KOMATIITE DYKES OF DODKANYA, MYSORE DISTRICT, KARNATAKA STATE, INDIA

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Introduction: Following the critical evaluation of the geochemical data of the Precambrian granite-greenstone belts of South India (Sreenivas and Srinivasan, 1974), the authors have been engaged in evaluating the geochemistry of the cratonising dykes. During this study the analyses of a few dykes from Mysore district are found to correspond to basaltic komatiite composition. The purpose of this note is to discuss the significance of such occurrences.

Dykes of Dodkanya, Mysore district: Noritic olivine dolerites and gabbros are seen intruding the migmatitic gneisses in the Dodkanya and Hebya region of Mysore District. The migmatites are predominantly epibolitic and ophthalmitic types (Mehnert, 1968 p. 35, 354 and 356). They are composed of garnetiferous mica gneisses, hornblende mica gneisses with interlayers of amphibolite, bipyroxene granulites and ultramafic rocks. Rarely, charnockites occur as inclusions in migmatites. The dykes which trend NS to N30°W transect the foliation in migmatites which is N10°E to N30°E, so also the north-northeasterly trending ultramafic bodies of the area. Against the intruded rocks, they exhibit chilled contacts.

Petrography, mineralogy and petrochemistry of these dyke rocks have been described by Ramanathan (1955). The dyke rocks are greyish black in colour. The dolerites exhibit ophitic and the gabbros hypidiomorphic granular or poikilitic textures. They possess a peculiar mineralogical assemblage: The plagioclase exhibits a wide range of anorthite content (An 45-70%); four pyroxenes —diopside, augite, enstatite and hypersthene are present; olivine shows bastite rims; biotite and other accessories. The overall mineralogical assemblage suggests a state of metastable equilibrium under the influence of arrested crystallization.

The modal composition of the dyke rocks (Table I) brings out their mafic-rich character.

The chemical composition of these dykes is given in Table II. For comparison, the analyses of dyke komatiite of Kulamara, Bihar (Viswanathan and Sankaran, 1973) and the basaltic komatiites of South Africa (Viljoen and Viljoen, 1969) are also given.

The dyke rocks of Mysore district under discussion, are characterised by CaO/Al_2O_3 ratio ranging from 1.21 to 1.58 similar to basaltic komatiites of South Africa. Their komatiite affinity is also brought out by their low alkali content, K_2O content less than 0.9%, comparatively high magnesia content which is greater than 9%. Hart and Brooks (1974) have suggested that the TiO_2 index should also be considered when evaluating the komatiite affinity for a given rock composition. According to them, basaltic komatiites are characterised by low TiO_2 content, normally less than 0.9%. The TiO_2 content in Dodkanya dykes is less than 0.9%.

Discussion: The basaltic komatiite dykes of Mysore, possess clouded plagioclases and occur close to the charnockitic province. The common occurrence of basic dykes with clouded plagioclases in and close to the charnockitic province was

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observed by Pichamuthu (1959, p. 68). Pichamuthu considered that the clouded plagioclase bearing dykes were emplaced in the time gap between the formation of older gneissic charnockites and the younger coarse-grained granitic charnockites. The thermal impress accompanying the formation of granitic charnockites is stated to have affected the dykes bringing about the clouding of feldspars.

TABLE I

MODAL COMPOSITION OF DYKES OF DODKANYA AND HEBYA AREA, MYSORE DISTRICT, AFTER RAMANATHAN (1955, p. 47)

Specimen No.	Rock and Locality	Mineral	Mode per cent
D.16	Dolerite, Dodkanya	Plagioclase	23.6
		Pyroxene*	51.0
		Olivine	17.3
		Biotite and other accessories	8.1
D.58	Medium grained gabbro, Hebya	Plagioclase	25.4
		Pyroxene*	51.9
		Olivine	16.8
		Biotite and other accessories	5.9
D.67	Coarse grained gabbro, Hebya	Plagioclase	42.8
		Pyroxene*	39.8
		Olivine	7.4
		Biotite and other accessories	10.0

* Ortho- and clinopyroxenes together.

