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Deformation patterns in the Bagalkot Group of rocks in the intracratonic Kaladgi basin, south western India: A case of Mesoproterozoic gravity gliding of the cover over the basement during basin uplift

Mukherjee, M. K.[1]
[1]Department of Applied Geology, Indian School of Mines, Dhanbad-826004, INDIA.
Email:mrinal_km67@yahoo.co.in

Structural relations between the Archaean basement and overlying Mesoproterozoic sedimentary cover (Bagalkot Group) were examined in the Kaladgi basin of south western India with reference to association, mode of occurrence, distribution, interrelationship, variation and chronology of development of structural elements, deformation microstructures and crustal depths of deformation vis-a-vis subsidence of the cover.

The basement that forms a part of the Western Dharwar Craton is an assemblage of the Archaean Peninsular Gneissic Complex (PGC), Late Archaean Hungund Schist Belt (HSB) and Granites (Closepet Granite). The HSB, composed of Banded Iron Formations, quartzites, metapelites and mafic metavolcanics have undergone multistage deformation (D_1, D_2, and D_3 respectively). The D_1 stage involved a combination of layer parallel buckle shortening along NE-SW (with reference to present day geographic coordinates) and locally distributed layer parallel shear, leading to the development of tight-to-isoclinal recumbent folds that were refolded in the D_2 stage to develop plane non-cylindrical D_2 folds with transposed compositional banding, schistocity and D_2 crenulation lineations. The D_3 stage involved a mild buckle shortening of D_2 structures along NW-SE to develop gentle-to-open, upright, D_3 folds and D_3 crenulation lineations. The orientation of the overall structural grain of the HSB is 310°. The PGC consisting of granitoid gneisses are deformed in phase with the HSB and are parallel to the D_2 structures of the HSB. The Closepet granite (c. 2.5 Ga) is intrusive within the PGC and the HSB and is massive and relatively undeformed, in general.

The Bagalkot Group of the Kaladgi basin are composed of repetitive cycles of coarse siliciclastics (granular arkose, quartz arenites and polymictic conglomerates) and carbonates (limestones and dolomites). Based on type, geometry, distribution and association of structural elements, the deformation structures in the Bagalkot Group can be grouped to define an extensional domain in the northern sectors and a contractional domain in the south–central sectors of the basin. In the northern sectors, a gently dipping homocline that is affected at places by normal faults, tensile and hybrid joints, and torn–apart segments of the cover define an extensional deformation zone. In the south–central sectors of the basin, an association of WNW–ESE trending, both northerly and southerly verging, asymmetric-to-overturned, plane non-cylindrical, gently plunging folds with axial planar cleavages, E-W striking thrusts, and N-S trending strike-slip faults, together define the contractional deformation zone. Distribution, mode of occurrence, variation and interrelationship of structural elements in the cover rocks, indicate that, the extensional and contractional domains are spatially linked and are related to a single deformation event of the cover.

The contrasting structural anatomy of the basement vis-a-vis Mesoproterozoic sedimentary cover of the Bagalkot Group, in terms of geometry, association and inter-relationship of structural elements, deformation history and deformation microstructures, indicate non-involvement of the basement

during the deformation of the cover. The spatially linked extensional and contractional domains of deformation of the cover rocks from north to south in the basin together with the detached basement, indicate the origin of the deformation of the Mesoproterozoic sedimentary cover by a southerly directed gravity gliding of the cover over the basement.

A Study on recrystallized quartz grain-size paleopiezometry from the quartzites and illite crystallinity index from the argillites of the Bagalkot Group, indicate that the basin subsided to a crustal depth of 4-8 km and the gravity gliding of the Mesoproterozoic cover resulted at a relatively shallower crustal depth of 1-3 km during the uplift of the basin.