

Phase relationships of granulite-facies metapelites of the Madurai Block, southern India

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The Madurai Block of the Southern Granulite Terrane (South India) is a key location for studying the nature of the Gondwana formation, as it is situated between two postulated Neoproterozoic Gondwana-forming orogenic belts, the East Africa Orogen and the Kuunga Orogen (Collins et al., 2007). The Madurai Block is dominated by charnockitic massives, which are surrounded by a high-grade metamorphic volcano-sedimentary sequence, comprising abundant layers of migmatitic metapelites. The evolution of the mineral assemblages of the metapelites is deciphered by integrating P-T-X phase diagrams in the NCKFMASH system with geothermobarometric calculations. Different mineral assemblages of the metapelites reflect variations of the bulk-rock composition but also indicate regional differences in the metamorphic grade between various structural parts of the Madurai Block. The metapelites follow clockwise P-T paths, which culminated at regionally different granulite-facies peak-temperatures at different crustal levels: early Bt-Sil-Qtz assemblages, preserved as mineral inclusions in peak-metamorphic porphyroblasts, broke down via melt-producing reactions to higher-temperature assemblages consisting of garnet, cordierite, K-feldspar and orthopyroxene. In comparably Fe-rich samples (bulk-XMg: 0.32-0.41) of the northern Madurai Block Grt(XMg up to 0.33)-Bt-Sil-Kfs±Qtz constitutes the peak-assemblage, which equilibrated at c. 780°C and c. 8 kbar. More magnesian metapelites (bulk-XMg: 0.42-0.51) occur in the central and eastern Madurai Block. The peak-assemblage Grt(XMg up to 0.46)-Crd-Sil-Kfs-Qtz formed at 800-900°C/6-7 kbar. Cordierite coronas around garnet record decompression to 4-5 kbar at c. 750°C. Mg-rich metapelites (bulk-XMg: 0.58-0.69) of the central Madurai Block preserve the assemblage Grt(XMg up to 0.56)-Opx(Al₂O₃: up to 5.8 wt%)-Sil-Kfs-Qtz, which equilibrated at peak-conditions of c. 850°C/ c. 7 kbar. Garnet is resorbed by conspicuous decompression textures, including cordierite coronas, Crd-Spl symplectites and Crd-Opx (Al₂O₃: up to 6.0 wt%) symplectites, which record decompression to c. 5-6 bar/c. 800°C. In Mg-rich samples (bulk-XMg: 0.58) of the western Madurai Block the peak-assemblage Opx(Al₂O₃: up to 6.5 wt%)-Crd-Kfs-Qtz formed at c. 850°C and low pressures of c. 5 kbar. The clockwise P-T paths recorded by all studied metapelites are attributed to a Pan-African orogenic event related to the Gondwana formation. Since the age of high-grade metamorphism in the Madurai Block is controversial and is interpreted to occur in the early Cambrian (Collins et al., 2007) or early Neoproterozoic (Braun et al., 2007) a precise tectonic interpretation remains uncertain. We will conduct chemical dating of monazite and U-Pb dating of zircon to link the P-T paths with the geochronological record.

References

- Braun I, Cenko-Tok B, Paquette J-L, Tiepolo M (2007) *Chem Geol* 241: 129-147
Collins AS, Santosh M, Braun I, Clark C (2007) *Precambrian Res* 155: 125-138

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