Pressure, temperature and fluid regimes in selected granulite tracts of the Eastern Ghats of India

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The Eastern Ghats Belt, skirting the eastern coast of India, exposes mainly granulites, anorthosites, alkaline rocks and granitoids. There is a widespread impress of three periods of deformation throughout the belt, with F_2 resulting in NE-SW trending structures, the most pervasive. The ages of metamorphism reported commonly are middle to late Proterozoic; vestiges of 2.5-2.7 Ga events have also been recorded in a few places.

The high-grade metamorphic rocks consist of charnockites, basic and metapelitic granulites and gneisses, in the main. Among the variety of mineral assemblages observed, some display well-developed corona and other reaction textures, which help trace the changes in the pressure, temperature and fluid regimes during cratonisation processes. Applying some common discontinuous and continuous mineral reactions towards this end, sets of similar clusters of frozen pressures - temperatures are evident in the granulite terranes of Angul, Chilka, Bolangir, Koraput, Paderu, Araku Valley, Garbham and Vizianagram. The peak temperatures and pressures attained by these granulite suites are 900^0-1000^0C and 8.5 - 10 kbar. These values are obtained from (i) orthopyroxene - garnet thermometry in basic granulites as in Koraput, Araku and Garbham; (ii) corona garnet of virtually pure grossular composition between wollastonite and plagioclase in wollastonite - calcite - quartz plagioclase - scapolite assemblages in calc - gneisses, as in Angul and Koraput; and (iii) stability relations of sapphirine as in Paderu, Araku Valley and Vizianagram.

Subsequent to reaching peak conditions, isobaric cooling resulted in prolific development of garnet coronas in basic granulites and charnockites.

Pyroxene-garnet thermometry shows that the relevant equilibrium conditions are in the neighbourhood of 700^0C at 6-8 kbar. The stamp of this P-T

set is pervasive in the Eastern Ghats, e.g., Angul (680°C, 7.2 kbar), Chilka (730°C, 6.2 kbar), Koraput (720°C, 8.2 kbar), Araku (750°C, 8.2 kbar), Paderu (760°C, 5.0 kbar).

In addition to these generally observed IBC paths, petrological lines of evidence suggestive of Isothermal Decompression Paths (ITD) have been uncovered at the Araku Valley, Vizianagram, Anakapalle and Paderu on the basis of mineral reactions, such as those producing cordierites.

Quantitative estimates of fugacities of H_2O and O_2 are available only for the Angul, Koraput and Chilka granulites, and to some extent for those from Bolangir. It was found that aH_2O was low in general ($X_{H2O} < 0.3$), and log f_{H2O} - log f_{O2} plots indicate fluid-absent metamorphism. The derived log f_{O2} values plot below QFM buffer and $C + O_2 = CO_2$ reaction in graphite-absent assemblages and signify the absence of CO_2-rich fluids. Subtle variations in X_{H2O} preserved in adjacent lithologies indicate fluid buffering by mineral assemblages. In Angul and Koraput, whole rock $\delta^{18}O$ values in spatially adjacent litho-units are different (+ 5.2 to + 11.8, + 5.3 to 8.1 per mil), thereby precluding pervasive fluid fluxing.

It will be of interest to search for and map signatures of ITD paths impressed after cratonisation processes, reflected in IBC paths, that matured these crustal segments, and to date them with respect to major metamorphic events as well as to the formation of the Godavari and Mahanadi rifts.