Abstract

In the Eastern Ghats Belt of India, granulite facies metapelites, feldspathic gneisses, calc-silicate gneisses and megacrystic granitoids of the Eastern Ghats Province (EGP) are separated from Archaean enderbites and charno-enderbites of the Jeypore Province in the west by a regional-scale lineament. This lineament is identified as the Sileru Shear Zone (SSZ). The EGP underwent ultrahigh temperature (UHT) metamorphism in Grenvillian times (980-930 Ma). The Koraput Alkaline complex (KAC) is hosted by the EGP and is located about 3 km east of the contact between the Jeypore Province and Eastern Ghats Province. The KAC comprises a central alkali gabbro fringed by nepheline syenite in the east and syenodiorite in the west. Reticulate syenite dykes, mafic dykes (metamorphosed to amphibolite) and pegmatitic granite cut across the gabbro. Previously, emplacement of the KAC was inferred to be syn- to late tectonic with respect to movement along the SSZ. In this work, structural study demonstrates that the KAC was emplaced after the earliest identified deformation (D_{1CR}, CR= country rocks) and associated granulite facies metamorphism in the EGP. A second, NE-SW trending and easterly dipping fabric (S_{2CR}) formed during penetrative thrust-related shearing (D_{2CR}) that is correlated with movement along the SSZ. D_{2CR} was accompanied by stabilization of biotite and amphibole in lithologies of the EGP. Retrogression continued during a third, localized shearing event (D_{3CR}) that resulted in E-W trending and steeply south-dipping shear bands. In the rocks of the KAC, an early magmatic fabric S_{1AC} (AC= alkaline complex) is preserved in the central part of the gabbro. This foliation is transposed parallel to a NE-SW trending easterly dipping S_{2AC} foliation that is well-developed in marginal parts of the complex and similarly oriented shear bands within the KAC. S_{2AC} is defined by biotite and amphibole and developed during a second deformation event, D_{2AC}. Structural orientations of S_{2CR} and S_{2AC} are conformable, implying that the KAC shared the D_2 deformation with its country rock. As in the surrounding EGP lithologies, a third deformation event (D_{3AC}), characterized by E-W trending shears, also occurs in the KAC. In the Jeypore Province to the west, an early S_{1JP} foliation defined by a granulite facies mineral assemblage is also transposed parallel to a biotite-defined S_{2JP} fabric that is correlatable with S_{2CR} across the contact. This indicates that the D_{2JP} deformation in the Jeypore Province is coeval with D_{2CR} in the EGP. Therefore, the two provinces must have been amalgamated prior

to this shared deformation (D_2) event. Microstructural and anisotropy of magnetic susceptibility studies on the KAC confirm that the D_{2AC} and D_{3AC} deformations in the complex occurred entirely in solid state, and suggest that temperatures increased progressively through these two events. Metamorphic studies on the feldspathic / quartzofeldspathic gneisses and megacrystic granitoid in the EGP reveal that orthopyroxene related to the early granulite facies metamorphism was retrogressed to biotite during D_{2CR} and D_{3CR}. A second granulite facies metamorphic event resulted in destabilization of this biotite to an assemblage of ilmenite, garnet, K-feldspar, orthopyroxene ± clinopyroxene. In the KAC, magmatic amphibole and biotite likewise broke down during post-D_{3AC} metamorphism, also stabilizing an assemblage that includes garnet, orthopyroxene, clinopyroxene and K-feldspar. The Jeypore Province also documents a sequence of reactions parallel to those observed in the EGP lithologies. Peak metamorphic temperatures and pressures during this second phase of granulite facies metamorphism in the granulites of the EGP and the Jeypore Province is estimated to be around 8 Kb, 800°C. Similar estimates are obtained from the metamorphic imprint within the KAC. The sequence, in which texturally constrained reactions occurred, coupled with Schreinemakers' analysis on the relevant mineral combinations in quartzofeldspathic gneisses of the EGP and the syenite dykes of the KAC, indicates a prograde sequence of heating followed by loading. In all cases, the activity of water was inferred to be low (< 0.2). Fluid inclusion studies on the KAC rocks indicate that the low water activity can be attributed to the presence of a carbonic fluid at the metamorphic peak, followed by rapid decompression. The heating followed by loading trajectory of the documented metamorphic imprint, and the subsequent rapid decompression are consistent with a tectonic model that involves fast convective thinning of the mantle lithosphere during shortening. Since amalgamation of the EGP and the Jeypore Province was complete before the observed metamorphic imprint, the entire tectonic event must have been intracratonic in nature.

Keywords: Eastern Ghats, Koraput Alkaline Complex, granulite facies metamorphism, anisotropy of magnetic susceptibility, fluid inclusions, reworking, P-T path.