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Temporal change of modal abundance of minerals during formation of arrested charnockite from Sri Lanka

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Charnockite occurs as a number of several-decimeters patches in hornblende-biotite gneiss in central Sri Lanka. This type of charnockite has been called arrested charnockite. Local condition of low-H_2O activity or low-oxygen fugacity could explain the difference of mineral assemblage in local scale. They might be caused by fluid influx and/or partial melting (e.g. Newton et al., 1980; Hiroi et al., 1990; Burton and O'Nions, 1990; Ravindra Kumar, 2004; Endo et al., 2012). The temporal and spatial development of charnockite has been unclear. This study describes variation in modal abundance of hornblende, biotite and orthopyroxene in melanocratic and leucocratic parts from surrounding gneiss to charnockite.

Charnockite and surrounding gneiss have layer structure composed of melanocratic and leucocratic parts. Each part can be traced continuously between the two rock types. Melanocratic parts consist mainly of hornblende and biotite in gneiss, and orthopyroxene added in charnockite. Leucocratic parts are composed of biotite and colorless minerals in gneiss, while biotite is absent in charnockite. Modal abundances of hornblende and biotite have no systematic trend in melanocratic parts of gneiss. Hornblende and biotite decrease drastically and gradually, respectively, while orthopyroxene increases gradually in melanocratic parts of charnockite. Biotite decreases gradually toward charnockite in leucocratic parts in gneiss.

Biotite of leucocratic parts breaks down within gneiss. Orthopyroxene appears in the location of dehydration reaction of biotite and hornblende in melanocratic parts. This suggests that the element released due to break down of biotite in leucocratic layer diffused from leucocratic part to melanocratic part to produce orthopyroxene. It is a possible that hornblende broke down first to produce significant amount of orthopyroxene in melanocratic part. The element released due to break down of biotite in leucocratic part transported to the location of preexisting orthopyroxene in order to grow the crystals. Biotite in leucocratic layers is enriched in Fe as compared with that in melanocratic part. Fe-rich biotite breaks down under lower temperature (or higher activity of H_2O) than Mg-rich biotite. This could explain the decrease of biotite in leucocratic layer in gneiss.

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