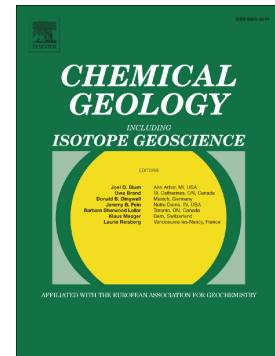


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Processes affecting the isotopic composition of dissolved iron in hydrothermal plumes: A case study from the Vanuatu back-arc

Philipp Nasemann^{1,2*}, Melanie Gault-Ringold^{1,2,5}, Claudine H. Stirling^{1,2,4}, Andrea Koschinsky³, Sylvia G. Sander^{1,4}

¹ Department of Chemistry, University of Otago, Union Place West, Dunedin 9054, New Zealand

² Centre for Trace Element Analysis, University of Otago, Union Place West, Dunedin 9054, New Zealand

³ Jacobs University Bremen, Department of Physics and Earth Sciences, Campus Ring 1, 28759 Bremen, Germany

⁴ NIWA/University of Otago Research Centre for Oceanography, University of Otago, Union Place West, Dunedin 9054, New Zealand

⁵ Now at: Antarctic Climate & Ecosystems Cooperative Research Centre (ACE CRC), University of Tasmania, 20 Castray Esplanade, Hobart 7000, Australia

*Corresponding author:

Email: philipp_nasemann@web.de

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Abstract

Hydrothermal discharge is one of multiple Fe sources contributing to the marine dissolved Fe budget, but its relative importance remains controversial and largely unconstrained. Isotopic characterization of Fe sources and mass balance calculations are considered as a potential tool to unravel the complex interplay of various Fe fluxes, but require a more profound knowledge of the processes that fractionate Fe isotopes in hydrothermal plumes. We present dissolved Fe isotope data from two buoyant plumes and profiles traversing the non-buoyant plume above the Nifonea vent field in the Vanuatu back-arc. Our findings support opposing controls from precipitation of Fe-sulfides and Fe-oxyhydroxides that either enrich the heavy or the light isotopes within the residual dissolved Fe fraction, but also suggest significant influence from size partitioning of oxidized Fe following precipitation as well as potential effects from organic complexation. At low aggregation of precipitated Fe-oxyhydroxides or stabilization of significant Fe(III)_{aq} dissolved $\delta^{56}\text{Fe}$ is only marginally affected by Fe(II) oxidation, which strengthens the role of Fe-sulfide precipitation during early plume rise in determining the isotope signature of hydrothermal Fe exported to the open ocean. Dissolved $\delta^{56}\text{Fe}$ range from $-0.73 \pm 0.05\text{‰}$ to $-0.16 \pm 0.05\text{‰}$, and suggest that sulfide-rich basalt-hosted hydrothermal systems and slow oxidation kinetics in the Pacific favor export of stabilized dissolved Fe with heavier $\delta^{56}\text{Fe}$ values than the true vent fluids ($\delta^{56}\text{Fe}$ of $\sim -0.5\text{‰}$).

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