

Serpentinite Geochemistry as an Indicator of the Tectonic Setting of Ophiolitic Assemblages: Examples from the Qilian Fold Belt of Northwest China

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The Qilian fold belt contains several ophiolitic assemblages representing the remnants of a Caledonian ocean basin consumed during collision of the North China block with Gondwana in the Early Paleozoic. Serpentinites taken from five localities range from serpentinised lherzolite to harzburgite with MgO contents from 39 to 46 wt% on recalculation to a volatile-free basis. Serpentinite from the Ta-Den Creek locality has a major element composition similar to average dredged ocean floor peridotite, whereas at the Lha-Jyi and Baijing Temple localities the serpentinites are more refractory, and while having CaO and Al₂O₃ similar to average oceanic harzburgite, have higher SiO₂ and lower FeO. Trace element profiles are characterised by a progressive enrichment in incompatible elements with negative Ce anomalies in MORB-normalised plots, while REE profiles are characterised by LREE enrichment with negative Ce-, positive Eu- anomalies. Two groups may however be recognised within these patterns: samples from the Qing-Shui Creek and Baijing Temple localities, along with the Lha-Jyi harzburgitic samples have U-shaped REE profiles with moderate LREE enrichment ((La/Sm)_n up to 6.6) and prominent Eu anomalies (Eu/Eu* up to +2.0). Samples from the Ta-Den Creek and Ayou Creek localities, along with a lherzolitic sample from the Lha-Jyi terrane show only minor LREE enrichment

((La/Sm)_n<2) and have only weak positive Eu anomalies (Eu/Eu*<+1.5). Two potential processes for the formation of serpentinite are (i) Hydrothermal alteration of the peridotite part of oceanic crust under conditions of relatively low temperature and pressure along ocean ridges, fracture zones, and on bending of the oceanic lithosphere prior to subduction (ii) Migration of slab derived fluids into the mantle wedge peridotite resulting in serpentinisation under relatively high temperature and pressure conditions in a fore-arc environment. The concentrations of incompatible trace elements are greater than in peridotites which represent the residues from MORB generation. Likewise, the range in epsilon Nd (500 Ma) of +5.5 to -15 shown by the serpentinites is less than for Caledonian oceanic crust (ca. epsilon Nd +10 to +7). All samples have therefore undergone an enrichment event. The increase in immobile trace elements such as Th, manifest in ratios such as Th/Nb (0.1 to 0.9) relative to values of <0.07 in MORB and peridotite residues suggests the serpentinites were metasomatised in a collisional tectonic setting. The evidence from the serpentinites therefore supports conclusions drawn from the associated volcanic rocks of a supra-subduction zone setting for the Lha-Jyi, Baijing Temple and Ta-Den Creek assemblages, and a collisional margin setting for the Qing-Shui Creek samples.