Multiscale boron isotope mapping of serpentinite from the Osayama Serpentinite Mélange, SW Japan

Chinatsu Yamada[1], *Tatsuki Tsujimori[1], Kazumasa Aoki[2], Qing Chang[3], Jun-Ichi Kimura[3]

1. Tohoku University, 2. Okayama University of Science, 3. JAMSTEC

Based on the boron isotope characteristics, Yamada et al. (2019a) [doi: 10.1016/j.lithos.2019.02.004] discriminated serpentinites in the Franciscan Complex of northern California into two groups. Serpentinites associated with blueschist- and/or eclogite-facies metamorphic rocks showed lower δ^{11}B value (−12 to +8.8‰) than blueschist-absent serpentinites (+7.2 to +24.4‰; mostly higher than +10‰). Yamada et al. (2019b) [doi: 10.2465/jmps.190726] also showed boron isotope difference of antigorite serpentinites among two different metamorphic units of the Itoigawa–Omi area; they found that low δ^{11}B (< +10‰) serpentinite in blueschist- and eclogite-bearing unit can be distinguished from high δ^{11}B (> +10‰) serpentinite in the amphibolite-facies unit. Recently, we also confirm same low-δ^{11}B feature in a clinohumite-bearing HP serpentinite from the Sambagawa Belt. These observations indicate that HP serpentinites were affected by forearc slab fluids with lighter boron isotope signature at deeper depths, being consistent with geochemical modeling. In order to evaluate the origin of serpentinite in a blueschist-bearing serpentinite matrix, we applied the isoscape approach for serpentinite exposures on a 1:5000 scale map of the Osayama Serpentinite Mélange (OSM) in the Chugoku Mountains, SW Japan. Based on the boron isotope characteristics, we could map the distribution of two distinct serpentinite units within the OSM.

The OSM serpentinites show only small chemical variations of relict Cr-spinel and no mappable systematics of those, excepting for sporadic occurrences of Na-bearing tremolite and Zn-rich metasomatic chromite rims. However, based on 219 spot isotope analysis of 39 samples, we were able to map the distribution of two groups of serpentinites. Overall, OSM serpentinites show a wide range of B concentration (9 to 913 μg/g; mostly > ~100 μg/g). The world-first boron isoscape in serpentinites revealed the distribution of lenticular antigorite-bearing serpentinite blocks with high-δ^{11}B (> +10‰) within low-δ^{11}B (< +10‰) matrix serpentinites. In-situ trace element characterization also supports the presence of two distinct serpentinites in OSM. The trace-element geochemistry found a positive correlation between W and B; the correlation among W/Th and Ba/W ratios suggest an inference of sediments-derived fluids. Moreover enrichment of As and Sb in the low-δ^{11}B serpentinite suggests an infiltration of As- and Sb-rich fluids from subducting sediments at blueschist-facies depth where sulfide breakdown occurs. We have also evaluated effects of contact metamorphism by granitic intrusions for boron isotope. The effect is not extreme in the isotope changes, but in the contact aureole, our data suggests that deserpentinization reactions release boron and cause a small decrease of δ^{11}B. Our isoscape approach represent an alternative and effective new method to constraint and map serpentinite mélange complexes.

Keywords: serpentinite, boron isotope, blueschist-facies metamorphism, serpentinite mélange, isotope mapping

