Distributions of halogen (Br, Cl, I) and boron isotopes in submarine hydrothermal fluids from Milos island (Greece)

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Abstract

Hydrothermal fluids collected from a shallow submarine region at Aegean island of Milos, Greece, were used for analyses of major and minor ions, halogen (Br, Cl and I) and boron, as well as boron isotopes to study fluid origin and geochemical processes.

Two types of hydrothermal vents were classified, namely “cave” type and “submarine” type. The cave fluids discharged through the rock fissures closed above sea level, associated with very low pH values and low halogen and boron concentrations. The latter fluids characterized by relatively high concentrations of halogen (about 2-3 times) and boron, and showed wide ranges of chemical compositions. The endmember values of $\delta^{11}B$ in brines showed extremely negative (～-3 to -35‰), magmatic origin probably reflected (Fig. 1). The enrichment of halogen and boron in brine seepages can be attributed to dissolution of calc-alkaline minerals or decomposition of organic matters thorough thermal interaction. The Br/Cl ratio decreased with increasing chloride concentration in the brines (Fig. 2). Our preliminary results suggest halogen, boron and $\delta^{11}B$ in cave fluids are mixtures of local groundwater and ambient seawaters. In contrast, submarine fluids were mainly influenced by an admixing of brine seeps and seawaters.

Key words: hydrothermal, halogen, boron, isotopic boron, Milos

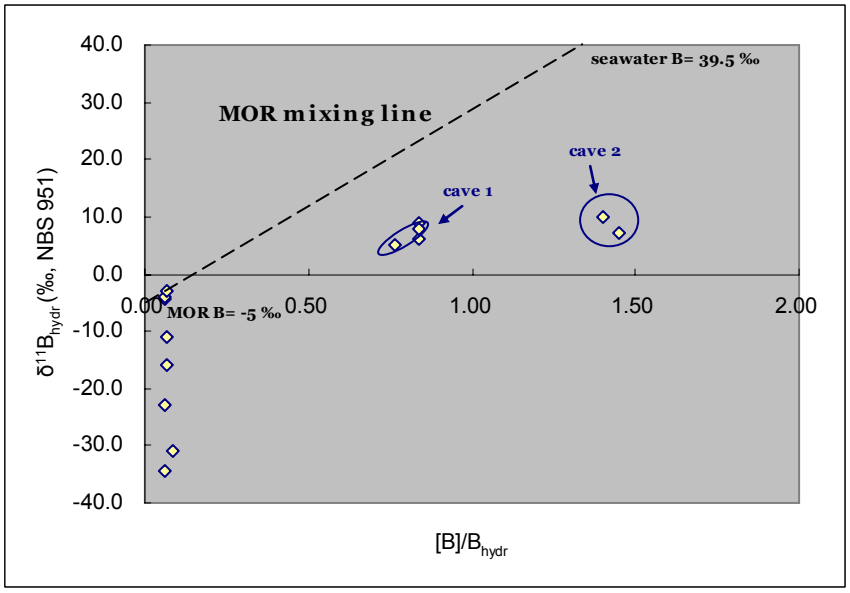

Figure 1. Endmember of $\delta^{11}B_{hydr}$ plotted against $[B]/B_{hydr}$. The $\delta^{11}B_{hydr}$ and B_{hydr} is endmember values of isotopic and element boron in pure hydrothermal vent fluids (assuming Mg= 0 mM) were estimated by extrapolation, respectively. [B] is average boron concentration in seawater (～0.42 mM). The MOR mixing line presents hydrothermal fluids mixing in mid-ocean ridge systems (MOR).

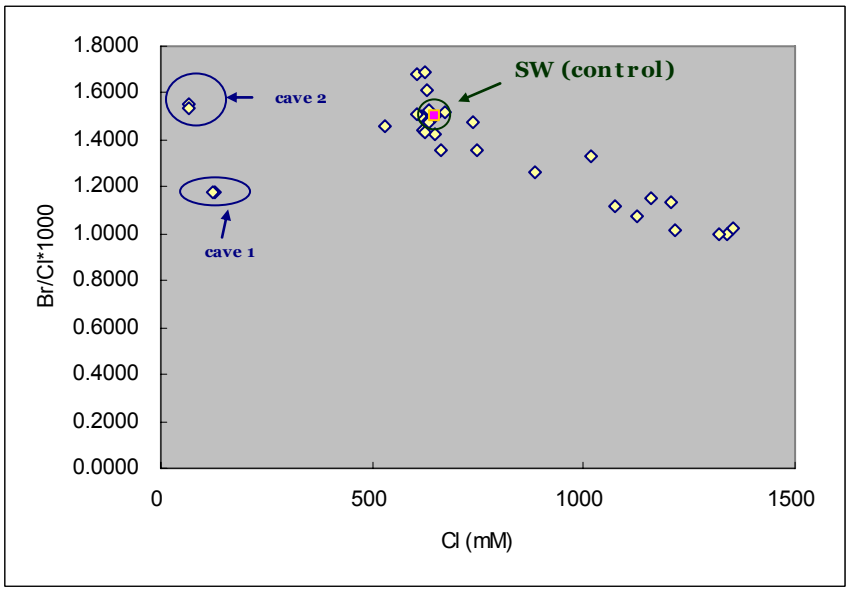

Figure 2. The bromide and chloride ratio (×1000) plotted against concentration of chloride in hydrothermal fluids. The lower ratio values in cave 1 solutions indicated the mixture of low salinity fluids (local groundwater) during alteration or outcrop. The other submarine solutions show strong increasing chloride relative to bromide, inferred the influence of brine seeps. The square means average measured seawater values.