Boron isotope fractionation during transportation of sea-salt particle

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Boron isotope ratio (δ^{11}B: $[(^{11}B/^{10}B)_{sample} / (^{11}B/^{10}B)_{NIST951} - 1]\times1000$) has been expected to be an atmospheric circulation tracer (e.g. Sakata et al., 2013). In previous studies, B isotope fractionation during transportation has not been considered, but the fractionation may occur in atmosphere due to the presence of gaseous and particulate B (Fogg and Duce, 1985). Therefore, clarification of the B isotope fractionation mechanism is essential to use δ^{11}B as the tracer. Firstly, B isotope fractionation mechanism in sea-salt is discussed here, because seawater (δ^{11}B: +39.5‰) is the largest soruce of atmospheric B.

Size-fractionated aerosols were collected at Hiroshima, Japan. Marine total suspended particulate (TSP) and size-fractionated aerosols were collected on the *R/V Hakuho-Maru* cruises of KH-12-4 (the North Pacific Ocean) and KH-13-4 leg. 4 (the Bay of Bengal), respectively. Boron isotope ratio was measured by MC-ICP-MS after chemical separation.

Enrichment factor (EF), which is normalized by B/Na ratio in seawater, suggests that B in marine and continental coase aerosols were derived from seawater rather than crustal and antropogenic materials. The δ^{11}B values in marine aerosols (+37‰-+44‰) increased in the order of < coarse aerosols < seawater < TSP < fine aerosols. In Hiroshima, δ^{11}B values in coarse aerosols were from +15 to +20‰, which was different from that of seawater. It is considered that differences of δ^{11}B were caused by B isotope fractionation because source of B in these aerosols is seawater. In seawater, there are two B species, $B(OH)_3$ and $B(OH)_4^-$. $B(OH)_3$, which has high δ^{11}B (+40‰), and prefenentially vaporizes compared to $B(OH)_4^-$ (+20‰). This idea is reasonable to explain high δ^{11}B in finer aerosols, which is formed by gas condensation. Isotope fractionation is also caused by coprecipitation of $B(OH)_4^-$ in sea-salt. It is known that $B(OH)_4^-$ prefenetially coprecipitates in evaporite, which typically has δ^{11}B values around +20‰, comparable to δ^{11}B in the coarse aerosols at Hiroshima. Thus, B isotope fractionations are caused by vaporization of $B(OH)_3$ and coprecipitation of $B(OH)_4^-$ during atmospheric transportation.