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Rheology in subduction channel inferred from P-T paths in tectonic blocks from serpentinite melange

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The Kamuikotan metamorphic rocks distributed around the Asahikawa-city have been known as typical high-P/T type metamorphic rocks. Serpentinite melange occupies the stratigraphically highest position of these metamorphic rocks, in which amphibolites tectonic blocks occur (e.g. Ishizuka et al., 1983). These blocks experienced medium to low pressure metamorphism followed by high pressure metamorphism, while blueschist blocks which did not experience polyphase metamorphism also occur, as explained below. There are three types of compositional zoning in amphibole constituting these tectonic blocks (Okamoto et al., 2013, Annual Meeting of Geological Society of Japan): Type I, actinolite overgrown by glaucophane; Type II, magnesio-hornblende overgrown by actinolite, which is further rimmed by glaucophane; Type III, tschermakite or pargasite overgrown by glaucophane or magnesio-riebeckite. While type I zoning occurs in amphiboles from blueschists, type II zoning occur in ones from amphibolites. It is clearly inferred from type II zoning that the rocks were once cooled before they experienced high-P/T type metamorphism. Amphiboles with type III zoning occur in a garnet-amphibolite sample, for which higher pressure and temperature for formation are inferred from the mineral assemblage than the amphibolites and cooling are also inferred to have occurred from the compositional zoning of garnet (Okamoto et al., 2013).

Takeshita et al. (2013, Annual Meeting of Geological Society of Japan) reported quartz c-axis fabric patterns from three metachert layers intercalated with blueschists. Although all of these show monoclinic symmetry, indicating shear-dominant flow, the shear direction relative to geographical orientations is unknown because of the occurrence as tectonic blocks. Further, these quartz c-axis fabric patterns are significantly different, which are characterized by (1) asymmetrical small circle girdles with the half-opening angle less than 30o, (2) asymmetrical type I crossed girdles, and (3) a pattern close to asymmetrical type II crossed girdles with a Y-maximum. The patterns (1), (2) and (3) indicate that basal<a>, basal<a>+rhomb<a>, and basal<a>+prism<a>are dominant slip systems in quartz, respectively, and the temperatures for formation are inferred to have increased from (1) to (3), ranging between 300 to 500 oC.

Those P-T paths inferred from compositional zoning in amphiboles, and different temperature conditions for deformation inferred from quartz c-axis fabric patterns could indicate that these rocks with different P-T paths could have been juxtaposed in the ancient subduction channel, and were cooled with time. These results are in accord with the previous studies that the subduction responsible for the formation of Kamuikotan metamorphic rocks was initiated at c. 140 Ma by the jump of trench (Kiminami and Kontani, 1983), which was followed by the steady state subduction leading to the cooling of subduction channel and resultant formation of high-P/T type metamorphic rocks. Further, the juxtaposition of tectonic blocks in subduction channel could have resulted from the weak rheology of serpentinite, as simulated by Gerya et al. (2002). In the present talk, we will demonstrate that the weak rheology in subduction channel could have been also contributed by dissolution-precipitation creep assisted by fracturing in amphibolites and blueschists in addition to the well-known weak serpentinite rheology.

Keywords: Kamuikotan metamorphic rocks, P-T paths, quartz c-axis fabric, dissolution-precipitation creep, compositional zoning in amphibole, blueschist