スリランカ Wanni 岩体 Ginikarawa に産出する incipient charnockite の形成過程

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Petrogenesis of incipient charnockite at Ginikarawa in the Wanni Complex, Sri Lanka: new insights from phase equilibrium modeling

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Charnockite (orthopyroxene-bearing brownish to dark grayish granitic rock) is known as one of the fundamental lithologies in many granulite terranes worldwide. It occurs either as large massive bodies probably crystallized from dry felsic magma (which corresponds to 'igneous charnockite'), or small (a few dm to several m) irregular patches or tubes within foliated orthopyroxene-free biotite gneiss probably formed during high-grade metamorphism. Patchy distribution of the latter charnockite, which is called as 'incipient charnockite', overprinting the foliation of host biotite- and/or calcic amphibole-bearing hydrous gneisses clearly suggests dehydration reaction/melting processes during the formation of such metamorphic charnockite. Such incipient charnockite patches have been found in many high-grade metamorphic terranes, particularly in southern India, Sri Lanka, and Madagascar, which correspond to the major part of the Gondwana orogeny formed by continent-continent collision during Neoproterozoic to Cambrian (590-530 Ma). However, detailed petrological study particularly focused on the fluid condition associated with incipient-cuarnockite formation in Sri Lanka is still limited.

In this study, we report the petrogenesis of orthopyroxene-bearing assemblage of incipient charnockite at Ginikarawa near Kurunegala in the Wanni Complex, Sri Lanka, on the basis of petrography and mineral equilibrium modeling. In Ginikarawa, dark brownish to grayish irregular patches and lenses of charnockite (biotite + orthopyroxene + K-feldspar + plagioclase + magnetite + ilmenite + quartz) occur within orthopyroxene-free leucocratic biotite ± hornblende orthogneiss (biotite + K-feldspar + plagioclase + magnetite + ilmenite + quartz ± ferro-edenite). The application of mineral equilibrium modeling on the mineral assemblage within charnockite in NCKFMASHTO system to constrain the conditions of incipient-charnockite formation defines a *P–T* range of 3.0-3.7 kbar and 740-790^{o}C at relatively low H_2O activity ($a(H_2O)$) condition of 0.46. We confirmed that orthopyroxene becomes unstable at higher H_2O activity condition of >0.46, which is consistent with the available model of incipient-charnockite formation that local decrease in $a(H_2O)$ within hydrous biotite gneiss gave rise to the progress of dehydration reaction and formation of orthopyroxene-bearing assemblage. The estimated *P–T* condition is lower than the available peak metamorphic conditions reported for typical granulites from the Wanni Complex (~850°C and ~7 kbar). Our phase equilibrium modeling therefore confirmed that incipient-charnockite formation is a post-peak retrograde event possibly related to local infiltration of low-$a(H_2O)$ and CO_2-bearing fluid.