ORIGIN AND EVOLUTION OF GNEISS-CHARnockite ROCKS OF
DHARMAPURI DISTRICT, TAMIL NADU, INDIA; D. Rameshwar Rao and B.L.
Narayana, National Geophysical Research Institute, Hyderabad, India -
500 007

A low- to high-grade transition area in Dharmapuri district has
been investigated petrologically and geochemically. The investigation
has confirmed the continuous section through a former lower crust, with
felsic charnockites predominating the lower part and felsic gneisses
the upper part.

The structure of original gneisses is preserved in charnockites
and the latter show petrographic evidence for prograde metamorphism.
The prograde metamorphism is of isochemical nature as revealed by the
similarity of compositions of tonalitic gneisses and tonalitic
charnockites. However, the depletion of LIL elements particularly Rb,
caused variation in K/Rb ratios from low values (345) in the gneisses
in upper part to higher values (1775) in the charnockites in the lower
crust. This variation in K/Rb ratio in a north to south traverse is
related to the progressive break-down of hydrous minerals under
decreasing H₂O and increasing CO₂ fluid conditions. Metasomatism and
partial melting has also taken place to a limited extent along shear
planes and weak zones. During cooling the H₂O circulation affected
substantial auto-regression in the transition zone resulting in the
formation of second generation biotite.

Geothermometry and geobarometry of orthogneisses also show a
prograde metamorphism from about 5-6 Kbars and 725±25°C near the
orthopyroxene isograd at the top of the section in the north, to about
7 to 8.5 Kbars and 775±25°C towards south. The progressive increase in
metamorphic grade is demonstrated by the systematic change in the
mineral composition from felsic gneisses in the north to felsic
charnockites in the south (eg. hornblende composition varying from
hornblende-edenite to pargasite composition, and increase in contents
of An in plagioclase, Ti in biotite and hornblende). The mineral
chemistry in such rocks can record a depth of equilibration of minerals
at 18 to 21 km and 25 to 29 km, and indicate steep geothermal gradients
ranging from 35 to 38°C/km and 26 to 30°C/km in the upper and lower
parts of the crust respectively. The presence of such rocks now at
the surface of the continental crust (ca. 35 km) could be cited as an
evidence for this part of the Archaean crust to have been at least 53
to 64 km thick. The differences in recorded pressure conditions might
be related to the differences in erosional rates, rather than to
tectonism.
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The petrochemical studies do not support the formation of the precursors (rocks of tonalitic and mafic composition) through primary fractionation of andesitic-dacitic magma or intra-crustal partial melting. The origin of precursors may be explained by the fractional crystallization of basaltic magma or partial melting of amphibolite, leaving a mafic restite containing hornblende.

REFERENCES