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Multiple breakdown and chemical equilibrium of silicic clinopyroxene under extreme metamorphic conditions in the Kontum Massif, central Vietnam

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Abstract

Clinopyroxene in ultrahigh-temperature mafic granulites from the Kontum Massif in central Vietnam records multiple metamorphic stages, manifested as exsolution textures (quartz rods and orthopyroxene + hornblende + plagioclase needles), and as symplectitic intergrowths (involving clinopyroxene + plagioclase). These textures suggest a metamorphic evolution characterized by decompression and subsequent cooling from eclogite-facies to amphibolite-facies conditions through ultrahigh-temperature conditions. Quartz rods in clinopyroxene and clinopyroxene + plagioclase symplectites were formed under eclogite conditions prior to ultrahigh-temperature metamorphism. The orthopyroxene + hornblende + plagioclase needles in clinopyroxene are regarded as cooling products after ultrahigh-temperature metamorphism. Recalculated compositions of precursor clinopyroxene show supersilicic composition. During the metamorphic evolution, the chemical composition varies from silicic (Ca-Eskola-rich) via sodic (Jadeite-rich) to aluminous (Ca-Tschermak-rich) compositions. Presence of supersilicic clinopyroxene suggests that the granulite decompressed from possible ultrahigh-pressure conditions (ca. 800–900 °C at 2–3 GPa) preceding the ultrahigh-temperature stage (1050 °C at 1.3 GPa), which provide strong constraints on the tectonic evolution of the Indochina region, and it also provides insights on crustal exhumation at a continental collision zone. Another significant aspect of this study is that the breakdown textures of clinopyroxene and its chemical variations may provide important information in establishing pre- and post-peak evolution, especially for extremely high-temperature or high-pressure metamorphic rocks.

Keywords: Silicic clinopyroxene, exsolution, ultrahigh temperature, ultrahigh pressure, Kontum Massif, Vietnam