CORRESPONDENCE

Basaltic komatiite occurrences in the Kolar gold field of India?

SIR,—The well-known Kolar gold field of Mysore State, India, is 3100 million years old (Pichamuthu, 1971), and comprises pillowed mafic metavolcanic flows (Narayanaswamy & Ziauddin, 1972). This communication has two objectives: (1) to show that some metabasalts from Kolar have unusual chemical characteristics typical of basaltic komatiites from the 3400 million year old Barberton Mountain Land of South Africa (Anhaeusser, 1971*a*), and (2) to suggest the possibility that the earliest crustal material that developed in the Indian Shield was composed of mafic komatiites similar to those described by Viljoen & Viljoen (1969*a*) from Barberton.

Chemical analyses of three metabasalts from the Kolar gold field are presented in Table 1, together with the average chemical compositions of two types of basaltic komatiite from the type area Barberton greenstone belt (Viljoen & Viljoen, 1969*a*), namely, the *Barberton*, and *Geluk* types. The average chemical compositions of oceanic tholeiite (Engel, Engel & Havens, 1965), continental tholeiite (Manson, 1967), and Archaean metabasalt from the Superior Province of the Canadian Shield (Wilson *et al.* 1965) are also given in Table 1 for comparison.

On a variation diagram of Ca *versus* Al – two of the most distinctive chemical components of basaltic komatiite (Viljoen & Viljoen, 1969*a*), the three Kolar metabasalt samples plot within the field delineated for the type area Barberton basaltic komatiites, a field that lies above the Ca:Al = 1:1 level, and clearly separated from the field of

Table 1. *Chemical analyses of Archaean metabasalts, basaltic komatiites, and well-established classes of basalts*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SiO_2	45.28	50.40	45.05	52.73	47.37	49.94	51.50	49.83
TiO_2	0.58	0.74	0.63	0.85	0.46	1.51	1.20	0.94
Al_2O_3	12.21	11.12	9.46	9.83	6.79	16.69	16.30	14.64
Fe_2O_3	1.28	1.73	1.30	1.23	1.18	2.01	2.80	3.03
FeO	12.09	11.31	10.86	9.70	8.08	6.90	7.90	8.77
MnO	0.40	0.36	0.20	0.22	0.19	0.17	0.17	0.21
MgO	11.86	11.66	20.46	10.10	20.39	7.28	5.90	7.36
CaO	10.68	9.20	7.13	9.99	8.31	11.86	9.80	10.46
Na_2O	1.10	2.49	0.80	2.65	0.39	2.76	2.50	2.02
K_2O	0.33	0.19	0.20	0.46	0.06	0.16	0.86	0.23
H_2O^+	3.30	0.04	3.76	1.87	5.26	—	—	—
H_2O^-	0.20	0.60	0.08	0.16	0.25	—	—	—

(1–3) Metabasalts from the Kolar gold field, India (samples C/447, C/422 of Ramachandra Rao (1937) and sample 1C12 of Datta & Sen (1969) respectively).

(4) Barberton type basaltic komatiite from the Barberton greenstone belt (Viljoen & Viljoen, 1969*a*).

(5) Geluk type basaltic komatiite from the Barberton greenstone belt (Viljoen & Viljoen, 1969*a*).

(6) Average oceanic tholeiite (Engel *et al.* 1965).

(7) Average continental tholeiite (Manson, 1967).

(8) Average Archaean metabasalt from the Superior Province of the Canadian Shield (Wilson *et al.* 1965).

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average oceanic tholeiite, continental tholeiite, and the Canadian Archaean metabasalt which plot below the Ca-Al = 1:1 line. Representation of the chemical data on a CaO–Al_2O_3–MgO ternary diagram proposed by Viljoen & Viljoen (1969*a*) shows that two of the Kolar samples (Table 1, nos. 1 and 2) are of the *Barberton type* basaltic komatiite, and that the third sample (Table 1, No. 3) is of the *Geluk type*.

