

Geochemical and Isotopic Constraints on the Nature of the Indus and Shyok Suture Zones, Remnants of the Neo-Tethyan Ocean in the Trans-Himalayan Region

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The Indus and Shyok suture zones of the Trans-Himalayan region are considered to represent remnants of the Neo-Tethyan ocean that closed via subduction as the Indian plate moved northwards with respect to the Asian plate. Geochemical and isotopic (Sr and Nd) data for the magmatic rocks of the Indus and Shyok sutures reveal important contrasts. The volcanic rocks of the Indus and Shyok suture zones are sub-alkaline basalt, basaltic-andesite, andesite and rhyolite.

The Indus suture rocks have nearly flat to slightly depleted light rare earth and large ion lithophile element (LREE-LILE) characteristics, with strong negative anomalies for the high field strength element (HFSE: Nb, P and Ti). These incompatible elemental characteristics indicate that they probably represent intra-oceanic island arc setting. Shyok suture rocks, on the other hand, have enriched LREE and LILE respectively and depleted HFSE trace element characteristics. They probably represent ocean-continent island arc system.

In addition to the arc component, the Indus suture contains the Zildat ophiolitic mélange with dominant OIB characteristics as evidenced by highly enriched Nb (60 to 130 ppm) and strongly negative values for fSm/Nd (-0.4147 to -0.4676) relative to CHUR. However, these rocks have positive epsilon Ndt=110 Ma of about +3 and +4, like many OIBs, indicating their derivation from isotopically depleted sources that got elementally enriched prior to melting. A minor component of this mélange is characterized by depleted LILE-LREE, highly positive epsilon Ndt=110 Ma of about +9 and initial Sr of 0.70466 to 0.70666, seen in many N-MORBs. The arc component, represented by the Nidar ophiolitic complex, have higher abundances of the LREE-LILE with respect to N-MORB and positive epsilon Ndt=110 Ma of about +8 and +9, similar to Zildat mélange. Initial Sr values for Nidar gabbros vary between 0.70422 and 0.70546 indicating absence of continental crustal component.

Shyok volcanics and Nubra ophiolitic volcanics of the Shyok suture zone have epsilon Ndt=110 Ma of about +5 to -2, fSm/Nd of -0.2553 to -0.2921 and initial Sr values of 0.70376 to 0.70471. Elemental and isotopic characteristics for the rocks of the Shyok suture zone indicate involvement of juvenile crustal component in their genesis.

Thus, the geochemical and isotopic data from Indus and Shyok suture indicate that the Neo-Tethyan ocean in this region was represented by contrasting tectonic scenarios ranging from dominantly OIB to minor MORB on the one hand and from ocean-ocean to ocean-continent arc system on the other.