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Supersaturated metal contents in hydrothermal fluids of the Northern Volcanic Zone, Iceland: Implication for element transport in the crust.

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Hydrothermal fluids are the principal agent of element transport, segregation, and concentration in the crust, and play a major role in ore formation. The transporting capacity of these fluids, and selectivity therein, is thought to be controlled by their physico-chemical properties including temperature, pH and Eh, and the abundances of solvating ligands. Experimental and computational methods have built an understanding of the aqueous species that solvate elements at varying conditions. The resulting data of species' stability constants permits forward modelling of the transporting capacity of fluids and is a key tool to understand element mobility in the crust. However, recent studies have indicated that mobilisation of elements is not exclusively as dissolved aqueous species, but can also take place by colloids (*e.g.* Au[1,2] and Si[3]). Moreover, there is mounting evidence that precipitation of minerals from fluids involves clustering of elements into nanoparticles[4], and that these nanoparticles are an intermediary in mineral dissolution. Neither colloids nor nanoparticles are generally accounted for when calculating element concentrations in equilibrium thermodynamic modelling of fluids. This implies that we potentially significantly underestimate the transporting capacity of hydrothermal fluids.

Here, we present data on the metal contents in deep fluids from basalt-hosted hydrothermal reservoirs in northern Iceland. The sampled fluids are ≤290°C, near-neutral pH, and Cl-poor. Their major constituents, pH and Eh are buffered by the reservoir rocks' secondary mineralogy, whereas the trace elemental signature indicates a strong magma degassing contribution[5]. These well-constrained fluids place tight limits on element saturation concentrations, and show that a number of metals exceed their saturation level. This can reflect metastability or the presence of non-dissolved constituents, but in either case indicates that these fluids transport a higher element load than would be predicted from mineral solubility modelling. We will discuss the implications of this finding for crustal element transport and ore formation.

1. McLeish et al. (2021) PNAS 118:e2100689118.
2. Hannington et al. (2016) Nat. Geosci. 9:299–302.
3. Williamson et al. (1997) Contrib. Mineral. Petrol. 127:119-128.
4. Putnis and Ruiz-Agudo (2021) Chem. Geol. 586:120614.
5. Saby et al. (2022) Sci. Rep. 12:21952.