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Garnet-spinel intergrowths in ultrahigh-temperature granulite, Eastern Ghats, India: Possible evidence of an early Tschermak-rich orthopyroxene during prograde metamorphism

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ABSTRACT

UHT metamorphosed aluminous granulites from the Eastern Ghats Belt, India, contain contrasting mineral assemblages in closely spaced domains. Reaction textures and mineral chemistry in one domain are consistent with prograde metamorphism. A unique intergrowth texture is found in garnet porphyroblasts from the other domain. Lamellar to vermicular intergrowth of spinel solid-solution occurs in garnet, particularly in the central part of the porphyroblast. Locally, sapphirine, overgrowing spinel, is also intergrown with garnet. Three possible mechanisms are discussed to account for the garnet-spinel intergrowth: (1) from early stabilized orthopyroxene + sillimanite; (2) spinel forming pseudomorphs after early sillimanite inclusions in garnet; and (3) from an early stabilized hypothetical, highly aluminous orthopyroxene involving a complex reaction between the (Fe,Mg)-Tschermak and Fe^{3+}-Tschermak components. Sapphirine is produced by a reaction involving spinel and aluminous pyroxene. Regardless of the exact mechanism, available thermodynamic data suggest that all such reactions presumably occurred due to loading and/or heating during prograde metamorphism consistent with the conclusion from the other domain. Such an intergrowth texture has not been reported previously in aluminous granulite parageneses, but these could provide crucial information regarding the prograde segment of the metamorphic evolution of deep crustal rocks.

Keywords: garnet-spinel intergrowth, early aluminous orthopyroxene, prograde path for UHT rocks, Eastern Ghats, India