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Development of Neoproterozoic Malani Silicic Large Igneous Province (SLIP) on fragmenting Rodinia Supercontinent: Implications for Non-Plume origin

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The northwestern Indian shield has a unique evolutionary history to explain the Supercontinental building processes during the Precambrian time. The crust in the region evolved through orogenic, anorogenic, magmatic, granulite exhumation phases during the Precambrian time. The Aravalli, Delhi and Sirohi orogeny show the compressional tectonic regime in the shield. The Rodinia fragmentation resulted change from compressional to extensional lithospheric tectonism, which initiated development of Malani Silicic Large Igneous Province (SLIP) under intraplate rift setting in the northwestern India, Pakistan, and Seychelles during $\sim$750-770 Ma.

The Malani volcano-plutonic igneous province is spread over in western Rajasthan, Tosham and Kutch region of northwestern Indian shield. Besides this, the Malani activity is reported from Kirana area of Pakistan, Madagascar and the Seychelles. Continental fragmentation caused the spread of the large Malani province into detached outcrops on different landmasses. The Malani magmatism represents the largest Precambrian silicic igneous province on the earth. The substantial erosion of the Malani rocks since 750 Ma has reduced the preserved magmatic volume. The largest outcrop is the Malani province of India and constitutes more than 50, 000 km^2.

The Malani activity took place between $\sim$750-770 Ma post-dating the Erinpura granite and ended prior to Marwar Supergroup sedimentation in the northwestern India. Malani eruptions occurred mostly on land, but locally sub-aqueous conditions are shown by the presence of conglomerate, grits and pillow lava. The Malani rocks are undeformed and do not show any type of regional metamorphism. The Malanis are bimodal in character with a dominant silicic volcanism. The volcanism resulted in

ignimbrite eruptions, rhyolite flows, hot avalanches and ash fall eruptions through multiple fissure/rift systems that developed in the intraplate tectonic setting. This was followed by granite plutonism and terminal felsic/silicic dykes. An angular unconformity between Malani lavas and basement is observed, with the presence of conglomerate at various places. This indicates that the crust was quite stable and peneplained prior to the Malani activity. The absence of any thrust zone, tectonic mélange and tectonised contact of the Malanis with the basement goes against a plate subduction setting for their genesis. The Malani rhyolites can be divided into two; the peraluminous rhyolites, characterized by more K2O than Na2O, and the peralkaline rhyolites, which show a marked increase in Na2O compared with K2O. The relative enrichment of Th, La, Ce, Zr and Y suggests a crustal component in the melt. The elevated initial $^{87}Sr/^{86}Sr$ ratio of Malani rhyolites indicates the involvement of continental crust in the formation of Malani magma generation. The absence of a substantial volume of basic component in the dominantly felsic Malanis does not support a mantle plume origin for Malani magmatism.

The silicic igneous provinces are result of major crustal melting which took place under extensional lithospheric tectonics and decompressional melting during Supercontinental fragmentation. Rodinia splitting resulted into widespread Neoproterozoic anorogenic, commonly bimodal, magmatism on most of the continents under extension tectonic regime. Prolonged heat build up in the stable lithosphere causes thermal expansion in the silicic crust, which results into extensional tectonism and intraplate anorogenic magmatism along rift zones.