

THE PROBLEM OF THE BASEMENT IN MYSORE STATE

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CAPTAIN T. J. NEWBOLD (1844, p. 145) was one of the earliest to investigate the rock-formations of Mysore State and to distinguish the schistose from the gneissose rocks. In 1886, R. Bruce Foote named the schistose rocks as 'Dharwar' from the district in Mysore State, where he recognised them as constituting a distinct and separate 'system' (Foote, 1888, p. 41).

Foote was probably the first geologist who thought that the gneiss formed the basement on which the Dharwars were deposited. R. D. Oldham (1893, pp. 23-24) was also of this view. T. H. Holland (1902, p. 74) generally agreed with Foote, though he had some doubts as to whether the considerably folded Dharwar rocks of the Kolar Schist belt could be younger than the much less deformed Peninsular gneiss. J. M. Maclaren (1906, p. 107) also concluded that in the Gadag belt of Dharwar schists, the gneisses were the fundamental rocks on which the Dharwars were laid down. He noticed, however, that there were some gneissic intrusions along the cleavage planes of the schists. C. S. Middlemiss (1917, p. 197) also favoured the view that the Dharwars were deposited unconformably on the gneisses; according to him the gneissic intrusions into the schists were probably caused by local refusion or plastic deformation and penetration.

Geological work done in Mysore State from 1899 onwards by the officers of the Survey under the Directorship of W. F. Smeeth led to some very divergent views on this question of age relationship between the schists and the gneisses. They found that the granites and gneisses were intrusive into the schists and so did not form the basement for the Dharwars. According to Smeeth (1901, p. 19), no rocks older than the Dharwars could be definitely recognised anywhere in Mysore State. Fermor (1909, p. 998) also noticed intrusive contacts and, therefore, agreed with Smeeth that Dharwars were the oldest rocks, and that the associated gneisses were intrusive into the Dharwars.

That the gneisses formed the basement was generally accepted until certain evidences were produced in Mysore to show that they were intrusive into the Dharwars. The elongated and often irregular or angular inclusions of amphibolite and schists in the gneiss were considered to be the unassimilated remnants of Dharwar rocks which had been caught up during the intrusion of the Peninsular gneiss. This reversed the relative age relationship and made the Peninsular gneisses younger than the Dharwars. If this is the correct interpretation, then on what solid base were the Dharwar rocks laid down? Do the Lower Dharwars which are composed of acid and basic volcanic flows constitute the earliest formed rocks of earth history, or were these lavas erupted on a very ancient gneiss platform which represents the primordial crust? In the oldest basic volcanic rocks pillow structures have been recognised, and this indicates that these flows were of submarine origin. Associated with these volcanic rocks there are also ferruginous cherts and siliceous schists which represent the primeval sediments. The Lower Dharwars cannot, therefore, be the oldest rocks in the region.

As already mentioned, one of the reasons for considering the Peninsular gneiss as intrusive into the Dharwar Schists was the occurrence of numerous xenolithic inclusions of amphibolitic and schistose rocks in the gneiss. According to Sampat Iyengar (1920, p. 13), the Peninsular gneiss affords abundant evidences of intrusion and bristles to a variable extent with caught up lenses, patches and fragments of the Dharwar schists. In a number of places contact metamorphic phenomena can be noticed. In his Presidential Address to the Geology Section of the Indian Science Congress, Fermor (1919) made the following categorical statement: 'All the evidence I have seen forces me to the same conclusions as Dr. Smeeth, viz., that the Dharwars are the oldest rocks wherever they occur, and that the associated gneisses and gneissose granites are intrusive in their relationships.'

B. P. Radhakrishna (1967, pp. 102-103) has recently expressed the view that the amphibolitic and schistose inclusions found in the gneisses represent basic igneous rocks and sediments which are older than the Dharwars, and that the Peninsular gneisses as a whole are not intrusive into the Dharwars. Neither, according to him, are there undisputed evidences of any granitic intrusion into the Dharwars. He is of the opinion that the whole complex of granites and gneisses with lenses and patches of an earlier series of sediments and basic igneous rocks, forms the basement on which the Lower Dharwars rest. Geological thought on this question of the basement appears, therefore, to have made one complete circle and come back to the views held by the earliest workers.

There is need, however, to investigate this question further with great thoroughness. The crux of the problem appears to be whether the xenoliths in the gneisses and granites are fragments of Dharwar rocks or of an earlier series. It is improbable that conclusive field evidence can be obtained for the existence of such an older series of schists; at least, at the present time, there is none. Petrographic methods may also not yield any definite results. Radiometric dating could throw some light; but, on the other hand it may not, if the dates obtained give only the age of the latest episode of metamorphism.

