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Structural, Geochronological and Geochemical Evolution of Banded Gneisses and Granites in the Aravalli Craton: Current Status and Future Perspectives

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Reconstruction of the earliest crust-forming processes requires a comprehensive understanding of the structural and geochemical evolution of the Archean cratons. The Aravalli Craton (NW India) is characterised by polydeformed banded gneisses, mafic granulites, and Neoarchean granitoids, preserving a complex history of deformation and magmatism. However, the structural framework, deformation chronology, and magmatic evolution of these rocks remain elusive. This study integrates mesoscale structures, geochemistry, and geochronology from granite-gneiss associations exposed to the east of Udaipur to decipher the Archean crustal evolution. The gneisses in the area experienced three major deformation events. The earliest fabric formed during D1 (S0//S1) in the gneisses is a shallow to moderately dipping fabric with variable strikes. The S1 fabric was regionally folded during D2 deformation, which resulted in the development of steeply dipping S2 axial planar fabric (mean: 021/86E). A later D3 deformation event produced moderately dipping folds, locally preserved, on the earlier fabrics in the gneisses with fold axes (L3) directed towards the southeast and steep S3 foliation. Similarly, the granitoids preserve two distinct sets of fabric—gentle and steep dipping planes with mean orientations of 341/26E (S1) and 008/73E (S2), respectively. Geochemically, gneisses show alkalic and calc-alkaline affinities and are of TTG and granitic compositions, with metaluminous to peraluminous signatures and magnesian character. The gneisses dominantly possess negative anomalies indicative of the derivation of gneisses from a garnet-free shallow crust. Positive Eu anomalies in some samples suggest deeper origins with garnet and rutile in the source. These differences reflect diverse crustal melting conditions. The granitoids are alkalic, peraluminous, ferroan, and follow high-K calc-alkaline to shoshonite series. Previous reported ages are 3.3–2.7 Ga for TTG gneisses, while the granites have the following ages: Untala (2.50 Ga), Gingla (2.6–2.4 Ga), Berach (2.44 Ga), and Ahar (2.56 Ga) [1]. This new structural and geochronological data offers new perspectives on the structural and tectonic evolution of the complex. Further, the study will discuss enhancing models of Archean crustal evolution with reference to northwestern India.

References

[1] Wiedenbeck at al. (1996). Chem. Geol. 129.