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TIMING AND DURATION OF ULTRA-HIGH TEMPERATURE METAMORPHISM IN SAPPHIRINE-BEARING METAPELITE GRANULITE FROM KODAIKANAL, MADURAI BLOCK, SOUTH INDIA: CONSTRAINTS FROM MINERAL CHEMISTRY AND U-TH-TOTAL Pb EPMA AGE OF MONAZITE

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Abstract

The southern part of Peninsular India, popularly known as the Southern Granulite Terrane (SGT) witnessed a pervasive granulite facies metamorphism, ductile shearing and widespread migmatization during Pan-African orogeny, which marks the final assembly of the Gondwanaland during Cambrian (ca 500 Ma). The tectonic evolution of SGT, irrespective of its Gondwana connection, is far-reaching due to occurrences of ultra-high temperature (UHT) granulites in different parts of the SGT. In the present study, dynamics of melting and temporal evolution of sapphirine-bearing metapelite granulite, hosted within the Kodaikanal charnockite massif, during syn- to post-UHT metamorphic conditions are examined.

The onset of UHT metamorphism in the rock is marked by the growth of Al-rich orthopyroxene (Al_2O_3 ~ 8 wt%) porphyroblast, sapphirine-cordierite symplectite via biotite dehydration melting. Embayment of orthopyroxene porphyroblast and accumulation of melt, now preserved as mesoperthites, in the pressure shadow region around the porphyroblast attest to syn-tectonic melting and crystallization. Monazites of varying sizes (40 to 100 mm) occur pervasively, either as inclusion in peritectic phases or in the biotite-mesoperthite rich matrix. Diagnostic chemical variation diagram, such as 4(REE+Y+P) versus 4(Th+U+Si), (Si+Y+REE) versus (Ca+P) suggests that the core and rims domains are linked by dominantly huttonitic ($Th^{4+}+Si^{4+} = REE^{3+} + P^{5+}$) and cheralite ($Th^{4+}+Ca^{2+} = 2REE^{3+}$) substitutions. An increase in partitioning of Th towards the rim is also accompanied with a decrease in La/Sm ratio towards the rim. This together with core to rim chemical variation in monazite attests to monazite growth (core) and overgrowth (rim) during peak UHT metamorphism and subsequent cooling. U-Th-total Pb monazite ages constrain the timing of dehydration melting as well as peak UHT metamorphism at ~560 Ma and post-peak cooling at ~510 Ma. This establishes a time span of about 50 Ma for UHT metamorphism in Madurai Block.

Keywords: UHT metamorphism, monazite, EPMA chemical age, Pan-African orogeny