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Palaeomagnetic dating of Sankra dyke swarm

There is an inherent contradiction in the palaeomagnetic work on Sankra pluton by Poornachandra Rao *et al.*[1]. According to the NGRI Annual Report[2], Bhalla *et al.* (of which Poornachandra Rao is the second author) state that 'palaeomagnetic data from the surface samples of gray granite and syenite (Sankra pluton) reveal magmatic activity between Late Palaeozoic to Late Cretaceous'. Further 'the pink granite in which the dolerites intrude show downward magnetic inclination whereas, the dolerites exhibit upward magnetic inclinations acquired in normal and reverse fields, with intermediate and shallow southern hemispheric locations respectively. This is in conformity with movement of the subcontinent during the Palaeozoic era'. If the Sankra pluton represents igneous activity during Palaeozoic era (and I am inclined to agree with this interpretation), how do the dykes intruding it give ages between 750 and 50 Ma, as suggested by the authors?

In the absence of (reliable) geochronological data on Sankra and other adjacent plutons, it may not be appropriate to include the plutons in the Malani igneous suite (MIS) and it would be farfetched to propose a tectonic trio. The 700–750 Ma event is very well documented in the form of anorogenic, A-type magmatism, in the Trans-Aravalli block and the South Indian block (north of the Palghat–Cauvery shear zone) of the Indian shield[3]. All the magmatic activity in the Indian shield (except MIS) centred around 700–750 Ma cannot be included in the MIS. The MIS is characterized by epizonal, volcano-plutonic ring structures, 'within plate' A-type magmatism indicating extensional tectonic environment[4]. High quality data generated should be commensurate with strong field base.

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Reply:

We appreciate the interest of Kochhar on our work reported in ref (1). He has worked quite extensively in the region and his concern is understandable. The main reason for his comments arises because some more results were obtained from the region subsequent to that presented in the Annual Report 1998–99 of NGRI[2]. Our earlier palaeomagnetic results on the granite and dolerite bodies in the region reveal that the magmatic activity is of late Palaeozoic to late Cretaceous periods. Subsequently we have extended these studies on an aplite dyke also in the region. This aplite dyke revealed remanent magnetic directions similar to that of Malani rhyolites that were well constrained with palaeomagnetic and geochronological results[3–7]. Therefore, in the light of this new result, we have revised the period of magmatism in the region to Neo-Proterozoic to Palaeocene (750–50 Ma). Bhushan and Khullar[8] proposed the stratigraphy of the dyke swarms in the region to be of Neo-Proterozoic to Palaeocene on the basis of geological, aerial photo and field relationships. Therefore, there is a very good agreement of palaeomagnetic and radiometric data of aplite dyke and Malani rhyolites which extend the magmatic activity in the region to Neo-Proterozoic era.

The other comment by Kochhar is that the proposal of tectonic trio formed by the Indian subcontinent, Madagascar and Seychelles Islands is far fetched. In the Rodinia supercontinent proposed by Weil *et al.*[9], the Indian subcontinent, Madagascar and Seychelles Islands were found to locate towards the NW corner of the reconstruction. It is proposed by Torsvik *et al.*[10] that India, Madagascar and Seychelles Island formed an outboard continental terrane of the Rodinia supercontinent during the Neoproterozoic (ca. 750 Ma). Subsequent palaeomagnetic and geochronological studies on the Malani Igneous Suite from Rajasthan and granitoids from Seychelles Islands support their locations in the reconstructed Rodinia supercontinent. Our palaeomagnetic results of the aplite dyke from the Sankra dyke swarm are similar to the palaeomagnetic results of Malani rhyolites and therefore, we are inclined to agree with the proposal of a tectonic trio of these continents.

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Rajasaurus narmadaensis

This has reference to the News item that appeared in *Current Science*[1], wherein it is stated that *Rajasaurus* was perhaps a 'truly Indian dinosaur' whose morphological characters might have evolved indigenously. This is nowhere stated in the paper under reference[2]. On the contrary, while discussing the phylogenetic affinity of the Indian species, the authors point out its close affinity to *Majungatholus* from Madagascar and *Carnotaurus* from South America[2].

Secondly, the palaeogeographic picture for the Late Cretaceous[1] is one of the popular hypothesis and not the one propagated in the research paper[2]. It has been suggested[2] that area cladogram implied by the phylogenetic relationships of the Gondwana dinosaurs (Figure 1) offers credence to an altogether different hypothesis that Africa broke away from other Gondwanan land mass before land connection was severed between India, Madagascar and South America[3,4]. Under this hypothesis, connection between Africa and South America was cut-off in Early Cretaceous that fully isolated Africa (Figure 2 *a* and *b*) while connections were maintained between India and Madagascar with South America through Antarctica via Kerguelen Plateau till the end of Cretaceous (Figure 2 *c*).

The above palaeogeographic implications of abelisaurid dinosaur may not find support from the most popular palaeogeographic reconstructions that depict India as an island drifting independent of other Gondwanan land masses in the Late Cretaceous. But if the phylogenetic affinity of the new species and other abelisaurid dinosaurs from India with similar dinosaurs from other Gondwana continents is to be believed, the palaeogeographic picture was drastically different during greater part of the Cretaceous.

The revised reconstruction suggested by Cretaceous dinosaurs predicts a greater similarity of the Late Cretaceous terrestrial biota between South America and Indo-Madagascar (via Antarctica) than between South America and Africa.