

Tectonometamorphism of the high-grade Barrovian zones of the Scottish Highlands

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The Barrovian zones in Scottish Highland are the type locality for a intermediate P/T metamorphic belt, defined as the root zone of a collision zone (e.g. Miyashiro, 1973). The nature of the collision zone metamorphism has been re-interpreted following the discovery of UHP minerals throughout the world (e.g. Maruyama et al., 1996). It is becoming increasingly realized that the metamorphic zonation of many orogenic belts is a product of retrograde hydration after UHP or HP metamorphism. However, little research has studied the Barrovian zone metamorphism in terms of retrograde hydration at the exhumation stage or UHP metamorphism due to collision. Here we would like to represent our preliminary description of the high-grade Barrovian zones from the view- point of retrograde hydration.

Three hundred and sixty four rock samples were collected from the high-grade Barrovian zones (staurolite, kyanite and sillimanite). Mineral textures and assemblage were identified under the microscope, SEM-EDS and EPMA. Inclusion minerals in garnets were also identified using Laser-Raman. In the staurolite zone, staurolite was not recognized in metapelites and amphibolites. In the amphibolites, biotite and garnet occur with chlorite. In the kyanite zone, abundant chlorite occurs in all specimens. Staurolite, kyanite and tourmaline are present in some amphibolites. In the sillimanite zone, sillimanite is scarcely recognized, although Vorhies (2011) identified it.

Chemical zonation of garnets and mineral inclusions in garnets are useful to decipher the P-T trajectory of prograde and retrograde metamorphism. However, most garnets from the amphibolites are strongly deformed and fragmented. The garnets in metapelites are relatively smaller and inclusion-free. Therefore, a P-T path cannot be easily deciphered from the zonation of the garnets. The presence of chlorite with garnet in the whole studied area indicates that retrograde hydration had consumed garnet to form chlorite. Based on pseudo-section analysis, the metamorphic P-T conditions will be discussed.

Post-collision TTG due to subduction of Dalradian under inter-oceanic island arc has a wide distribution Barrovian zone in Scottish highland. UHP-HP records has been overprinted by TTG intrusion. Radiometric ages Dalradian metamorphic minerals range in a long time span from 520Ma to 390Ma (Oliver et al, 2000). Because of thermal effects by TTG intrusion mainly occurred at 430- 380 Ma (Oliver, 2008). Most Collision orogens do not have TTG pluton hence UHP-HP records tend to be remained.

In addition to Abundant tourmaline overgrows evident in Ky zone. Extensive hydration events are ubiquitous over sillimanite to garnet zones, and presumably due to late stage after progressive metamorphism.

Barrovian metamorphism is not progressive at all as described above. There are three stage summarized as follows. First, Barrovian metamorphism in Scottish highland is collisional metamorphism at 520-480 Ma. Second, retrograde hydration at the mid- crustal depth occurred at 480-460 Ma. Third, overprinting of granite contact metamorphism occurred at 430-380 Ma.

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