## 3.4.26

# Submarine hydrothermal trace metal input into the ocean through island arc volcanism in the Lesser Antilles

B. GEORG[1], M. FRANK[1], H. MARBLER[2], A. KOSCHINSKY[2,3], T. VAN DE FLIERDT[1,4], V. BOLZ[1], P.W. KUBIK[5] AND P. HALBACH[2]

[1] Institute for Isotope Geology and Mineral Resources, ETH Zürich, 8092 Zürich, Switzerland (frank@erdw.ethz.ch)
[2] FU Berlin, FB Geowissenschaften, 12249 Berlin, Germany
[3] now at: International University of Bremen, Geosciences and Astrophysics, 28725 Bremen, Germany
[4] now at: Lamont-Doherty Earth Observatory of Columbia University; Palisades, NY 10964, U.S.A.
[5] Paul Scherrer Institute, c/o Institute for Particle Physics, ETH Zürich, 8093 Zürich, Switzerland

High temperature hydrothermal fluids have been invoked as important sources for the global oceanic budgets of trace metals such as Sr, whereas for other metals such as Nd or Pb this source has been considered unimportant. There is, however, considerable uncertainty about the potential importance of low temperature hydrothermal fluids, which are abundant at off-axis locations. There is also evidence that submarine hydrothermal inputs linked to volcanism at island arcs and seamounts may play an important role. We have tried to tackle this issue by analysing the radiogenic isotope compositions of Sr, Os, Nd, Pb, and Hf on leached subsamples of sediment-hosted hydrothermal ferromanganese encrustations from the vicinity of the island of Montserrat in the Lesser Antilles island arc. There is elemental and mineralogical evidence that these samples, collected during RV Sonne cruise 154 from water depths between 600 and 900 m depth, precipitated from relatively low temparature fluids. Attempts to date the partly visible growth layers in one of the crusts using $^{10}Be/^{9}Be$ profiles yielded a maximum age of 6 million years but it is likely that the precipitates are significantly younger than that. The two main crusts analysed have been overgrown by a thin layer of hydrogenetic ferromanganese crust over the most recent few 100 kyr. For all radiogenic isotope systems including Be isotopes this layer gives the expected isotope composition for ambient seawater. The hydrothermally dominated layers of the crust exhibit large variations of the isotope compositions of Nd, Sr, Hf, and Os which cover the entire range between the composition of seawater and that of the island arc rocks. Mixing calculations confirm predominantly binary mixtures between these two endmembers with hydrothermal contributions of up to 30% in the case of Sr, up to 45% for Nd and up to 100% for Hf. This is particularly noteworthy for Nd which generally does not show hydrothermal contributions in crusts precipitating at high-temperature sites. Our data indicate that low temperature hydrothermal fluids may be an important contributor to ocean trace metal budgets.

## 3.4.27

# Tracing the history of submarine hydrothermal inputs using Pb isotopes from ferromanganese crusts

T. VAN DE FLIERDT[1,2], M. FRANK[2], A.N. HALLIDAY[2], B. HATTENDORF[3], D. GÜNTHER[3], P.W. KUBIK[4] AND J.R. HEIN[5]

[1] now at: Lamont-Doherty Earth Observatory of Columbia University; 61 Route 9W, Palisades, NY10964, U.S.A. (tina@ldeo.columbia.edu)
[2] Institute for Isotope Geology and Mineral Resources, ETH Zürich, Sonneggstr. 5, 8092 Zürich, Switzerland
[3] Laboratory of Inorganic Chemistry, ETH Zürich
[4] Institute for Particle Physices, ETH Zürich
[5] U.S. Geological Survey, Menlo Park, CA 94025, U.S.A.

Submarine hydrothermal vent fluids typically exhibit compositions distinct from that of seawater for a large range of elements. When vent fluids mix with ambient seawater, a significant fraction of the dissolved metals precipitate instantaneously as sulfides. Other hydrothermal particles, mainly Fe oxyhydroxides are transported within the hydrothermal plume and Mn oxyhydroxides are transported even farther. Such dispersion can extend up to 2000 km from the ridge crest. Hydrothermal vent fields are, however, dynamic, commonly relatively short-lived, and venting waxes and wanes at any one site over time.

In order to investigate the hydrothermal history of the extinct Galapagos Rise in the Eastern Equatorial Pacific, we analyzed Pb, Nd and Hf isotope time-series from a ferromanganese crust recovered from the Bauer Basin (D22-3, 4435-4212 m water depth). Main and trace element concentrations reveal a mixed hydrothermal-hydrogenetic origin. An age model was obtained by combining $^{10}Be/^{9}Be$ data and Co-constant flux modelling. Continuous time-series for Pb, Nd and Hf isotopes were measured at high precision using a Nu Plasma MC-ICP-MS.

Secular variations in the Pb isotope composition provide clear evidence for changes in hydrothermal contributions during the past 7 Myr. The nearby Galapagos Rise spreading centre provided a strong hydrothermal flux prior to 6.5 Ma. After 6.5 Ma, the Pb became stepwise more radiogenic and more like Pacific seawater, reflecting the westward shift of spreading to the presently active East Pacific Rise. A second, previously unrecognized enhanced hydrothermal period occurred between 4.4 and 2.9 Ma, which reflects either off-axis hydrothermal activity in Bauer Basin or a late-stage pulse of hydrothermal Pb from the then active, but waning Galapagos Rise spreading.

Neodymium and Hf isotope time-series of the same crust show typical seawater values, clearly indicating that hydrothermal Hf, similar to Nd, does not travel far from submarine vents. Therefore hydrothermal Hf fluxes do not contribute significantly to the global marine Hf budget.