Phase relation of lawsonite-blueschists and their role as a water budget: A case study from the Hakoishi sub-unit of the Kurosegawa belt, SW Japan

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This study investigated progressive changes in the mineral assemblage of a Palaeozoic lawsonite-blueschist (BS) unit of the Kurosegawa belt, Kyushu, Japan. The BS unit is mainly composed of intercalated metachert and metabasaltic rocks surrounded by serpentinite. Based on the spatial distribution of mineral assemblages in metabasaltic rocks, three mineral zones can be identified in a ca. 10 km-long east¬-west oriented unit: (1) a pumpellyite (Pmp) + Na-amphibole (Namp) assemblage dominated area (Zone 1); (2) an intermixture area of lawsonite (Lws) + Na-pyroxene (Napx) + Pmp and Lws + Namp + Pmp assemblages (transition zone); and (3) an area dominated by Lws + Namp + Napx assemblages (Zone 2), with excess chlorite (Chl), albite (Ab), quartz (Qz), titanite, and Fe oxides. Na-pyroxene varies its composition from jadeite(Jd)20-diopside(Di)25 of Zone 1 to Jd35Di15 in Zone 2 with a similar composition range of aegirine(Ac) content (from 40 to 55). Glaucophane component {XGln =Al/(Al+Fe3+)} of Na-amphibole associated with Lws and Pmp increases from XGln =0.2 in Zone 1 to XGln =0.8 in Zone 2. Jd contents and a lack of epidote and zeolite group minerals suggest that the pressure (P) conditions of the BS increase from Zone 1 (0.50 GPa) to Zone 2 (0.75 GPa) between 200-300 °C, suggesting that a low geothermal gradient (ca. 5-10 oC/km). Schreinemakers' analyses in a NaCaMgFe3+AlSiH (NCMF3ASH) system using mean mineral compositions of representative samples with excess of Chl, Ab, Qz and H2O suggest that 1) observed variations in mineral assemblages can be formed by a hydration reaction of Pmp + Napx + Chl + H2O = Lws + Namp, which was driven by a P increase from Zone 1 to Zone 2 and they represent the transition from the Pmp-BS to Lws-BS sub-facies; 2) the total H2O content stored in hydrous minerals increases from 3.6 wt % in the Pmp-Namp assemblage of Zone1 to 5.0-6.4 wt % in the Lws + Namp + Napx assemblages in Zone 2; and 3) along with the Lws-Namp and Pmp-Namp assemblages, the Napx + Chl assemblage can retain a significant volume of H2O and its stability field can expand to higher P conditions by decreasing the Di and increasing the Jd and Ac contents of Napx.

Keywords: lawsonite blueschist, phase relation, H2O budget in subduction zone, Kurosegawa belt.

