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Low pressure-high temperature compressional tectonics in Central Indian Tectonic Zone: A study of the metapelites of Mahakoshal Group of rocks in Central India

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The Palaeoproterozoic Mahakoshal Group of rocks in the northern part of the Central Indian Tectonic Zone is exposed as disjoint regional scale outcrops along a linear horst bounded by the Son-Narmada-North Fault in the north and the Son-Narmada-South Fault in the South. The portion of Mahakoshal Group exposed near the city of Jabalpur is chiefly composed of dolomitic marbles, calc-silicates, metapelites, psammopelites, minor quartzite and deformed granitoids. Interpretations of field features in combination of microtextural studies from calc silicates and adjoining pelites identify three sets of folds (F_{1-3}) that are correlated with three deformational phases (D_{1-3}). The first set of folds (F_1) are plane noncylindrical with development of regional axial planar schistosity (S_1) having roughly east–west trend. F_2 folds are near coaxial with F_1 and have developed axial planar schistosity (S_2) only in places. The third set of folds is open with roughly north–south axial plane and without development of any axial planar cleavage. D_1 sheath folds, well developed in both the calc silicate unis, suggest a regional shear zone development during first phase of deformation. This is also corroborated by the structural studies by Roy and Bandyopadhyay (1990).

Porphyroblasts of garnet, staurolite and andalusite have developed in the both low alumina and high alumina metapelites and psammopelites encompassing both D_1 and D_2 deformations. Based on these porphyroblasts, three metamorphic zones, namely garnet zone, staurolite zone and andalusite zone have been marked from north to south. Quantitative geothermobarometry and numerically computed pseudosections in the representative system Mn-NCKFMASH show that the intensity of metamorphism increased from garnet zone (~480°C, 3 kbar) in the north to andalusite zone (~530°C, 3 kbar) in the south with a geothermal gradient of 55 ºC/km that falls in the realm of high temperature–low pressure metamorphism reported elsewhere in the world.

While contact metamorphism easily explains the anomalously high heat flow under low pressure conditions, the Mahakoshal metapelites with syn-deformational andalusite porphyroblast growth typically suggests that the high temperature regime under low pressure conditions prevailed through compressional tectonics. Combining the petrological and microtextural attributes we demonstrate that the Mahakoshal Group of rocks in the study area evolved on a clockwise P–T path that involved two-stage loading during D_1 and D_2 punctuated by a phase of heating under near isobaric conditions. The P–T path agrees well with the model suggested by Thompson (1989). Accordingly, a tectonic model has been suggested that involve the formation of the Mahakoshal rift in the southern extremity of the Bundelkhand craton during the Palaeoproterozoic (≥ 1.8 Ga). Sedimentation initially occurred in an open basin and later in a closed aulacogen. Intrusion of granitoid magma through partial crustal melting, some mafic magma through decompression of the mantle below the thinned crust and finally rift

closure and accompanying moderate thickening of the thinned crust led to the development of low-P-high-T set-up during deformation.

References:

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