Sugavanam (1974) noted that the dolerite dykes with clouded plagioclases belong to an emplacement episode between 2100-1600 m.y. Radiometric ages of cratonising dykes are very few. Only two age data are available for basic dykes with clouded plagioclases. An age of 2100 m.y. has been obtained for a dolerite dyke of South Kanara that occurs in the proximity of charnockite region (Balasubramanian, 1971). Afnasseyev *et al,* (1964) have recorded an age of 1680 m.y. for a dolerite dyke intruding the charnockites of Madras region.

Mafic dykes in gneiss-charnockite terrain can be broadly classified as in Table III.

The relative age of a given dyke can be arrived at in the light of the above classification by knowing the closing date of regional metamorphic event that affected the region. Those dykes older than the event will have been made over to epidiorite, amphibolite or granulite depending on the grade of metamorphism; those which postdated the regional metamorphic event would preserve their parental igneous characters intact.

TABLE II

CHEMICAL ANALYSES OF BASALTIC KOMATIITE DYKES OF MYSORE DISTRICT COMPARED WITH THE ANALYSES OF BIHAR AND SOUTH AFRICAN KOMATIITE

	1	2	3	4	5	6	7	8
SiO_2	50.80	51.36	49.29	50.66	47.37	49.19	52.73	52.22
TiO_2	0.53	0.35	0.24	0.63	0.46	0.43	0.85	0.56
Al_2O_3	6.74	8.43	12.98	7.16	6.76	3.76	9.83	5.43
Fe_2O_3	1.79	0.79	0.12	4.78	1.18	11.00	1.23	0.98
FeO	11.84	9.98	8.40	10.72	8.08		9.70	8.88
MnO	0.02	0.04	0.15	0.06	0.19	0.17	0.22	0.22
MgO	15.81	13.02	9.82	10.51	20.39	20.03	10.10	15.25
CaO	10.95	12.69	15.73	12.60	8.31	9.51	9.99	12.83
Na_2O	1.34	1.85	1.52	1.68	0.39	0.10	2.65	1.21
K_2O	0.54	0.30	0.32	0.28	0.06	0.02	0.46	0.09
P_2O_5	0.06	—	—	—	—	—	—	—
H_2O^+	0.38	0.54	0.76	0.92	5.26	—	1.87	2.05
H_2O^-	0.06	0.06	0.07	—	—	—	—	—
Total	100.14	99.41	99.40	100.00	98.45	94.21	99.63	99.72

1. D.16, Dolerite dyke, norrh of Sindhuvalli, Mysore District
2. D.58, N-S running gabbroic dyke, W. of Solepura, Mysore District
3. D.67, N-S running gabbroic dyke near Hebya, Mysore District

(1–3: Analyst S. Ramanathan (1955))

4. Metabasalt from Kulamara, Bihar, Sample 114 of Dutta & Sen, 1966, p. 177.
5. Average high alumina Geluk type komatiite
6. Average low alumina Geluk type komatiite
7. Average Barberton type basaltic komatiite
8. Average Badplass type komatiite

(5–8: Viljoen and Viljoen, 1969, p. 55-85.)

TABLE III

CLASSIFICATION OF MAFIC DYKES IN RELATION TO METAMORPHISM IN KARNATAKA

MAFIC DYKES

- Metamorphosed
  - Regional
    1) Charnockite (hypersthene granulite) dykes.
    2) Amphibolite dykes.
    3) Epidiorite dykes.
  - Thermal
    - Dolerite, gabbro and norite dykes with clouded plagioclases.
- Unmetamorphosed
  - Dolerite, gabbro and norite dykes without clouded plagioclases.

