Boron isotope as tracer for seawater pH reconstruction and submarine hydrothermal circulation

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Here I present case study by using boron isotope, to demonstrate potential of boron isotopic investigation.
1) Seawater pH reconstruction from coral record
Ocean acidification caused by anthropogenically elevated CO_2 concentration in the atmosphere can pose a critical threat to calcifying marine organisms and coral reef ecosystems. However, because of temporally and spatially limited instrumental pH records, little is known about the actual long-term trend and natural variability of seawater pH during the past century. We present an annually resolved time series of a pH proxy record for 1940–1999 using boron-isotope composition ($\delta^{11}B$) in a modern massive Porites coral from Guam Island (NW Pacific). When superimposed onto interannualvariability, the data show a slightly decreasing trend of ~0.39‰ (equivalent to ~0.05–0.08 pH units for surface water pH) in the northwestern tropical Pacific since the mid-20th century (Shinjo et al., 2013).
2) Submarine hydrothermal circulation: interstitial water B isotope profile
Many active hydrothermal venting fields have been discovered at the spreading axes of the Okinawa Trough, a nascent back-arc basin. In order to explore sub-seafloor extent of hydrothermal fluid circulation, boron isotopic compositions of interstitial water (IW) of drilled core sediments by the D/V CHIKYU were analyzed. While IW at the reference site have $\delta^{11}B$ similar to seawater ~70 m below sea floor (mbsf), IW from active venting site and site at 200 m far from venting site show depth profile lowering $\delta^{11}B$ at deeper than ~40 mbsf. Low $\delta^{11}B$ values are approaching to those of venting fluids on $\delta^{11}B$ vs $1/B$ diagram, implying hydrothermal fluid extension to far from the venting site. These results confirm that boron isotope of IW is a powerful tracer for exploration of hydrothermal activity at young rift or back-arc basin system (Ishibashi et al., 2017).

Keywords: boron isotope, ocean acidification, submarine hydrothermal ore deposits

