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Late-Cambrian upper amphibolite to granulite-facies metamorphism in the Mikir Hills, Assam-Meghalaya Gneissic Complex (NE India): P-T history and tectonic implications

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This work presents the metamorphic *P–T* history and zircon-monazite geochronology of pelitic migmatites from the Mikir Hills region (NE India) to examine its tectonic relationship with the Assam-Meghalaya Gneissic Complex (AMGC). The Mikir Hills region consists of pelitic and granitic gneisses with intense migmatization and coarse-grained porphyritic granitoids. Phase equilibrium modelling of pelitic gneisses in the MnNCKFMASHTO system combined with the melt reintegration method provides an insight into the initial composition of rock (garnet + plagioclase + K-feldspar + biotite + quartz + rutile + ilmenite) before the melt-loss event in pelitic gneisses. Based on isopleth thermobarometry, the peak metamorphic assemblage, represented by garnet + sillimanite + plagioclase + K-feldspar + biotite + quartz + rutile + ilmenite + melt, is stabilized at ~7 kbar and ~730°C. The peak metamorphism was followed by the stabilization of retrograde assemblage of garnet + cordierite + spinel + plagioclase + K-feldspar + biotite + quartz + ilmenite at *P–T* conditions of ~3 kbar and ~690°C. The combination of peak and retrograde metamorphic conditions suggests a near-isothermal decompression path, indicating rapid exhumation of pelitic gneisses. This inference is supported by the development of corona-type textures showing the growth of medium-grained cordierite aggregates around garnet. The U-Pb zircon dating yielded a concordant age of 1647 ± 05 Ma (~1624–1682 Ma) which represents the age of the protolith. In contrast, texturally constrained monazite grains yielded a strong age population of ~503–441 Ma, representing the timing of migmatization and peak metamorphism in pelitic gneisses. This event is contemporaneous with the emplacement of ~510-539 Ma porphyritic granitoids in the Mikir Hills. By integrating *P–T* evolution and monazite geochronology, it is evident that the Mikir Hills region underwent collision-induced crustal thickening, followed by rapid exhumation during ~503–441 Ma. Globally, this Pan-African tectono-thermal event coincides with the India and Australia-Antarctica collision in the Gondwana assembly, leading to the extensive deformation, high-grade metamorphism, crustal anatexis and granitoid emplacement in NE India.