

Large pressure-temperature gaps between Ballantrae blueschist and their surrounding hydrothermal ophiolite, southern Scotland, UK

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NEE-SWW trending serpentinite-matrix melange, bearing blocks of metabasite rocks, occur within the Ballantrae ophiolite complex, southern Scotland, UK. The blocks of metabasite are less than 3x3 m in size, and have metamorphic conditions of greenschist, blueschist and epidote amphibolite. The mineral assemblage of the greenschist is epidote, chlorite and actinolite. The blueschist contains Na-amphibole, actinolite, epidote, titanite, and minor amount of chlorite. The epidote amphibolite contains epidote, Na-amphibole, barroisite, actinolite, titanite and minor amount of chlorite. Composition of Na-amphibole is ranging from crossite to glaucophane. A compositional zoning of Na-Ca amphibole was observed; the core of barroisite is surrounded by rim of crossite. Metamorphic facies series of those metabasites corresponds to the high-pressure-intermediate type.

The surrounding rocks of the serpentinite-melange are hydrothermal metamorphosed ophiolitic-basites, which preserve the low-pressure-type metamorphic-facies-series. The 300 m thick gabbro is extending parallel with the serpentinite melange on the south of the melange, which has actinolite, hornblende, chlorite and Ca-rich plagioclase as secondary minerals. Sporadic distributions of gabbro and serpentinite-melange suggest that the primary contact of those two units is faults. Basalt breccia-matrix melange and 1 km thick basalt occur on the south of the gabbro. Within the basalt unit, a few dorelite outcrops are observed. Secondary minerals of the dorelite are actinolite, chlorite and Ca-rich plagioclase. The basalt contains chlorite and pumpellyite as secondary minerals. The preserved metamorphic facies of those ophiolitic-basites have the perfect correspondence with the lithostratigraphy, which are prehnite-pumpellyite facies of basalt, actinolite-calcic-plagioclase sub-facies of dorelite and amphibolite-facies of gabbro. Therefore, the metamorphic sequence of the ophiolitic-basites represents to a hydrothermal metamorphism of the ophiolite.

The pressure-temperature gap between the high-P series blueschist and the adjacent hydrothermal ophiolitic-basites suggests that the blueschist within the serpentinite-melange was extruded from at least 25 km depth along the cold subducted-slab, and juxtaposed with the bottom of hydrothermal-ophiolite at the crustal level. The 501 \pm 12 Ma arc-lavas extends southwards from the blueschist cropping out around the Mains hill. The location of the arc suggests that the subduction of ocean lithosphere was to the south, although the metamorphic age of blueschist must be determined.