Slab-derived halogens and noble gases with a marine pore-fluid signature

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Subduction volcanism is generally considered to form a 'subduction barrier' that efficiently recycles volatile components contained in subducted slabs back to the Earth's surface. Nevertheless, subduction of sediment and seawater-dominated pore fluids to the deep mantle has been proposed to account for the non-radiogenic elemental abundance and isotopic pattern of heavy noble gases (Ar, Kr, Xe) in the convecting mantle [1]. To verify whether and how subduction fluids preserve a seawater signature, we determined noble gas and halogen compositions of the exhumed mantle wedge peridotite and eclogite from the subduction-related Sanbagawa metamorphic belt, southwestern Japan, in which relicts of slab-derived water are contained as hydrous mineral inclusions or aqueous fluid inclusions.

The observed noble gas and halogen compositions of the peridotite [2] and eclogite samples shows striking similarites with marine pore fluids, challenging a popular concept that the water flux into the mantle wedge occurs only by hydrous minerals in altered oceanic crust and sediment. These results indicate that subduction and closed system retention of marine pore fluid occurs to depths of at least 100 km, necessitating a reassessment of the dominant transport mechanism and source of water in subduction zones. Further subduction of a small amount of marine pore fluid can account for the heavy noble gas composition observed in the convecting mantle.

[1] Holland & Ballentine (2006) *Nature* **441**, 186–191.
[2] Sumino *et al*. (2010) *EPSL* **294**, 163–172.

Temperature controls of sulphur isotope fractionation during sulphate reduction by *Thermodesulfobacterium* and *Desulfovibrio* strains

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Sulphate reducers are known to fractionate sulphur isotopes during dissimilatory sulphate reduction. Unravelling the factors controlling the fractionation pattern would be essential to identify the contribution of each enzymatic pathway at the cellular level, interpret the isotopic signatures in geological materials, and track the sulphur cycling in natural occurrences. This study examined the sulphur isotope fractionation patterns catalyzed by a thermophilic *Thermodesulfobacterium*-related strain and a mesophilic *Desulfovibrio gigas* over wide temperature ranges.

The *Thermodesulfobacterium*-related strain grew between 34 and 85 °C with an optimal temperature at 72 °C and the highest cell-specific sulphate reduction rate at 68 °C. The isotope fractionation ($\varepsilon^{34}S_{\text{sulphate-sulphide}}$) ranged between 9.1 and 25.7 ‰ over temperatures ranging from 51 to 77 °C. The fractionations remained at high levels for the growth above 55 °C and decreased significantly for the growth at 51 °C. The *D. gigas* grew between 10 and 45 °C with an optimal temperature at 36 °C and high cell-specific sulphate reduction rates between 30 and 36 °C. The isotope fractionation ranged between 8.5 and 52.0 ‰ over temperatures ranging from 19 to 39 °C and peaked at 24 °C. The relationships between the fractionation and temperature for two strains in this study in part resembled those previously reported for *Archaeoglobus*-related strains but distinct from those for *D. desulfuricans*, *T. indicus* and *Desulfobacterium autotrophicum*, suggesting that the isotope fractionation is controlled by the complex combinations of contribution from individual pathways. Measurements of multiple isotopes are warranted to reconcile the modelled uncertainty.