Rb-Sr WHOLE ROCK ISOCHRON STUDIES ON GRANITIC ROCKS FROM CHITRADURGA AND NORTH MYSORE

V. S. VENKATASUBRAMANIAN AND R. NARAYANASWAMY
Physics Department, Indian Institute of Science, Bangalore

Introduction: There is an even greater paucity of age data for the Precambrian formations of North Mysore than for those of South Mysore. The Dharwar sequence is here characterised by a predominance of chloritic schists as contrasted with the hornblendic schists of the south, and the relative ages of the chloritic and hornblendic divisions are not known. There is a progressive increase in metamorphism of the Dharwar sequence southwards across Mysore (Pichamuthu, 1967), the chloritic schists exhibiting a low grade of metamorphism (the greenschist facies). The extent to which this variation in metamorphic grade is reflected in the age relationships of whole rocks and minerals of this region has not been studied; on the other hand, there exists a good body of data indicating that the Peninsular gneissic suite of rocks extends all the way from S. Mysore to Hyderabad and beyond, yielding whole rock isochrons of 2500-2600 m.y. in many localities (Crawford, 1969). In the present study, whole rock Rb-Sr isochron ages have been determined for granites in the vicinity of Chitradurga, and a reconnaissance study carried out on granites collected from an extended traverse in Gulbarga, Raichur, Bellary and Shimoga districts of N. Mysore. The specimens from Chitradurga were collected with the kind assistance of B. P. Radhakrishna, while the granites for the reconnaissance study were kindly supplied by S. V. P. Iyengar.

Chitradurga granites—data and discussion: The Chitradurga granite, being intrusive into the chlorite schists of the Chitradurga schist belt, occupies a long strip of country for about 56 km from Chitradurga town. The geology of this region has been summarised by Radhakrishna (1967) and the specimens examined in the present study comprise the following.

(1) Cg 1: granite with zoned feldspar from a quarry 4 km S. of Chitradurga on the Chitradurga-Chandravalli road. (quartz 35%; orthoclase 40%; plagioclase 18%; biotite 5%)

(2) Cg 2: Coarse grained hornblende-biotite granite from the same quarry (quartz 30%; orthoclase 44%; plagioclase 16%; hornblende and biotite 8%)

(3) Cg 3: Medium grained granite from quarry 3 km from Chitradurga on the Chitradurga-Holalkere road. (quartz 35%; orthoclase 40%; plagioclase 20%, biotite 5%)

(4) Cg 4: Coarse grained granite from the same quarry with nearly the same modal composition.

Isotope dilution measurements of Rb and Sr, and unspiked sample measurements of Sr^{87}/Sr^{86}, were made the analytical data are given in Table I. The best computer fit isochron by the method of Brooks *et al.* (1968) is given in Fig. 1.

It is seen that the 4 granites define an isochron age of 2475 ± 85 m.y. with an initial $Sr^{87}/Sr^{86} = 0.706 \pm .004$. Two biotite granites in the lowest tors of this area were found to be highly enriched in Rb and individual ages of 2450 and 2535 m.y. were obtained for these, while similar ages were computed for enriched samples from adjacent Jampalnaikankote granite, (2575 m.y. and 2620 m.y.) by Crawford (1969);

Holmes (1955) also refers to galena ages of 2450 ± 120 m.y. for Ingaldhal specimens from the same area.

There is considerable field evidence of the granites being intrusive into the schists (Sampat Iyengar, 1905) – the deformation of the schist beds and the grey trap of Jogimardi hills by the impact of the granite, the abrupt cutting off of quartz reefs

TABLE I

ANALYTICAL DATA ON CHITRADURGA GRANITES

Specimen	Rb^{87} (ppm)	Sr^{86} (ppm)	(Rb^{87}/Sr^{86})	(Sr^{87}/Sr^{86}) at normalized
Cg 1	134.6 ± 1.2	34.9 ± 0.3	3.82 ± 0.05	0.837 ± .003
Cg 2	86.0 ± 0.9	15.9 + 0.1	5.35 ± 0.06	0.889 ± .003
Cg 3	56.2 ± 0.8	21.0 ± 0.2	2.65 ± 0.05	0.798 ± .004
Cg 4	35.8 ± 0.5	33.6 ± 0.3	1.06 ± 0.02	0.745 ± .004

