

Cumulates from the Nidar Ophiolite, Ladakh: A Record of Pulsed Slab–Fluid Supply in Supra–Subduction Zone

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Abstract:

The Nidar Ophiolite Complex, along the Indus–Yarlung Tsangpo Suture Zone in Ladakh, preserves one of the most complete supra-subduction zone (SSZ) sections in the Himalaya. Its lower plutonic unit contains two cumulate types: orthopyroxene-bearing gabbro-norites and orthopyroxene-free gabbros. Such pairings are commonly interpreted as evidence of separate magmatic pulses or different mantle sources. We tested this assumption using petrography, EPMA mineral chemistry, whole-rock major and trace elements, clinopyroxene thermobarometry and PELE forward crystallisation modelling on fourteen samples collected along two transects. The two rock types are interleaved on a decimetre-to-metre scale within a single structural panel. They yield overlapping clinopyroxene temperatures of approximately 1135 and 1155 °C and pressures of 3.1–10.2 kbar, equivalent to about 14–36 km depth. Their slab-flux and melting indices (Ba/La, Sr/Nd, Nb/Yb and Th/Yb) are statistically indistinguishable and indicate approximately 5–10% melting of a spinel lherzolite source modified by slab-derived fluids, with back-arc basin basalt affinities. They differ mainly in features governed by melt water content and oxidation state: orthopyroxene stability, plagioclase anorthite content and amphibole abundance. We interpret this contrast as evidence of pulsed slab-derived fluid supply within one polybaric plumbing system rather than separate magmatic events or mantle sources. Together with ultra-depleted and boninitic rocks reported from Nidar, the cumulate suite records transition from subduction initiation to early back-arc extension during Early Cretaceous Neo-Tethys evolution.

Keywords:

Nidar Ophiolite, Supra-subduction Zone, Gabbro-norite, Gabbro, Slab-derived Fluids, Cumulates, Polybaric Plumbing System, Neo-Tethys.