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Chemical and textural characteristics of multistage fluid inclusions with high Li/B ratio found from the Sanbagawa belt.

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Recent studies invoked that the variation of peculiar fluid soluble light elements, such as Li, B and Cl, are capable of suggesting generation depths of fluid released in subduction zones (e.g., Scambelluri et al., 2004; Bebout et al., 2007; Marschall et al., 2009). Crush-leached fluids extracted from quartz veins intercalated with metabasites of the Sanbagawa metamorphic belt show high Li and B concentrations, whose Li/B ratios show a positive correlation with metamorphic grade of the host rocks, i.e. from 0.02 for pumpellyite-actinolite facies to 0.27 for eclogite facies (Sengen et al., 2009). Furthermore, crush-leached fluids extracted from quartz veins intercalated with metasediments in proximal to the eclogite unit in the Besshi district show much higher Li/B ratio (ca. 0.36-1.99). Yoshida et al. (2011) pointed out that Li/B ratio of dehydrated fluids was controlled by the rock types of the host rocks, i.e. Li/B ratio of dehydrated fluids derived from tourmaline-free metasediments show much higher values than those expected from metabasites. Those obtained data suggest that the Li/B ratio of the deep fluid has a potential as a depth indicator but there remain many unknown factors for establishing it.
The Li/B ratio of extracted fluid obtained by the crush-leached method integrates the whole fluid activities which the host rocks were taken place. To investigate the fluid activity history for the sample showing the highest Li/B ratio (1.99), detailed petrographical and microthemometric studies were performed. The studied sample IR04 is a foliation-parallel quartz vein intercalated with a Grt-Hbl-Ph schist probably derived from clay, whose peak P-T conditions are estimated as 600 ℃ and 1.3 GPa using pseudosection analysis. The quartz vein shows a foam microstructure, suggesting that low differential stress and high-T conditions were attained during its texture formation. Three types of fluid inclusions have been identified: the earliest one, FIA-I, is characterized by two phase inclusions arranged along intragranular planes and mainly composed of CH4 gas and aqueous saline fluid with salinities of 7.0-8.7 mass% NaCleq; FIA-II, texturally comparable to FIA-I, consists of CH4-N2-CO_2-H2 single phase inclusions with rare two-phase inclusions; the latest type, FIA-III, is characterized by arrangements along transgranular planes consisting of two-phase inclusions mainly composed of CH4-N2 vapor and aqueous saline fluid with salinities of 8.8-9.5 mass% NaCleq. FIA-I contains annular fluid inclusions, which are attributed to 'reequilibration' of the fluid inclusion due to a confining pressure increase. This fact suggests that the host rock underwent the compression after the entrapment of FIA-I. Textural observations and chemical characteristics of fluid inclusions, compared to host rock petrography, show that FIA-I and -II were trapped during prograde or near the peak metamorphic stage, and that FIA-III was probably trapped at an early stage of the exhumation. These results certificate that metamorphic dehydration fluids from metasediments at a prograde and/or near the peak stage should have a high Li/B ratio.