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Proterozoic Evolution of the Assam-Meghalaya Gneissic Complex (AMGC): Nd-Sr Isotopic Insights from the Shillong Group and Khasi Mafic Intrusives

GAURAV KUMAR[1], MEDARD AUGUSTINE KHONGLAH[2], DAMEPAIA S M PDAH[3], BORIS V. BELYATSKY[4] AND ARUNDHUTI GHATAK[5]

[1]Indian Institute of Science Education and Research, Bhopal
[2]Geological Survey of India
[3]Directorate of Mineral Resources
[4]VSEGEI,CIR
[5]Indian Institute of Science Education and Research Bhopal

The Shillong Plateau preserves a significant Proterozoic history recorded in its metasedimentary and intrusive rocks. This study integrates Sr-Nd isotope geochemistry and geochronology to resolve the stratigraphic debate between the Shillong Group and Khasi Mafic Intrusives (KMIs) while refining their geodynamic significance. The Shillong Group, primarily quartzite and phyllite, yields Nd model ages (T_{DM}) of quartzite (1.72-2.35 Ga) and phyllite (1.71-2.02 Ga), indicating derivation from mixed Paleoproterozoic to Mesoproterozoic crust, likely sourced from the Assam-Meghalaya Gneissic Complex (AMGC). These ages suggest detrital input from older cratonic sources, including the Archean basement gneisses of the Indian Shield. Isochron dating of phyllite (~2720±270 Ma) confirms an inherited Archean component, while quartzite (~413±62 Ma) records a later metamorphic overprint, possibly linked to Himalayan or Grenvillian orogenesis. The decreasing $^{143}Nd/^{144}Nd$ with increasing $^{147}Sm/^{144}Nd$ ratios of Shillong Group suggest progressive crustal reworking and isotopic mixing.

The KMIs exhibit Sr-Nd systematics ($^{87}Sr/^{86}Sri$ = 0.704-0.715; εNd_t = -23 to -27), indicating a subduction-modified lithospheric mantle source. Their emplacement at 950-990±80 Ma postdates the Shillong Group, confirming their intrusive nature. AFC modelling suggests lower-crustal granulites of the AMGC as the primary contaminant rather than the Shillong Group. The T_{DM} ages (1.5-2.0 Ga) suggest an enriched Proterozoic mantle-derived source, while whole-rock geochemistry (Gd/Yb_N = 1.8-2.1) supports partial melting (7-11%) of a spinel-garnet lherzolite at ~60-70 km depth. The high $^{87}Sr/^{86}Sr$ ratios (>0.710) in the Shillong Group indicate long-lived radiogenic Sr accumulation from sedimentary recycling, while lower ratios (<0.705) in KMIs point to mantle-derived contributions, supporting deposition in an active tectonic margin.

Geochemical and isotopic trends indicate that the Shillong Group evolved from a passive margin to a more complex collisional setting, leading to metamorphic overprinting. The Archean preservation in phyllite, contrasted with younger disturbed ages in quartzite, indicates differential sedimentary and metamorphic patterns across the Shillong Plateau. This study redefines the Shillong Plateau's Proterozoic history by demonstrating that the Shillong Group represents a Paleoproterozoic sedimentary basin, whereas the KMIs record Mesoproterozoic extensional tectonics. Their isotopic decoupling suggests a suture zone between the Northern and Southern Indian Blocks, i.e., CITZ, offering new constraints on Columbia-Rodinia transition in the Indian Shield.