Anorthosites from Hullahalli, Mysore District Karnataka State

A. S. JANARDHAN AND H. M. RAMACHANDRA

Abstract

The note records the occurrence of gabbroic anorthosites in the Kabini right bank canal sections, south of Hullahalli, close to the spot from where the same authors had originally described charnockites, and discusses the origin of these gabbroic anorthosites, with particular reference to their occurrence in Sargur type high grade terrains of Karnataka.

Introduction

Gabbroic anorthosites occur in two localities in the canal section, in association with charnockites near Hullahalli (Long. 76°33′ and Lat. 12°14′)—(i) near Shiramalli, 2 km ESE of Hullahalli and (ii) near Kanenur, 2 km WSW of Hullahalli. The anorthosites are fresh and occur as bands, varying in width from a few decimetres to tens of metres, conformable to the gneissic foliation. They exhibit sharp contacts, with the quartzo-feldspathic (leuco) gneisses, much similar to the ones exhibited by two pyroxene granulite (meta-norite) bodies, and in this aspect differ structurally from spatially associated highly serpentinized and boudinaged ultramafics. Pink pegmatite veins profusely cut the anorthosite bands slicing them into smaller patches.

In the canal sections, the anorthosites are associated with high grade leuco gneisses, hornblende granulites, amphibolites, migmatitic hornblende gneisses along with ultramafics and two pyroxene granulites mentioned above. The type Sargur schists (as meta-sedimentary enclaves) occur in force immediately to the west and southwest of the area (Janardhan and Srikantappa, 1976). Their mineral assemblages show a metamorphic grade ranging from upper amphibolite to transitional hornblende granulite facies (Turner, 1968). The geological setting in general is similar to the trimodal gneiss-amphibolite-anorthosite assemblage described by Windley (1976).

Petrography

The anorthosites are typically gabbroic, varying in modal composition from mafic rich to plagioclase dominant varieties. The typical mineral assemblage is Pl-Opx-Cpx-brownish green Hb$\pm$Ga$\pm$late Qz (introduced), with a general granoblastic texture. Crude banding is seen in thin sections by the clusters of fine grained mafics alternating with larger plagioclase plates, reflecting original cumulate texture. Plagioclase grains are often twinned with prominent secondary deformation twinning and at times show triple point junctions. The anorthite content varies from An 45% in mafic rich varieties to 65% in plagioclase rich types. Orthopyroxene is distinctly pleochroic ($2V_\alpha$ 66°) often occurring as big, slightly lamellar grains. Clinopyroxene is also present ($2V_\gamma 56°$; $\gamma \wedge c 40°$), with a distinct green coloration. Both the pyroxenes are seen to be breaking down to secondary brownish green hornblende. This fact is proved by the increase of hornblende content in these gabbros with concommitant decrease of the pyroxenes. Late porphyroblastic garnet (almandine rich) at places, occurs almost enveloping, as it were, the entire mafic cluster of minerals. The mineral assemblages of the rock indicate a transitional hornblende granulite facies (Turner, 1968).

Specimens of the gneisses collected at the anorthosite contacts, in thin sections, are seen to be highly epidotized and sericitized.

Correlation with Konkanahundi complex

Hullahalli anorthosites can be correlated with the Konkanahundi anorthosite-gabbro-norite complex (Ramakrishnan and Mallikarjuna, 1975) occurring about 24 km east of the present area. Both areas generally exhibit the same geological set up, in terms of metamorphic grade and structural features, excepting for the fact that Konkanahundi pluton occurs in a more migmatized terrain bereft of any sedimentary enclaves in the immediate vicinity. Mineralogical assemblages and petrographic characters of the two occurrences, viz., gabbroic texture; Opx-Cpx-Pl (An 50%) – secondary Hb (mineral assemblage); presence of ultramafic enclaves—are strong evidences for correlating the two occurrences as belonging to the same episode.

