

# Malani Magmatism of Northwestern Indian Shield: Implications of Mantle Plume?

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The Neoproterozoic magmatism in the Trans-Aravalli region (SW Rajasthan) of the northwestern Indian shield is characterised by anorogenic magmatism. This magmatic event dated around 750 my; post-dating Sirohi Group (Delhi Supergroup) and predating Marwar Supergroup. The rocks occur as hillocks, inselbergs and tors covering approximately 51,000 km<sup>2</sup> area. This comprises basalt, rhyolite, granite and various porphyry dykes.

Presently, most of the workers are of the view that the real cause of the Malani magmatism is Mantle Plume activity. The Plume resulted wide spread bimodal volcanism, plutonism and dyke intrusions. (Bhushan, 2000; Roy, 2001; Kochar, 2001; and Raval 2000)

After having detailed study of Malani outcrops it is concluded that Malani activity took place along almost parallel fractures in the cratonised thick northwestern shield. The salient characteristics of Malani event can be summarised as follows.

1. The initiation of the event is characterised by the bimodal volcanism with locally occurring conglomerate. At a number of places the basic flows are not exposed and underlie the felsic flows (Pandit and Amar Deep, 1997; Bhushan, 2000). Wherever present, the basic component of volcanism is restricted only to the lower part of the sequence and younger volcanic phases are free from any associated basic volcanics. The Malani magmatism is dominantly acidic in nature.
2. The Malani rocks are free from any type of metamorphism and penetrative deformation as indicated by well-preserved magmatic fabric and absence of any deformational related features.
3. The initiation of the magmatic cycle is marked by an extrusive phase (bimodal at places) followed by emplacement of plutonics (peraluminous and peralkaline granites) and the terminal phase is represented by dyke swarms emplaced through pre-existing volcanic as well as plutonic rocks. The important dyke swarms are present at Sankara, Redana, and Dhanta.

Taking clue from the linear disposition of conglomerates and other sedimentary features in close association with the Malani volcanics, it is obvious that the activity is lineament controlled. Presence of discontinuous conglomerate and associated hydroclastic units suggest development of shallow basins along the tectonic line. These linear fractures initially developed into shallow basins at places, which accorded conglomerate, grit, arkose followed by bimodal volcanics. The initial basic flows in aqueous conditions developed pillow lava structures at Sindreth, Khamal and Bambholai (Sharma, 1996). The bimodal volcanism took place through fissures and central conduits forming cones and calderas. Bhushan (2000) identified cones and fissures in the SW Rajasthan. It is quite likely that some of the magma got emplaced into the shoulders of these incipient basins, coeval with the volcanics.

The crustal fractures manifest a rift setting in intra-cratonic and anorogenic tensional tectonic regime. These N-S trending subparallel rifts are separated by basement segment slices, visible at Undwaria, Sindreth, Bamholai, Miniari etc. The narrow-linear outcrop pattern of Undwaria-Sindreth-Miniari is the best example of this. The bimodal volcanism took place in the shallow and narrow basins, which show angular relationship with Sirohi Group and other basement rocks. Similar setting is also observed at Bambholai-Khamal region. These features may not be visible at other places due to sand cover. The plutonic activity is marked by emplacement of granites (Jalore and Siwana Mirpur, Isra and other outcrops) at the margins of the basins. It is quite likely that some of the granites were emplaced (along the margins) simultaneously with the outpouring of felsic lavas. Development of dykes transverse to these rift margins was related to secondary rift fractures (Sharma, 1996; Roy and Sharma, 1999).

The typical basin setting along north-south running tectonic grain and dominantly felsic character of the Malani rocks do not support mantle plume model for their origin. The presence of intermittent basement slices parallel to the Malani rocks indicates anorogenic rift setting. The crust prior to Malani activity was quite stable for long time. This is attributed by pre Malani fine-grained shale-carbonates depositories of the Sirohi cycle. The extensional tectonic regime initiated due to the fragmentation of the Rodinia Supercontinent caused the wide spread Malani felsic magmatism around 750 ma.

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Figure: The linear rift basin setting of Malani Rocks in the Sindreth Region. (Sharma, 1996)