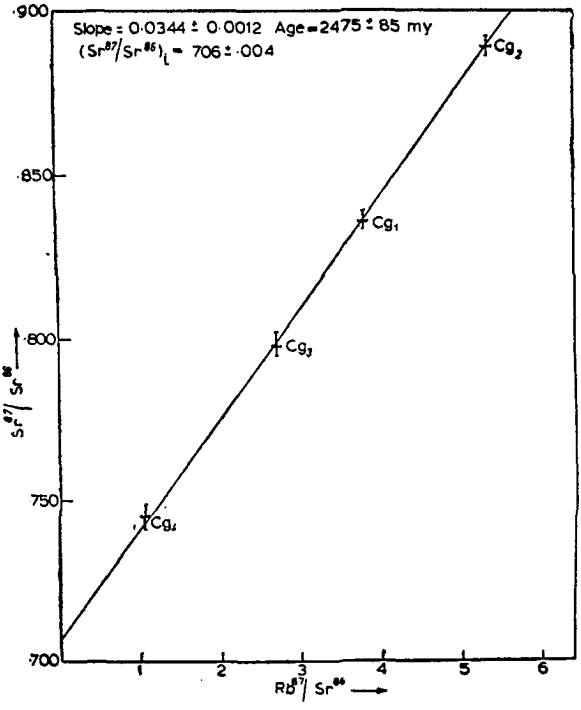

Figure 1. Chitradurga granites.

adjacent to them etc. Rama Rao cites some evidence to regard these as likely equivalents of the Closepet suite (Rama Rao, 1962). Crawford (1969) discusses measurements on the Dharwar system volcanic rocks of the Chitradurga area – borehole samples from Ingaldhal, and pillow lavas of Kurubaramaradikere, Mardihalli, and Jogimardi; these samples poorly enriched in Rb yield isochrons of 2345-2385 (±60) m.y. with $Sr^{87}/Sr^{86} = 0.704$. As this also does not differ significantly from the isochrons

reported in this study, it may be suggested that the granitic intrusion was part of the igneous-plutonic event represented by the basic lava flows. The low value of the initial Sr^{87}/Sr^{86} is probably suggestive of the granitic magma originating from a source of low Rb/Sr ratio, (e.g. subcrustal) rather than from fusion of old sedimentary material of the usual Rb/Sr ratio.

Reconnaissance study of North Mysore granites: The following granites from an extended area in Gulbarga, Raichur, Bellary and Shimoga districts have been studied:

(1) Ng 1–Pink grey granite, Shahpur (76°50′E 16°40′N) Gulbarga Dt.
(2) Ng 2–Grey granite, north of Thinthini (76°40′E, 16°23′N) Gulbarga Dt.
(3) Ng 5–Pink granite, Shahabad, Bhima river bed, Gulbarga Dt.
(4) Ng 3–Grey granite, 8 km from Maski on road to Lingasugur, (76°30′E, 16°10′N), Raichur Dt.
(5) Ng 4–Granite, Siraguppa, 50 km north of Bellary, Bellary Dt.
(6) Ng 6–Granite, Horeguppa (75°22′E, 14°15′N) Shimoga Dt.
(7) Ngb 4, the biotite separated from Ng 4.

The prevalent formations are the chlorite schists and associated gneisses and granites. The schistose bands of Lingasugur, and near Bellary, have the Dharwarian trend. The area NE of Shikaripur, near Horeguppa, contains greywackes with well rounded grains of quartz and feldspar in a base of sericite and chlorite, these being regarded as products of the Dharwar basement. The Horeguppa granites are regarded as an acidic schistose member of the Champion gneiss suite.

