Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10380

Bimodal Volcanism in Betul Fold Belt, Central India: Implications on Petrogenesis

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The Betul fold belt (BFB) in the Central Indian Tectonic Zone (CITZ) consists of volcano-sedimentary sequences, mafic-ultramafic rocks and granitoids. The bimodal volcanic rocks represented by basalts and rhyolites form part of the Baragaon Group. The basalts are predominantly composed of clinopyroxene and plagioclase, whereas the rhyolites comprise quartz, plagioclase and alkali feldspar. The basalts are characterized by high LREE, LILE over HREE along with negative anomalies of Nb, Ta, Zr and Hf. The rhyolites have enriched LREE and prominent negative anomalies of Nb, Ta, Sr and Ti. The low Nb/La, Th/Nb, Th/La, and Th/Ce ratios combined with consistent Nb/Th ratios favor insignificant crustal contamination in these basaltic rocks. The high Ba/Nb, Ba/Th and low Th/Yb, Th/La ratios suggest the addition of slab-derived aqueous fluids to the basaltic mantle source. The rhyolites are classified as type-I (low Æ©REE and HFSE) and type-II (high Æ©REE and HFSE) in which the former follow the basaltic partial melting trend while the latter indicates the fractional crystallization process. The low Sr/Y and La/Yb ratios depict their generation at the plagioclase stability field. Trace element modeling indicates that the Betul basalts are erupted from ~8 to 12% partial melting in the spinel-garnet transition zone, whereas the low-temperature type-I rhyolites T_{Zr} < 850 °C (788 to 825°C) are generated by the assimilation fractional crystallization of the underplated juvenile basaltic rocks, and the high-temperature type-II rhyolites T_{Zr} > 850 °C (865 to 928°C) are produced by ~79% fractional crystallization of the least evolved rhyolitic magma. The generation of mafic magma is attributed to arc-rifting setting, and the subsequent felsic melt generation is due to the partial melting of coeval juvenile underplated basalts, combined with fractional crystallization of least evolved felsic melts and succeeded by assimilation fractional crystallization, thereby restricting the intermediate compositional magma generation.