The localities in Mysore State, where earlier geologists have reported instances of intrusion of Peninsular gneiss into schists, will have to be re-examined, and their conclusions reassessed, if necessary. One such area is a part of the Shimoga schist belt where the Peninsular gneiss apparently cuts east to west right across, and completely separates rock formations whose trends are north to south. On either side of the Tarikere valley, the schist belt has been abruptly terminated. The schist outcrops projecting into the gneisses at both ends appear to have been once continuous. There are also schist islands in the gneiss which look like links connecting the severed parts of the belt. On the face of it, the geology of this area cannot be satisfactorily interpreted in any other way except that of considering the Peninsular gneiss as having intruded the Shimoga belt of Dharwar rocks, and sundered a sequence of schists, quartzites, and conglomerates.

Sampat Iyengar (1920) has also cited several localities in Mysore State where, according to

him, there are clear evidences of granites and gneisses intruding the schists. All these areas will also have to be investigated to determine whether the Peninsular gneiss as we know it at present, is younger or older than the Dharwars.

An important evidence for intrusion is the termination of a succession of sedimentary strata of differing ages by a rock like gneiss. A good example is furnished by the map of part of the Sausar Series given by West (1933) in his paper on the streaky gneisses of the Nagpur District. The intrusive relation of the gneisses to the members of the Sausar Series can be made out from this map since the whole sequence of the Sausars gets cut out step by step towards the east, until the gneisses come into contact with the big central outcrop of the Bichua stage. In Mysore State there is fairly good evidence for inferring that as one proceeds northwards, one comes across progressively younger rocks (Pichamuthu, 1951, pp. 117-119). This sequence of Dharwars, from the oldest to the youngest, is found somewhere or other to be in contact with gneisses. Normally, this will have to be interpreted as an instance of the gneisses having intruded the Dharwars, unless, of course, the gneisses in northern Mysore are different from, and younger than, the gneisses occurring in the south; or, if the younger Dharwar beds have successively overlapped the older strata. There is no evidence at present, however, for either of these alternatives.

No conclusive light has also been thrown on the relative ages of the Dharwar schists and Peninsular gneisses by geochronological data which are available; if anything, they favour an older age for the schists. Hornblende schists from the Hutti Gold Mine and Channagiri have given ages of $3,295 \pm 200$ m.y., and 2,631 m.y. respectively (Sarkar and Miller, 1969). According to Aswathanarayana (1968, p. 591) the Dharwars bear the impress of three episodes of folding, metamorphism, and emplacement of granites, the first of which happened about 3,000 m.y. ago. This corresponds to Phase I (c. 3,000-2,800 m.y.) of Dharwar orogeny, metamorphism, and granitisation as envisaged by Sarkar (1968, p. 17). The Dharwar schists near Mysore have given an age of 3,000 m.y. (Crawford and Compston, 1967, p. 33). According to Ramamurthy and Sadashivaiah (1967, p. 73) the Lower Dharwars must be older than or equal to about 3,100 m.y. Vino-

gradov and Tugarinov (1968) determined the ages of Kolar amphibolite and Chitaldurg galena as $2,900 \pm 200$ m.y.

On the other hand, Peninsular gneisses of Mysore State have given a comparatively lower age. According to Crawford and Compston (1967, p. 33) Peninsular gneiss near Bangalore is $2,635 \pm 45$ m.y. old, and gneiss near Mysore is $2,800$ m.y. old. A similar age of $2,700 \pm 100$ m.y. was also obtained by Vinogradov and Tugarinov (1968) for a migmatitic gneiss near Bangalore. The age of Peninsular gneiss as given by Ramamurthy and Sadashivaiah (1967, p. 73) is $2,480$ m.y., and that by Sarkar (1968, p. 17) is $2,635$ m.y. In Crawford's latest paper (1969, p. 134) the Peninsular gneiss of Bangalore is $2,580 \pm 50$ m.y. old.

The Dharwars occur at the present time in bands of varying dimensions which are remnants of a formation that probably covered a much more extensive area in Mysore State. Both the Dharwar schists and the Peninsular gneisses have together been subjected to intense tectonic disturbances with the result that they now appear to be interbedded and interfolded. We are dealing with very ancient rocks whose ages range from about 2,000–3,000 million years. During this long period of time several orogenic cycles must have occurred and left their impress both on the composition and disposition of the rock sequences. There are variations in stratigraphical succession, dislocations on a gigantic scale, and differences in metamorphic grade. It would be difficult, therefore, to identify with any certainty, and differentiate between the original crustal basement and the first-formed lava flows or sediments. With the help of available field criteria such as current bedding, graded bedding, pillow structures, drag folds, etc., the stratigraphy of the unfossiliferous Dharwar formations should be worked out, and an accurate stratigraphical column set up, just as Fermor did for the Sausar series. Careful search will then have to be made in the neighbourhood of the oldest Dharwar rocks for vestiges of the basement (Pichamuthu, 1968, pp. 199–200).

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