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COMMENT

Angular unconformity between Sargur and Dharwar supracrustals in Sigegudda, Karnataka Craton, South India

(A comment on the paper by M. N. Viswanatha, M. Ramakrishnan and J. Swami Nath, published in the Journal of the Geological Society of India, Vol. 23, No. 2, pp. 85-89).

I am one among those who consider majority of the enclaves in the gneisses as older than the Dharwar greenstone belts. I do not consider the enclaves as either lower Dharwars or keels or roots of Dharwar greenstone belts. In this respect I agree with the authors of the above mentioned paper and Chadwick *et al.*, (1981).

But the exact role (or physical state) of the gneisses during the folding of Dharwar greenstone belts has not been clearly understood and is not made clear in the paper under discussion. (Viewing this paper in the background of Chadwick *et al.*, 1981).

In this regard I wish to communicate the following comments: (1) While the difference in the metamorphic grade between the rocks of the Dharwar Supergroup (here Sigegudda belt) and the adjoining enclaves in the gneisses (Sargur lithologies) is an acceptable common feature, the structural difference is not everywhere demonstrated. The difference in the attitude of structural elements (specifically, while comparing foliation attitude with bedding plane attitude as done by the authors) is demonstrated only in the western and northwestern portion of the Sigegudda belt while the structural elements are conformable along the eastern margin of the belt. This situation is comparable to that at the southeastern portion of the Bababudan belt (Chadwick *et al.*, 1981); While there is structural *discontinuity* near Sindagere, structural *continuity* is seen between the enlaves east of Machanahalli, and the bedded quartzites/schists within the main Bababudan Basin immediately across the contact. (see Plate I of Sampat Iyengar, 1909. Enclaves east of Machanhalli, are not shown on Fig. 2 of Chadwick *et al.*, 1981). There is thus structural discontinuity as well as continuity. How this happens has to be convincingly explained.

(2) Did or did not the gneisses (with their tracts of enclaves viz; Sargur lithologies) participate in the Dharwar folding? Was there not fresh influx of granitic fluids into the gneisses and along the interface between the gneisses and the main greenstone belts? (barring late to post tectonic granitoids like the Chitradurga or Arsikere granites).

(i) Present morphology of the Dharwar greenstone belts, (ii) structural conformity across the belt margins at many places and higher grade metamorphic impress along the actual margins of the belts, (iii) differences in the composition of the gneissic pebbles of the Dharwar conglomerates when compared with the surrounding gneisses, and (iv) the fact that the gneisses and the tracts of migmatites cannot remain static during the basin shortening process (Dharwar folding), demand participation of the Peninsular gneisses in the Dharwar folding.

The basin shortening, which brought about broad synclinal structure, is a gravity response to extruded heavier basaltic piles sinking into a less dense sialic substratum. This lateral shortening and the consequent partial melting of the down sagged sialic crust, under the P. T. conditions of the Archaean, demand modification of the basement-cover interface zones through upward mobilisation of the granite melt. *The process however, does not necessitate thinking of the enclaves* (Sargur lithologies) *as younger than the gneisses.* On the other hand, it would help in explaining the higher grade metamorphic impress upon the actual borders of certain greenstone belts and remobilisation of gneisses along planes of schistosity of the greenstones.

The gneisses surrounding the Dharwar greenstone belts abundantly exhibit features of deformation in a plastic state, the timing of which has been attributed to as syn-sargur by the authors. But, considering the above mentioned four features, I expect another major event of plastic state deformation coinciding with folding of the Dharwar Supergroup.

The authors have stated (on page 88,) that the ". . . . enclaves of Sargur rocks extending from Sigegudda to Bababudan are *unmodified by the later Dharwar deformational episodes* '. It is dfficult to visualise such a static behaviour of the immediately surrounding migmatite gneisses while the Dharwar belts were involved in this folding. Chadwick *et al.*, (1981, p. 599) on the other hand, have stated that ". . . . . during the deformation of the Dharwar Supergroup, the unconformity with the underlying gneisses and Sargur rocks was rotated to a steep orientation . . . ." (while referring to Ghattihosahalli-Chitradurga belt region).

Accepting that there may well be an unconformity, the two instances just cited taken together with the points raised under (2) above, do not convincingly explain the physical state of the gneiss and the extent of its involvement during the Dharwar folding episode without which the Sargur-Dharwar problem cannot be laid to rest.

(3) The geological map (Fig. 1) published by the authors differs significantly from that of the earlier published map of Sampat Iyengar (1909). Both the maps are of the same scale and hence afford quick comparison. All along the northwestern contact (excepting a small portion) of the quartzite-conglomerate bed, amphibolite (hornblende schist) is shown to be present while the map published by the authors show (excepting a small portion) banded migmatite. This difference necessitates remapping of the northwestern part of the area.