The major metamorphic event in Karnataka State is related to Dharwar metamorphism, whose closing date could be taken as corresponding to the emplacement of the late syntectonic Closepet granites. Venkatasubramanian *et al*, (1971) have determined an isochron age of 2000 ± 80 m.y. for the Closepet granites. In the light of the above considerations, the dykes under study are probably younger than 2100 m.y.

If the close of the Archaean is taken as 2500 m.y. in the peninsular Indian shield as elsewhere (e.g., U.S.A., Canada, Western Europe, U.S.S.R.), then these dykes would belong to the post-Archaean times. Although Gale (1973) has recorded the occurrences of basaltic komatiites in the Palaeozoic group of rocks, Hart and Brooks (1974) by a study of 20000 analyses of mafic and ultramafic igneous rocks, found that basaltic komatiites are rare in the post-Archaean geological column.

Komatiite dykes of Mysore have intruded migmatitic gneisses which constitute the main sialic component of the Precambrian shield. The occurrence therefore suggests that komatiite magmas could develop beneath sialic crust. Instrusion of komatiite dykes into granites has also been noticed in Western Australia, e.g., Jimberlana dyke, which led McCall (1973) to suggest that high magnesia basalts (komatiites) in Western Australia were emplaced even after the thickening up of the Earth's crust. The dyke komatiite of Kulamara in Bihar has been considered by Viswanathan (1974) as an emplacement after the thickening up of the Earth's crust (i.e,, after the development of sial).

The occurrence of dykes of komatiite composition intruding the gneisses of Mysore suggests (1) that komatiite magmas could develop towards the close of a tectonomagmatic cycle and not necessarily be confined to the inaugural episode of volcanism of greenstone belts; (2) they developed probably in post-Archaean times in this part of the shield; however, radiometric age determination of these very dykes is essential to confirm this view, and (3) the tectonic regime of generation and emplacement of komatiites is not restricted to oceanic domain, but they could develop in continental crust environment.

Conclusion: The occurrence of komatiite dykes intruding the gneisses in Mysore, viewed together with the occurrence of Kulamara dyke, Bihar (Viswanathan and Sankaran, 1973), Jimberlana dyke in Australia (McCall, 1973) and Wawa island arc type volcanics, Ontario (Brooks and Hart, 1972) raises doubts on the spatial significance of komatiites (as confined to oceanic crustal regime) warranted by the Barberton Mountain Land komatiites. The Upper Mantle inhomogeneity and the history of magmatic evolution are probably dominant factors in the genesis of komatiite magmas which need further detailed investigation.

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GEOLOGICAL ASPECTS OF THE KINNAUR EARTHQUAKE HIMACHAL PRADESH

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Introduction: The border districts of Spiti and Kinnaur in the Himachal Pradesh were rocked by a severe earthquake of intensity 7.00 on Richter Scale and VIII to IX on the Modified Mercalli Intensity Scale (Singh *et al*, 1975) at 1.31 P.M. on 19th Jan., 1975. Resulting ground motion caused heavy damage to property and loss of several lives. The epicentre of this earthquake has been located 450 km north of Delhi at Long. 78°E Lat. 32°N (Chaudhri and Srivastava, 1975) in the vicinity of the Samsag ridge near Sumdoh. The earthquake was felt all over the Himachal Pradesh, J. & K., Punjab, Haryana, Chandigarh, hill districts of U.P. and as far south as Delhi, though no damage to property and loss of life was reported except in Spiti and Kinnaur Districts of Himachal Pradesh. Maximum damage due to this earthquake has taken place along the Spiti river in the lower Spiti valley and the areas around the confluence of the Spiti river with the Sutlej. The worst affected villages include Chango, Shalkar, Leo, Sumra, Hango, Nako, Malling, Pooh, Namgia, Kaurik, Tashigong, Sumdoh, Dhankar, Giu, Thabo, Po, Lari, Kaza, Hurling. Larling, Damul and Kay.

The present communication describes the geological setting of the area around the epicentre and discusses possible causes of the earthquake.