Petrology and geochemistry of the Xiugugabu ophiolitic massif, western Yarlung Zangbo Suture Zone, Tibet

Rachel Bezard[1], Réjean Hébert[1], Chengshan Wang[2], Jaroslav Dostal[3], Jingen Dai[2]

[1] Département de géologie et de génie géologique, Université Laval, Québec, QC, G1K 7P4, Canada, rachel.bezard.1@ulaval.ca
[2] Research Center for Tibetan Plateau Geology, China University of Geosciences, Beijing 100083, China
[3] Department of Geology, Saint Mary's University, Halifax, NS, B3H 3C3, Canada

The Yarlung Zangbo Suture Zone (YZSZ), southern Tibet, is a more than 2000 km discontinuous belt composed of Neo-Tethyan Mesosoic ocean relics. The Xiugugabu ophiolitic massif is a thrust sheet of more than 260 km^2 overlying the tectonic mélange south of the YZSZ in SW Tibet. Its main lithologies are harzburgites and clinopyroxene(cpx)-harzburgites with porphyroclastic and porphyromylonitic textures. In the southern part of the massif, peridotites are intruded by amphibole(am)-bearing microgabbro and microgabbronorite sills. A diabase unit overlain by a sedimentary sequence crops out on the NE flank of the massif.

The orthopyroxene (Mg# 0.05-0.95, Cr_2O_3 1.03-0.10 wt. %), cpx (Mg# 0.92-0.99, Cr_2O_3 0.31-1.5) and olivine (Fo_{89-92}, NiO 0.35-0.50 wt. %) chemistry in harzburgites and cpx-harzburgites indicate compositions ranging from the abyssal to the forearc fields. The Mg# and Cr# (Cr/(Cr +Al) of the brown to reddish brown spinels range from 0.20-0.80 and 0.15-0.70 respectively, corresponding to 5-35% of partial melting. Non-modal fractional melting modelling shows a similar range of partial melting rate for the whole rock samples. Peridotites are slightly LREE enriched with $[La/Yb]_{CN}$ 0.06-2.8 and $[La/Sm]_{CN}$ 0.34-2.64. These ultramafic rocks are inferred to be the residues of 5-35% of partial melting that have been then percolated by metasomatic fluids in a supra-subduction context.

Am-microgabbro and am-microgabbronorite sills are mostly composed of brown to green amphibole (Mg# 0.72-0.87, TiO_2 0.66-1.64 wt. %), calcic plagioclase (An_{44-80}), cpx (En_{33-50}, Wo_{40-49}, Fs_{8-21}), ilmenite and orthopyroxene in gabbronorite. Textures and compositions of the brown amphiboles indicate a sub-solidus high temperature hydrothermal origin (> 800°C). These rocks are tholeiitic and show N-MORB type REE patterns ($[La/Yb]_{NC}$ 0.35-0.90), a LILE enrichment and noticeable Nb, Ta and Ti negative anomalies. These trace element compositions are similar to the Lau back-arc basin mafic rocks and also fit with the mantle diabase compositions of the central and eastern YZSZ ophiolites interpreted as being of back arc affinity. These mafic sills have suprasubduction affinity and are interpreted to have formed in a back-arc basin setting. The diabase unit cropping out to the NE of the massif has a strong alkalic composition and do not belong to the ophiolite. It suffered from low-grade hydrothermalism with chloritization, sericitization and interstitial quartz crystallisation but shows relics of sodic plagioclase (Or_{0-10}, An_{0-18}, Ab_{99-77}) brown-green amphibole (Mg# 0.49-0.77, TiO_2 0.22-0.43 wt. %) and needles of apatite. It is LREE enriched ($[La/Yb]_{NC}$ 8-8.9) and shows slight Nb, Ta and Ti negative anomalies. No significant crustal assimilation seems to be involved. The diabase is of oceanic intraplate affinity according to its multi-element pattern and may derive from an enriched mantle source. It is similar to the mélange-related alkalic mafic rocks found further east and formed within the Neo-Tethys. The absence of continental crustal contamination indicates that these rocks were emplaced after the Triassic disaggregation of the Indian plate.

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