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AUTHORS' REPLY

BASEMENT TECTONICS IN DHARWAR FOLD BELTS

We are gratified to note that V. N. Vasudev is in full argeement with our fundamental thesis that the majority of enclaves or schist relics (designated by us as Sargur Group) are older than the main Dharwar supracrustals (called by us as the Dharwar Supergroup). The critical difference in our views centres around the behaviour of crystalline basement (Peninsular Gneiss) during Dharwar folding.

The involvement of continental basement in folded belts is a characteristic feature of most orogenies. But, as rightly cautioned by Bally (1981), *it is important to separate the more rigid lithospheric realms from an extensively remobilised basement.* It is a well-known fact that in many orogenic belts 'the mobility of sialic basement increases from the edge of the orogen to its core. In the core zone of the orogens, the basement is more ductile than many of the cover rocks, whereas the opposite is true close to the edges of the orogenic belts, *where cover sediments are often tightly folded above a rigid, unaffected basement*' (Ramberg, 1981). Examples of rigid basement are noted in the foreland regions of most Phanerozoic orogenic belts like the Caledonides, Appalachians, Alps, Cordilleras etc. Important Precambrian examples are the Early Proterozoic Labrador Trough of Canada (Dimroth, 1981) and the Hamersley-Nabberu basins of Australia (Goode, 1981).

In the foreland regions of these fold belts, the crystalline basement has yielded by brittle fracturing and small-scale shearing in many areas. Local development of cataclasites, mylonites and highly flattened gneisses is also common. Retrograde metamorphism and low grade metasomatism (chloritisation, carbonation, epidotisation etc.) are also superposed on the basement gneisses during the deformation and metamorphism of the cover rocks. Lack of penetrative deformation features over wide areas of rigid basement has been recorded by many investigators. It is only logical to expect that in such a milieu, the older orogenic trend lines are well-preserved in the rigid basement, and therefore there is no ambiguity in the statement that 'enclaves of Sargur rocks extending from Sigegudda to Bababudan are unmodified by later Dharwar deformational episodes' (Viswanatha *et al.*, 1982, p. 88). It is in these unaffected areas (e.g., the Belur nucleus) that the Sargur trendlines and angular unconformities with the Dharwar rocks are clearly preserved. The basement rocks are regarded by us as Peninsular Gneiss *sensu stricto*, which corresponds to the *craton-wide* thermal event of 3000 Ma.

The presence of rigid continental lithosphere in these areas of Dharwar folding does not preclude the coexistence of areas showing varying degrees of basement mobility and buoyancy in other parts of Karnataka craton. In these areas there is a tendency for the tectonic conformity of basement and cover, brought about by ductile deformation of the crystalline basement. Clear examples of such features are seen in the Herambapura arm of Shimoga belt and Yadiyur-Karighatta arm of Chitradurga belt. The gneisses from such areas of basement reactivation have not been dated so far, and it is not certain whether this remobilisation would reset the radioactive clocks in these areas. The presence of 2600 Ma age components in the gneisses around the Holenarsipur belt (Beckinsale *et al.*, 1982) suggests that these may represent products of Dharwar orogeny and may correspond to Peninsular Gneiss (Phase II) visualised as younger than Dharwar by Ramakrishnan (1980). It is, however, reiterated that such younger components are less extensive when compared to the main phase of Peninsular Gneiss of 3000 Ma (Swami Nath and Ramakrishnan, 1981).

There are also many areas in Karnataka where thrust sheets of rigid basement are interleaved with supracrustals, as in the Hagalvadi area of Javanahalli belt. In areas close to the main thrust at the eastern margin of Chitradurga belt, the basement has been clearly remobilised. It is common knowledge that the basement exhibits varying degrees of mobility in different segments of such thrust zones (Bally, 1981). In such areas of ductilised lithosphere, the structures are conformable between cover and basement as in the case of eastern margins of Bababudan, Sigegudda and Chitradurga belts.

There are also areas of intermediate deformation between the relatively rigid and completely ductile (plastic to semi-plastic of Vasudev) regimes. In the western margin of Chitradurga belt, the older Sargur fabrics are rotated and/or enhanced into subparallelism with the Dharwar fabrics (Chadwick *et al.*, 1981).

The participation of the basement in the deformation of the cover is of variable intensity in different tectonic domains of an evolving fold belt in Karnataka. The structural evolution of these supracrustals is attributed to varying degrees of basement reactivation and granite diapirism (Chadwick *et al*, 1981a). These features bear a remarkable resemblance to the tectonic evolution of Phanerozoic and

Proterozoic orogenic belts. In strong contrast to this situation, structural relations between the Sargur Supracrustals and Peninsular Gneiss are controlled by a more mobile regime (Ramakrishnan *et al.*, 1976), concomitant with the lower tectonic and stratigraphic levels exposed progressively towards the southern parts of the craton.

The western contact of the Sigegudda belt has been carefully mapped by the authors (Fig. 1 of Viswanatha *et al.*, 1982). If differences with the earlier map of Sampat Iyengar (1909) necessitate remapping, it is for young geologists like Vasudev to take up the challenge.

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