Neoproterozoic fayalite-bearing charnockite from south-eastern India—its genesis and metamorphism

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Rare fayalite-bearing charnockite (orthopyroxene-bearing granitoid) has been identified at the south-eastern edge of the Madurai Block, a little-studied remnant of the south-eastern part of the Southern Granulite Terrane, India. The major rock type in the region is hornblende-rich charnockite, intercalated with thin disrupted layers of pyroxenite and garnet-rich felsic rocks. Fayalite-bearing charnockite is exposed in a rock quarry and nearby regions, hosted within hornblende-rich charnockite. The major reaction texture present is coarse-grained fayalite and clinopyroxene rimmed by orthopyroxene coronas. The clinopyroxene grains have criss-crossing exsolution lamellae of orthopyroxene oriented in at least three directions, a texture indicating that the primary clinopyroxene was pigeonite. In a few domains fayalite is associated with magnetite and minor quartz. The matrix assemblage is mostly plagioclase, mesoperthite and minor quartz. Zircon is associated with both the mafic and felsic matrix mineral assemblages. Zircon grains associated with olivine or clinopyroxene are rounded, with a concentrically zoned CL-bright core rimmed by a CL-dark mantle overprinted by a thin grey rim. Zircon grains associated with mesoperthite and plagioclase are more elongate, with a similar zoning pattern but a thick outer rim. Temperature estimates based on the composition of clinopyroxene and integrated mesoperthite are *ca.* 850–890˚C. The *P-T* estimates based on an isochemical phase diagram show that the primary minerals were formed at high temperature (*ca.* 850˚C) at a pressure of *ca.* 7.5 kbar. These mineral assemblages were later overprinted by orthopyroxene at a similar temperature (*ca.* 800˚C) but lower pressure (*ca.* 6 kbar). The U-Pb zircon dating gave a mean core age of *ca.* 800 Ma and rim age of *ca.* 520 Ma. There is a small cluster of analyses (n = 4) at *ca.* 670 Ma. Based on the textural relations and dating, the primary magma was emplaced at *ca.* 800 Ma, possibly in connection with the break-up of the Rodinia supercontinent. Primary zircon was later overgrown by *ca.* 520 Ma rims during metamorphism and orthopyroxene formation associated with the amalgamation of Gondwana. The primary crystallization of fayalite along with clinopyroxene falls below the fayalite-magnetite-quartz buffer, indicating low activity of oxygen and volatiles such as H_2O. This conclusion is supported by the absence of hydrous phases such as hornblende or biotite in any of the observed fayalite-bearing charnockite samples. These results indicate that during Rodinia break-up the lower crust of south-eastern India was subject to a high-temperature heat pulse under highly reducing conditions.

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