

Spinel+quartz assemblage in granulites from the Southeastern Madurai Block- Southern Granulite Terrain, India: Implications for ultrahigh-temperature Metamorphism

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Evolution of the ultrahigh-temperature Mg-Al granulites of southeastern Madurai Block serves as a window to mid- deep crustal processes and metamorphism. Spinel bearing khondalites are collected from southeastern part of Madurai Block that fall outside the Kambam UHT belt. Spinel+quartz assemblage enclosed within garnet in garnet orthopyroxene–cordierite granulites from keelaparpatti within the southeastern Madurai Block. Garnet contains numerous inclusions along sillimanite and biotite as well as spinel and quartz. The spinel in direct contact with quartz has moderate X_{Mg} ($= Mg / (Fe^{2+} + Mg) = 0.44\text{--}0.47$), and is Zn and Fe^{3+} poor ($X^{Zn} = Zn / (Fe_{2+} + Mg + Zn) = 0.027\text{--}0.036$, $Fe_{3+} / (Fe_{2+} + Fe_{3+}) = 0.12\text{--}0.17$). Spinel is also present in the matrix surrounded by magnetite, but the matrix spinel contains more Zn ($X^{Zn} = 0.067\text{--}0.072$) and does not show any contact relationship with quartz. Such Zn- and Fe^{3+} -poor spinel in direct contact with quartz has been regarded as a diagnostic evidence of ultrahigh-temperature (UHT) metamorphism. The diagnostic mineral assemblages, reaction textures and mineral chemical data obtained from the studied samples revealed ultrahigh temperature conditions. This implies that the Madurai Block has undergone peak metamorphic conditions at a temperature above 900° C. Phase diagrams provide further evidence for UHT conditions, which demonstrate a temperature above 950° C at a pressure range of 5 -12 kbar. The U-Pb zircon ages indicate that the area was metamorphosed at 550 Ma during final stages of Gondwana amalgamation. These ages, petrological characteristics and PT conditions are in accordance with data documented from previous studies within these UHT localities of the southeastern Madurai Block. Also, spinel + quartz assemblage enclosed in poikiloblastic texture garnet has also been reported from the southeastern part of Madurai Block trace of a major suture zone within the Gondwana amalgam with evidence for prograde high-pressure metamorphism followed by UHT event. The spinel + quartz may consequently indicate decompression from higher pressure conditions which accompanied the final collision and amalgamation of the Gondwana supercontinent during the latest Neoproterozoic.

Keywords: South-eastern Madurai block, ultra-high temperature, spinel-quartz