Chemistry

Four varieties of anorthosites from Hullahalli and four from Konkanahundi have been analysed and data presented in Table I. When plotted on an AFM

TABLE I. *Chemical analyses of Anorthosites*

	K 99	K 152	K 64a	K 66	K 1	K 2	K 3	K 4
SiO_2	46.12	49.07	47.15	46.73	56.72	54.80	51.93	56.69
TiO_2	0.26	0.26	0.98	0.91	0.59	0.70	0.79	1.06
Al_2O_3	29.60	23.30	15.42	16.60	28.48	22.86	23.04	16.18
Fe_2O_3	0.85	1.52	2.58	0.53	1.57*	3.98*	3.98*	8.04*
FeO	1.41	3.40	7.92	8.54	—	—	—	—
MnO	0.10	0.05	0.06	0.08	0.10	0.07	0.05	0.10
MgO	3.65	6.66	12.63	12.00	1.62	4.45	3.21	8.59
CaO	13.20	8.80	7.80	9.00	4.89	7.21	11.63	5.51
Na_2O	5.04	5.16	4.20	3.94	6.12	5.25	4.62	4.00
K_2O	0.48	0.69	0.34	0.34	0.25	0.25	0.12	0.18
H_2O	0.25	0.13	0.35	0.06	0.25	0.20	0.10	0.15
Total	100.96	99.04	99.43	98.73	100.59	99.77	99.47	100.50

*denotes total iron.

Analysts: H. M. Ramachandra (for K 99, K 152, K 64a and K 66) and B. Puttaraju (for K 1, K 2, K 3 and K 4).

K 99– Leuco anorthosite (pl-hb-opaques), K 152– Gabbroic anorthosite (pl-hb-opaques) K 64a– Gabbroic anorthosite (pl-opx-cpx-hb-ga) and K 66– Gabbroic anorthosite (pl-opx-cpx-hb-ga-opaques), have been collected near Kanenur and Shiramalli, WSW and ESE of Hullahalli, respectively.

K 1 and K 2 are leucocratic anorthosites (pl with minor hb) and K 3 and K 4 are Gabbroic anorthosites (dominant hb and pl and opaques)– specimens collected near (SE of) Thagadur belonging to Konkanahundi complex.

diagram (Fig. 1) along with the pyroxene granulite plots of the area (representing the gabbroic fraction in an ultramafic-gabbro-anorthosite sequence), they are seen to follow a calc-alkaline trend, without iron enrichment, very much similar to the trend shown by Sittampundi garnet granulite-anorthosite plots (Janardhan and Leake

1975). This signifies the bimodality of the ultramafic-gabbro-anorthosite-amphibolite sequence of the area, as the amphibolite and pyroxene granulites follow an iron enrichment trend similar to the Holenarasipur meta volcanics, while the anorthosites and their associates exhibit a calc-alkaline trend (Iyer and Kutty, 1977).

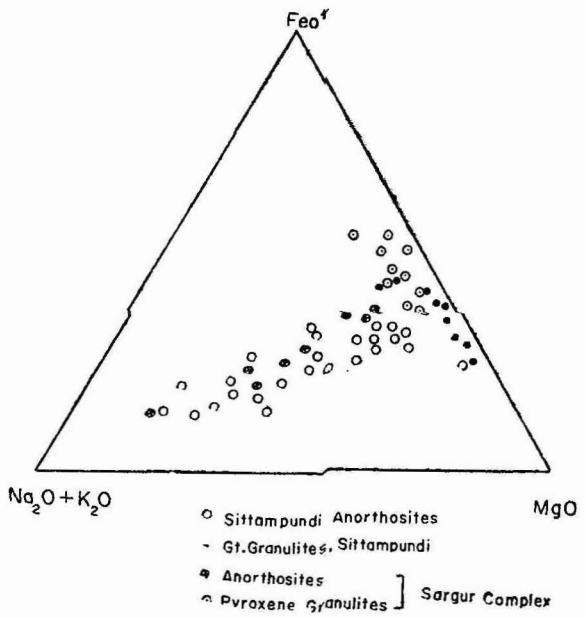

Figure 1.

Discussion

Gabbroic anorthosites are being increasingly reported from different parts of Karnataka and Kerala; viz., Konkanahundi anorthosite-gabbro-norite complex (Ramakrishnan and Mallikarjuna, ibid); Hullahalli (this note); as sheets in Sargur schist complex; spatially associated with ultramafics in Holenarasipur and Nuggihalli; associated with gabbros near Manantoddy (Nair *et al.*, 1976); and with pyroxene granulites near Perinthatta (Vidyadharan *et al.*, 1977).

