zones may be caused by Cd sulphide precipitation [1] and, further, that hydrothermal sulphides are isotopically ”light“ in Cd [2].

We report the first Cd and Pb isotope data on high temperature hydrothermal fluids collected on the Mid-Atlantic Ridge, at water depths of ~3000 m, from the ultramafic-hosted Logatchev field (350°C) at 14°45′N [3] and the young volcanic systems Turtle Pits (407°C) and Sisters Peak (>400°C) fields at 5°S [4].

The stable Cd isotopic compositions, expressed as $\varepsilon^{112/110}$Cd relative to NIST SRM-3108, range from +2.4 in the diffuse fluid to lighter values of -0.49 in the hot fluids, with corresponding Cd contents of 0.36 and 29 nmoles/kg, respectively. This negative correlation reflects mixing between Atlantic deep waters (~+2.4) and a fractionated "light" Cd pool (~0) represented by the oceanic crust. Pb isotopic compositions span a large range, overlapping those of Atlantic MORB, with the most radiogenic compositions found in the Logatchev and least radiogenic in the Sisters Peak fluids. These results show that hydrothermal vents have little impact on the modern oceanic mass balance of Cd and Pb which are removed efficiently near the vents in sulphide precipitates. The significance of hydrothermal sources for the trace metal budget of Cd and Pb might have been, however, different in the Early Precambrian oceans.

[1] Janssen *et al*. (2014) *Proc. Nat. Acad. Sci.* **111**, 6888-6893. [2] Schmitt *et al*. (2009) *Earth Planet. Sci. Lett.* **277**, 262-272.[3] Schmidt *et al*. (2007) *Chem. Geol*. **242**, 1-21. [4] Koschinsky *et al*. (2008) *Geology* **36**, 615-618.