Abstract

This investigation is based on detailed geological mapping of the Banpur-Balugaon anorthosite body and the bordering granulites, detailed petrographic study, whole rock chemistry, mineral chemistry and quantitative estimation of equilibrium P–T–a_{H_2O} conditions. Field relations and geological mapping of about 180 km^2 of the massif anorthosite-granulite association and statistical analysis of the foliations of the granulites and the primary flow layers and the joint system of the anorthositic rocks provides strong evidence of a forceful domical intrusion of the anorthositic pluton pushing apart the envelope of granulites thereby reorienting the structural elements of the granulites along the border. Structural data do not show any evidence of post intrusion tectonic event on a regional scale. The plagioclase rich anorthositic suite of rocks (in order of increasing abundance) includes norite ($>$ 35% mafic minerals), noritic anorthosite ($10 - 22.5$% mafic minerals) and anorthosite ($<$ 10% mafic minerals), the chief mafic mineral being orthopyroxene. The bordering granulites include (in order of decreasing abundance) charnockites (K-feldspar + plagioclase + quartz + garnet + orthopyroxene + biotite + ilmenite + apatite $\pm$ zircon $\pm$ sphene), khondalites (quartz + K-feldspar + garnet + sillimanite $\pm$ biotite $\pm$ rutile $\pm$ ilmenite), leptynites (K-feldspar + quartz + garnet + plagioclase $\pm$ biotite $\pm$ apatite $\pm$ rutile $\pm$ zircon $\pm$ allanite) and basic granulites (plagioclase + orthopyroxene + clinopyroxene + ilmenite $\pm$ hornblende $\pm$ biotite $\pm$ apatite). The major element compositions indicate a feeble fractionation trend: norite $\longrightarrow$ noritic anorthosite $\longrightarrow$ anorthosite with con-

siderable degree of compositional overlap. MgO/FeO ratio also indicates the iron enriched character of these anorthositic rocks. The Sr and Rb contents in the anorthositic rocks are also relatively low. REE data, however, show the noritic rocks to be more fractionated than the anorthosites. This may be due to the parallel evolution of early separated, modally sorted anorthosite and later developed noritic members in the upper cryptic sequence of a precursor layered complex, parental to the anorthosite massif. REE data also rule out any comagmatic relationship between the anorthosites and the granulites. The major Fe-Mg silicates of both the anorthosites and the granulites show a broad compositional similarity. These minerals are slightly more Fe-enriched in the granulites. The plagioclse composition range ($An_{64}-An_{86}$) in the anorthositic rocks is distinctly more calcic than in most massif type anorthosites. The granulites have more sodic plagioclases ($An_{46}-An_{56}$).

Geothermobarometric calculations from eight different mineral equilibria show a P-T convergence in the anorthosites and the granulites within the 3–6.5 kbar and 460°–720°C range. The orthopyroxene-garnet thermometer (Harley) and orthopyroxene–plagioclase–garnet–quartz barometer (Moecher–Essene–Anovitz) narrow down the convergence to a tighter P-T bracket of 5–6 kbar and 600°–720°C range. A single episode of slow cooling and annealing of the pluton after its intrusion during a pervasive thermal-teconic event is the likely major cause of this P-T convergence. Uniformly low a_{H_2O} values in both the anorthosites (0.052–0.160) and the granulites (0.067–0.382) point to a deep seated magmatic invasion and control. Careful analysis of the garnet core and rim P-T values along with the constraints of Al_2SiO_5 phase relations brings out a moderately steep cooling and upward transport path of the anorthosite within the calculated P-T range. The decompressional history interpreted from textural features and geothermobarometry and P-T path studies suggests that the exhumation of the anorthosite-granulite interface is related to crustal thickening by a magmatically induced process.