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THE NATURE OF THE INVERSE METAMORPHISM IN SIKKIM HIMALAYA AND ITS IMPLICATION

SOMNATH DASGUPTA[1], SUMIT CHAKRABORTY[2] and SUDIPTA NEOGI[3]

[1]*Department of Geological Sciences, Jadavpur University Kolkata700032, India*
[2]*Institute of Geology, Mineralogy & Geophysics Ruhr University, 44780 Bochum, Germany*
[3]*Geological Survey of India AMSE Division, Bangalore, India*

A continuous inverted Barrovian metamorphic sequence is well preserved in the Sikkim Himalaya, where the grade of metamorphism consistently increases towards progressively higher structural levels. The position of the Main Central Thrust (Zone) (MCTZ), which supposedly separates the Lesser Himalayan (LH) rocks from the Higher Himalayan (HH) rocks, in the Sikkim Himalaya is controversial. We have carried out detailed structural, geochemical and petrologic investigations of the entire sequence right from the chlorite zone to the sillimanite-K-feldspar-garnet-cordierite-spinel zone, thus covering the so-called LH, MCTZ and HH domains. Ductile shear zones occur throughout the sequence, and it is difficult to assign a particular zone as MCTZ. Porphyroblastmatrix relationships show one major phase of different isogradic mineral growth broadly synkinematic with the pervasive planar structure in all the units. Development of isograds (or isoreactiongrads) is remarkably continuous when bulk compositional effects are properly considered. Careful thermobarometry, performed after obtaining Xray compositional maps and profiling and using updated and well-constrained thermobarometers, shows a progressive increase in *both P and T* towards higher structural levels. Peak PT conditions range from 4.8 kbar, 490°C at the garnet isograd to 8.4 kbar, 715°C in the sillimanite – Kfeldspar zone in East Sikkim, and from 6 kbar, 552°C at the kyanite isograd to 10.5 kbar, 754°C in the sillimanite-K-feldspar zone in North Sikkim resulting in metamorphic field gradients of 62.5°C/kbar and 40.5° C/kbar, respectively. The thermobarometric results are consistent with relevant phase equilibria constraints, thereby providing further credence to the results. Bulk chemical characteristics of the rocks from the entire sequence show no break or jump in any compositional parameter across the metamorphic grades. The smooth transition from lowest to highest grades, the orderly sequence of reactions, the relationship of mineral growth to one deformational style at all grades, the petrological coherence, and the sequence of recorded P and T both increasing up section, collectively indicate a single, coherent lithotectonic package metamorphosed in one progressive episode in the rocks we have studied. The behavior of the entire sequence as a coherent lithotectonic package places further tight requirements for any tectonic model to be viable. Specifically, any such inversion mechanism must ensure that the metamorphic sequence behave as a coherent unit.

Keywords: Sikkim Himalaya; Inverted Metamorphism.