



Petrogenetic grids for sapphirine-bearing granulites

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Phase relations involving sapphirine, garnet, spinel, orthopyroxene, olivine, cordierite, alumina silicates, corundum, and quartz have been calculated in the system $\text{FeO}-\text{MgO}-\text{Al}_2\text{O}_3-\text{SiO}_2$ based on internally consistent thermodynamic properties of both the end-member minerals and the solid solutions (Gerya et al., 2004; Podlesskii et al., 2008). The derived P-T diagrams imply stable invariant points and stability fields of key assemblages that differ from those proposed by other authors (Kelsey et al., 2004; Harley 2008). The sapphirine + quartz assemblage, which is widely recognized as indicative of ultrahigh-temperature metamorphism, can be stable down to 835°C and ~6 kbar. The sapphirine + kyanite assemblage has been found stable at temperatures below 860°C and 11.3 kbar, whereas the sapphirine + forsterite assemblage may be stable below 800°C only under specific conditions of a very low activity of water. The existing constraints on the thermodynamic properties of sapphirine are considered insufficient to make decisive conclusions about metamorphic conditions. Granulites containing the sapphirine + quartz assemblage have been investigated with the microprobe to apply both the conventional thermobarometry and thermometry based on Ti contents of quartz (TitaniQ, Wark & Watson, 2006). The results demonstrate that, in some cases, this assemblage might have formed at relatively low temperatures during retrograde stages of metamorphism.

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