TABLE II

ANALYTICAL DATA ON N. MYSORE GRANITES

Specimen	Rb^{87} (ppm)	Sr^{86} (ppm)	(Rb^{87}/Sr^{86}) at	(Sr^{87}/Sr^{86}) at normalized
Ng 1	45.4 ± 0.8	18.0 ± 0.1	2.49 ± 0.05	0.808 ± .003
Ng 2	44.7 ± 0.7	36.0 ± 0.2	1.23 ± 0.02	0.761 ± .004
Ng 3	18.2 ± 0.4	44.1 ± 0.4	0.406 ± 0.01	0.727 ± .005
Ng 4	39.3 ± 0.6	22.9 ± 0.2	1.70 ± 0.03	0.779 ± .003
Ng 5	76.0 ± 0.9	19.6 ± 0.1	3.84 ± 0.05	0.864 ± .004
Ng 6	4.68 ± .08	3.02 ± .03	1.53 ± 0.03	0.769 ± .003

The analytical data are presented in Table II, and the results shown graphically in Fig. 2, the isochron being drawn by the computer fit method referred to above. It is seen that the 6 whole rock points fall on an isochron of age 2990 ± 120 m.y. with an initial ratio of $Sr^{87}/Sr^{86} = 0.707 \pm .004$. The biotite from the granite at Siraguppa *yields a mineral age of 2890 m.y.*

Practically no age data are avilable for the rock formations in these localities and the isochron age is of a reconnaissance character. However, the existence of such a high age value comparable for the highest obtained for the gneisses in SE. Mysore (Venkatasubramanian *et al* 1971) is interesting. Crawford's data, (1969) it may be

recalled, reveal 3000 m.y. ages in the Peninsular gneiss in 3 separate areas—Kerala, Nilgiris, Mysore and the present results confirm the fact that this emplacement event has left its impress in several areas including N Mysore. The fact that the granites from Shikaripur (Horeguppa sample), are regarded as a member of the Champion gneiss (Jayaram, 1917) suggests some relationship of the higher-age event with the

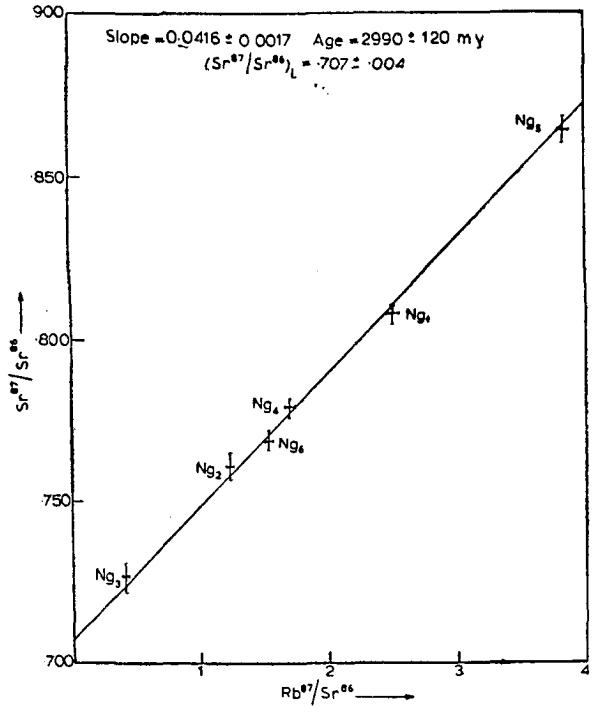

Figure 2. North Mysore Granites.

Champion gneiss, which, on the basis of field relationships and closer association with the Dharwars, have led to the opinion among some workers as being the oldest gneissic formation. It is clear however, that further detailed studies and data are required to unravel the genetic relationships in the different areas.

Acknowledgements: We acknowledge with thanks, the co-operation of Dr. B. P. Radhakrishna in the selection of the Chitradurga specimens, and Dr. S. V. P. Iyengar in supplying the specimens of granites for the reconnaissance isochron studies.