The authors are tempted to correlate the above newly reported occurrences with that of the prominent Sittampundi type anorthosite complex in Tamil Nadu, as both have been emplaced into similar type of high grade supracrustals of Shelf-facies (ferruginous quartzites-marble-graphite bearing pelite associations), show similar chemistry, cumulate texture and/or layering. Excepting for these, the two types are quite different in that, the Sittampundi anorthosites have plagioclases with high anorthite (= An 90%), contain chromitite and garnet-granulite layers (eclogites of Subramanyam, 1956), with very little non-chromite bearing ultramafic camponent. On the other hand the gabbroic varieties of Konkanahundi type are insignificant in size when compared to the associated ultramafics, have plagioclase with An 65% and are non-chromite bearing. These dissimilarities can probably be attributed to emplacement of these (comagmatic?) bodies at different structural levels. A similar set up is also noticed in the Limpopo belt (Coward *et al.*, 1976), which Windley (1977) terms as belonging to two different mega zones. This is supported by the fact that the Konkanahundi type are associated with two pyroxene granulites (granu-

lite grade of metamorphism), whereas the Sittampundi type is interbedded with deeper or high pressure garnet-granulite layers (Ito and Kennedy, 1970).

In recent years the occurrence of anorthosites in association with mafic and/or ultramafic counterparts, or their remnants is being used to demarcate tectonic belts in the Archaean gneissic terrains (Sutton, 1976). In this context the occurrence of Perinthatta and Manantoddy anorthosites north of Bavli lineament, which are supposed to be a continuation of Moyar-Cauvery lineament (Vidhyadharan *et al.*, ibid) and Konkanahundi occurrences is significant. They may indicate an early E-W (or WNW) major lineament activation.

Acknowledgements: The authors wish to thank Prof. M. N. Viswanathaiah for his encouragement and support during the course of the work. The junior author was financially supported by the University Grants Commission during the course of the work.

References

COWARD, M. P., JAMES, P. R. and WRIGHT, L., (1976) Northern margins of the Limpopo belt, S. Africa. *Bull. Geol. Soc. Amer.* v. 87, pp. 601-611.

ITO, K. and KENNEDY, G. C., (1970) The fine structure of the Basalt-Eclogite transition. *Mineral. Soc. Amer. Spec. Paper*, No. 3, pp. 77-83.

IYER, G. V. A. and KUTTY, T. R. N., (1977) The general geochemistry of the Archaean and Proterozoic granulites. *In Archaean Geoehemistry. The origin and evolution of the Archaean continental crust.* Symposium held at Hyderabad, India. *Abstracts*, p. 68.

JANARDHAN, A. S. and LEAKE, B. E., (1975) The origin of the meta-anothositic gabbros and garnetiferous granulites of the Sittampundi complex, Madras, India. *Jour. Geol. Soc. India*, v. 16, no. 4, pp. 391-408.

JANARDHAN, A. S. and SRIKANTAPPA, C., (1976) Geology of the northern parts of the Sargur schist belt between Mavinahalli and Dodkanya. *Ind. Mineralogist*, v. 16, pp. 66-75.

NAIR, M. M., VIDYADHARAN, K. T., PAWAR, S. D., SUKUMARAN, P. V. and MURTHY, Y. G. K., (1976) The structural and stratigraphic relationship of the schistose rocks and associated igneous rocks of the Tellicherry-Manantoddy area, Cannanore district, Kerala. *Ind. Mineralogist*, v. 16, pp. 89-100.

RAMAKRISHNAN, M. and MALLIKARJUNA, C., (1976) Konkanahundi pluton—a new layered basic intrusion from Karnataka. *Jour. Geol. Soc. India*, v. 17, no. 2, pp. 207-213.

SUBRAMANYAM, A. P., (1956) Mineralogy and petrology of the Sittampundi complex, Salem district, Madras, India. *Bull. Geol. Soc. Amer.*, v. 67, pp. 317-389.

SUTTON, J., (1976) Tectonic relationship in the Archaean. In Windley B. F. (Ed.), *The Early History of the Earth*, Wiley, London, pp. 99-104.

TURNER, F. J., (1968) *Metamorphic Petrology*, McGraw Hill Book Co., New York.

VIDYADHARAN, K. T., SUKUMARAN, P. V. and NAIR, M. M., (1977) A note on the occurrence of anorthosite near Perinthatta, Taliparamba Taluk, Cannanore District, Kerala. *Jour. Geol. Soc. India*, v. 18, no. 9, pp. 519-520.

WINDLEY, B. F., (1976) New tectonic modals for evolution of Archaean continents and oceans. In Windley, B. F. (Ed.), *The Early History of the Earth*, Wiley, London, pp. 105-112.

——— (1977) Layered Igneous complexes in Archaean high grade belts. *In Archaean Geochemistry. The origin and evolution of the Archaean continental crust.* Symposium held at Hyderabad, India. *Abstracts*, p. 85.

Address of the Authors

A. S. JANARDHAN and H. M. RAMACHANDRA, Department of Geology, Manasagangotri, Mysore-570006.