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Polyphase Neoproterozoic high-grade metamorphism in the Southern Granulite Terrain of India: implications from Th-U-Pb dating of monazite

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Strongly migmatitic sapphirine-bearing granulites are found as enclaves in granites in the southeastern part of the Madurai Block which represents the largest section of Neoproterozoic crust in the Southern Granulite Terrain of India (SGT) of India. The granulites are composed of quartzofeldspathic leucosomes and restitic domains of sapphirine, garnet, orthopyroxene, sillimanite and cordierite. Inclusions of sapphirine-quartz intergrowths in garnet testify to an UHT metamorphism [1]. Garnet breakdown to opx-sill intergrowths occurred during near-isothermal decompression of the rocks.

Monazites from both the granulites and their granitic hosts were investigated with the electron microprobe. The chemical composition in monazites from granites and in-situ leucosomes shows strongly varying REE, Th, U and Si abundances. Calculated ages from these rocks define a single Pan-African population with a mean value of 508 ± 11 Ma. The chemical composition of monazite inclusions in garnet from the restitic domains of the migmatitic enclaves is much more complex and infers at least two stages of monazite growth. Corresponding age data support this view and yield a bimodal distribution. Late Grenvillian (850 – 950 Ma) ages are commonly found in the cores of monazite and are rimmed by domains of Pan-African age (600 – 500 Ma). The early Neoproterozoic population is in good agreement with results from chemical dating of zircon and monazite and U-Pb dating of zircon in the southeastern Madurai Block [2, 3] and most likely reflects a previously unrecognized stage of UHT metamorphism in the Madurai Block which possibly is related to the break-up of Rodinia.

[1] Tateishi, K. et al. (2004): First report of sapphirine + quartz assemblage from southern India: implications for ultrahigh-temperature metamorphism. – Gondw. Res., 7: 899-912. [2] Jahn-Awe, S et al. (2003): Isotope geology and geochronology of high-grade metamorphic rocks from the Madurai Block, South India. Eur J. Min. 15, Beihefte: 91. [3] Santosh, M et al. (2003): Multiple tectonothermal events in the granulite blocks of southern India revealed from EPMA dating. – Gondw. Res., 6: 29-63.