References

CRAWFORD, A. R., (1969) Reconnaissance Rb-Sr dating of the Precambrian rocks of southern Peninsular India. *Jour. Geol. Soc. India*, v. 10, pp. 117-166.

HOLMES, A., (1955) Dating the Precambrian of India and Ceylon. *Proc. Geol. Assn. Canada*, v. 7, pp. 81-106.

JAYARAM, B., (1917) Notes on Revision Survey in Shimoga, Honnali, Shikaripur, Sagar and Tirthahalli taluks. *Rec. Mysore Geol. Dept.*, v. 16, pp. 67-108.

PICHAMUTHU, C. S., (1957) *The Precambrian of India in The Geological Systems: The Precambrian.* V. 3, ed. K. Rankama (Interscience, London).

RADHAKRISHNA, B. P., (1967) *Copper in Mysore State*, (Bangalore).

RAMA RAO, B., (1962) *A Handbook of the Geology of Mysore State, India.* Bangalore Printing and Publishing Co.

SAMPAT IYENGAR, P., (1905) Report of survey work in Chitaldrug District. *Rec. Mysore Geol. Dept.*, v. 6, pp. 57-92.

VENKATASUBRAMANIAN, V. S., IYER, S. S. and PAL, S., (1971) Studies on the Rb-Sr geochronology of the Precambrian formations of Mysore State, India. *Am. Jour. Science*, v. 270, pp. 43-53.

PALAEOMAGNETISM AND THE STRATIGRAPHIC CORRELATION OF CERTAIN PRECAMBRIAN FORMATIONS OF INDIA

P. C. PAL

Centre of Exploration Geophysics, Osmania University, Hyderabad

One of the applications of the palaeomagnetic data is its use in the stratigraphic correlations of the geological formations (Khramov, 1958; McElhinny, 1969; Irving, 1971). The absence of sufficient radiometric age data however considerably hinders such attempts for the Precambrian formations, although several workers (Brock and Piper, 1972; Irving and Park, 1972) have recently shown an effective use of the palaeomagnetic data in the correlation of the African and the Canadian Proterozoic rocks. In the case of the Indian geological column, the efforts made so far in this direction have been limited. Prasad and Reddy (1972) have, for instance, interpreted the palaeomagnetic data in support of the contemporaneity of lower Cuddapahs and lower Vindhyans with the Bijawars, a correlation originally suggested by Dubey (1950). An attempt is made here to show that this palaeomagnetic correlation is rather erroneous and is also modified when the relevant radiometric age data are taken into cognisance. A magnetostratigraphic correlation of the Indian Precambrian rocks is also attempted here.

It will be pertinent to mention at the very outset that, as pointed out by Crawford and Compston (1970), the palaeomagnetic result reported by Athavale *et al*, (1963) as belonging to the Bijawar traps does not pertain to the Bijawars at all and was actually based on studies conducted on the Gwalior lavas which were erroneously called Bijawar traps. In the following discussion, the term Bijawar traps used in the earlier palaeomagnetic work is therefore replaced by 'Gwalior lavas'.

The remanent magnetic directions of the lower Cuddapahs and B.H.Q. and B.H.J. have an approximate mean of 287° declination (E of true N) and $-9°$ (+ve down) inclination. Reversed of this direction will be 107° declination and $+9°$ inclination. Not a single Gwalior lava sample showed this direction even though these rocks showed a high scatter of the remanent magnetic directions (A_{95}, i.e. the radius of 95% circle of confidence = 18°) ranging from 30° to 90° declinations and $+10°$ to $-5°$ inclinations. The palaeomagnetic inference of Prasad and Reddy (1972) that the Gwalior lavas are magnetically reversed with respect to the lower Cuddapahs and the lower Vindhyans, the latter represented by B.H.Q. and B.H,J., is thus questionable.

Further, the lower Vindhyans are now believed to be about 1200-1400 m.y. old (Crawford and Compston, 1970) which is also the age of the lower Cuddapahs (Aswathanarayana, 1964 a, b; Crawford, 1969). The Gwalior lavas, on the other