The close chemical similarities between the Kolar metabasalt samples and the Barberton basaltic komatiites can also be demonstrated by variation diagrams of $(Na_2O + K_2O)$ *versus* $(SiO_2 + Al_2O_3)$ and MgO *versus* $FeO + Fe_2O_3$ (as FeO). On both these diagrams, the three Kolar samples plot in fields delineated for the Barberton basaltic komatiites that are distinctly separated from the fields of the average oceanic tholeiite, continental tholeiite, and the Canadian Archaean metabasalt.

The Indian Shield has not figured prominently in intercontinental comparisons of magma-types that evolved in Early Precambrian areas because of the scarcity of chemical data and the lack of a modern approach to interpreting those data that are available on the ancient volcanic rocks of India. Such comparative studies of the Early Precambrian volcanic sequences in South Africa, Canada and Western Australia (Viljoen & Viljoen, 1969*b*; Anhaeusser, 1971*b*) demonstrate the existence in these regions of rocks that consolidated from a pristine earth's first eruptible magma-type, komatiite, that has been interpreted as formed by a complete, or almost complete, melting of the upper mantle about 3.5–4.0 billion years ago. The occurrence of metabasalts in the 3.1 b.y. old Kolar gold field of India possessing the unusual chemical characteristics (high Ca/Al ratios, high MgO, and low Na_2O and K_2O) typical of basaltic komatiites from Barberton suggests the possibility that a similar magma, more primitive than oceanic tholeiite, also existed in the Early Precambrian of India. It thus appears that basaltic komatiite is a significant component of the Indian protocrust.

References

Anhaeusser, C. R. 1971(*a*). The Barberton Mountain Land, South Africa—a guide to the understanding of the Archaean geology of Western Australia. *Spec. Publ. geol. Soc. Austr.* **3**, 103–19.

Anhaeusser, C. R. 1971(*b*). Cyclic volcanicity and sedimentation in the evolutionary development of Archaean greenstone belts of shield areas. *Spec. Publ. geol. Soc. Austr.* **3**, 57–70.

Datta, A. K. & Sen, C. R. 1969. Generalised geological history and petrology of the basic and ultrabasic rocks of Indian Pre-Cambrian Shield. *Mem. geol. Surv. India* **100**, 13–35.

Engel, A. E. J., Engel, C. G. & Havens, R. G. 1965. Chemical characteristics of oceanic basalts and upper mantle. *Bull. geol. Soc. Am.* **76**, 719–34.

Manson, V. 1967. Geochemistry of basaltic rocks: major elements. *In* Hess, H. H. & Poldervaart, A. (Eds.): *Basalts* **1**, 215–69. Interscience Publishers.

Narayanaswamy, S. & Ziauddin, M. 1972. Gold. *Rec. geol. Surv. India* **102**(2), 41–50.

Pichamuthu, C. S. 1971. Precambrian geochronology of Peninsular India. *J. geol. Soc. India* **12**, 262–73.

Ramachandra Rao, M. B. 1937. The petrology of the hornblendic rocks of the Kolar schist belt. *Bull. Mysore geol. Dept.* **16**, 1–63.

Viljoen, M. J. & Viljoen, R. P. 1969(*a*). The geology and geochemistry of the Lower Ultramafic Unit of the Onverwacht Group and a proposed new class of igneous rock. *Spec. Publ. geol. Soc. S. Afr.* **2**, 55–85.

Viljoen, M. J. & Viljoen, R. P. 1969(*b*). A reappraisal of the granite-greenstone terrains of shield areas based on the Barberton model. *Spec. Publ. geol. Soc. S. Afr.* **2**, 245–74.

Wilson, H. D. B., Andrews, P., Moxham, R. S. & Ramlal, K. 1965. Archaean volcanism in the Canadian Shield. *Can. J. Earth Sci.* **2**, 161–75.

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