Coupled MORB and Arc signatures from a Neoarchean greenstone belt, central India: Intra-oceanic double-sided subduction

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An ongoing debate is whether the geochemical signatures from Archean greenstone belts fit into subduction related models, like younger domains. The Neoarchean Sonakhan greenstone belt (SGB) lying between Mesoarchean Bastar craton and Mesoproterozoic Chattisgarh Supergroup, central India, was interpreted to have arc-like affinity. SGB is a steep NNW-SSE trending fold-fault belt and constituted of mafic metavolcanic dominated Baghmara domain in the west, mixed mafic-felsic metavolcanics dominated Bilari domain in the east and a turbidite deposit of the Arjuni Formation lodged in between. SGB is also intruded by syn- to late-tectonic granitoids.

Low Al_2O_3/TiO_2 and Ti/V ratios, higher FeO, less variability of SiO_2 and TiO_2 relative to MgO and flat REE pattern of the Baghmara volcanics, imply their affinity to MORB and depleted mantle source of the parent magma that fractionated under low P_{H2O} [1,2]. In contrast, high Al_2O_3/TiO_2 and Ti/V ratios, lower FeO, more variability of SiO_2 and TiO_2, relative to MgO and enriched LREE pattern of the Bilari basalts are consistent with arc-related calc-alkaline affinity and derivation from a more refractory mantle source and high P_{H2O} fractionation [1,2]. The intrusives of SGB are calc-alkaline and metaluminous, similar to I-type granites.

Th/Yb vs. Nb/Yb ratios of the Baghmara and Bilari samples plot in the field for Eoarchean Isua greenstone belt, and Mariana Arc. Thus, two contrasting suites with MORB and arc affinity are juxtaposed together in SGB. The Arjuni Formation apparently represents an accretionary wedge. Based on new data a double sided shallow subduction model for the tectonic evolution of SGB is proposed.

[1] Mullen & McCallum, 2014, J. Petrology 55, 241–281.

[2] O'Neil, Francis & Carlson, 2011, J. Petrology 52, 985–1009.