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The genesis of mantle-derived sapphirine

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Abstract

Sapphirine, a typical ultrahigh-temperature metamorphic mineral, is rarely found in mantle xenoliths. Here we report the occurrence and characteristics of sapphirine in a mantle-derived xenolith from the Cenozoic basalts of Hannuoba in the North China Craton. The xenolith consists of a clinopyroxene, spinel, and sapphirine assemblage, with the sapphirine occurring as the reaction rim surrounding spinel. The mineral compositions of this sample are all characterized by high Mg contents, similar to those of minerals from other sapphirine-bearing rocks reported from high-Mg-Al granulites elsewhere in the world. Clinopyroxene is relatively rich in Al and Ca in comparison to pyroxene in peridotite and pyroxenite xenoliths in the Hannuoba basalts, as well as in global mafic and felsic granulites in other terranes, a feature that is consistent with the bulk composition. The *P-T* compilations from both experimental and natural rock data show a restricted stability field for the coexisting clinopyroxene + spinel + sapphirine assemblage of around 8–15 kbar and 800–900 °C. The rare occurrence of sapphirine in a mantle-derived xenolith therefore suggests specific bulk composition, restricted*P-T* range and possible melt-peridotite interaction. Such conditions are best satisfied in a tectonic setting with basaltic magma underplating and interaction between the infiltrating melts and the wall-rock peridotite.

Keywords: Sapphirine, pyroxenite, *P-T* condition, North China Craton