VINOGRADOV, A., TUGARINOV, A., ZHYKOV, C., STAPNIKOVA, N., BIBIKOVA, E. and KHORRE, K., (1964) Geochronology of Indian Precambrian. *Int. Geol. Congr. Rep. 22nd Session*, pt. X, pp 553-567.

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Rare earth element geochemistry of basalt-spilite association of Bombay and Carlsberg Ridge—a preliminary study

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Introduction

Sukheswala (1974) reported the occurrence of spilite with pillow characters from Bhoiwada, on the eastern ridge of Bombay island, in the Deccan traps of India for the first time. The Bhoiwada section exhibits the gradation of fresh black tholeiite into altered green spilite; perhaps this is the only known occurrence in the world showing complete gradation within one section. Therefore, this section provides a unique opportunity to trace the possible ancestry of the spilite. Similarly, Hekinian (1968) reported the presence of tholeiite and spilite from the Carlsberg Ridge, Arabian Sea, from two nearby dredge hauls.

In this short note, an attempt has been made using rare earth element (REE) geochemistry to see whether or not any genetic relation exists betwen the basalt (tholeiite) and spilite.

Results and Discussion

REE analyses of a tholeiite and spilite from Bambay and Carlsberg Ridge were made using Neutron Activation Analysis involving radiochemical group separations (Reddy *et al.*, 1976). The results are presented in Table I, while the chondrite-normalized REE patterns are shown in Fig. 1.

While both the rocks from the Bombay area display LREE enriched patterns, the absolute abundance of spilite is at least 3 times higher than that of the basalt. Similarly the $(La/Sm)_{e.f.}$ also shows an increase from 1.85 to 2.45 for tholeiite and spilite respectively.

Thus the contrasting REE geochemistry for these two rock types from the Bombay area opens up at least three alternatives:

1) That the increase in concentration of REE and $(La/Sm)_{e.f.}$ ratio may perhaps be related to spilitization, suggesting that the REE are not immobile at least under some secondary processes.
2) It is likely that the relative fractionation of LREE in spilite may be similar to that of the basalt, suggesting possible genetic relationship between these two rock types.

3) It is probable that the basalt and spilite are unrelated, i.e. two different flows. This is based on the assumption that the REE are unaffected by spilitization.

With this meagre data it is not possible to draw any definite interpretation, except to report this new data.

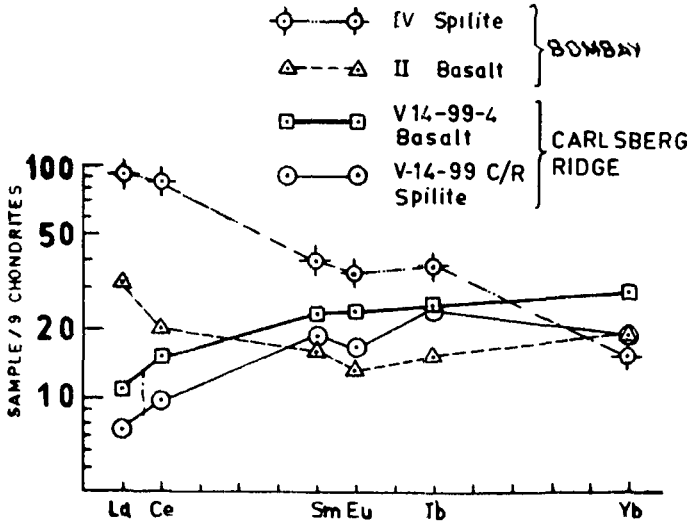

Figure 1. REE distribution patterns for volcanic rocks from Bombay and Carlsberg ridge.

For comparison, REE data for one basalt and one spilite from the Carlsberg Ridge are also included in Table I. It is obvious that the absolute REE concentrations, $(La/Sm)_{e.f.}$ ratios, and relative REE distribution patterns are nearly similar for both these rock types. Thus the oceanic association indicates that low grade metamorphism and spilitization apparently do not alter the original REE concentrations, assuming that both these rock types form one sequence. In view of the fact that both these samples were collected from two different dredge hauls from nearby areas, it is not possible to ascertain this fact with confidence.

TABLE I. REE data

Sample No.	La	Ce	Sm	Eu	Tb	Yb	$(La/Sm)_{e.f.}$
B II	10.3	18.0	3.04	0.93	0.71	3.81	1.85
B IV	31.5	74.7	7.06	2.38	1.78	3.06	2.45
V14-99-4	3.65	12.4	4.21	1.61	1.1	5 6	0.47
V14-99 C/E	2.41	8.52	3.33	1.13	1.13	3.61	0.39

B II : Tholeiite, Bhoiwada quarry
B IV : Spilite, Bhoiwada quarry
V14-99-4 : Tholeiite, Carlsberg Ridge
V14-99C/E : Spilite, Carlsberg Ridge

Further REE studies on rocks from different tectonic settings are in progress and are likely to offer better clues on the genesis.

The REE analyses for the Bhoiwada rocks were completed during March, 1977. However, detailed studies were also carried out by a British group on this same suite of rocks from Bhoiwada, and results appeared in 'Nature', May 1977 (Hellman and

Henderson). They suggested that 'spilitization may in some circumstances affect REE abundances and their chondrite normalized patterns', which is in fact a very significant point to be considered in these studies.

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References

HEKINIAN, R , (1968) Rocks from the Mid-Oceanic ridge in the Indian Ocean. *Deep Sea Research*, v. 15 pp 195-213

HELLMAN, P L. and HENDERSON, P , (1977) Are rare earth elements mobile during spilitization? *Nature*, v. 267, pp 38-40.

REDDY, G R , RAO, B L , PANT, D R and DAS, M S , (1976) Neutron activation analysis of 13 minor and trace elements in geological samples. *Jour Rad. Anal. Chem* , v 33, pp. 39-51.

SUKHESWALA, R N , (1974) Gradation of tholeiitic Deccan basalt into spilite, Bombay, India In *Spilites and spilitic rocks* (ed Amstutz, G C , *et al*) Heidelberg Springer Verlag, pp 229-250

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REVIEW

ASBESTOS EXPLORATION IN RORO—A PROSPECTIVE STRATEGY by P. C Pal assisted by S. Narasimha Rao and P Unnikrishnan, Centre of Exploration Geophysics, Osmania University, Hyderabad-500007.

Asbestos mineralisation at Roro is restricted to the thin zones of serpentinisation that occur at the interfaces of the rhythmically layered ultramafics. The fibre localisation, seemingly, is better at the interface of serpentinised saxonite (also called clot peridotite, CLP) and serpentinised pyroxenite (SRP). In chapter 1 and 2, the author (s) have done a commendable job in consolidating the available data on the Roro ultramafics in general and the asbestos mineralisation in particular.

The absence of direct observational evidences because of discontinuous exposures of ultramafics has necessitated resorting to geophysical surveys. The authors have rightly appreciated that the geophysical methods cannot straightaway unravel the mineralised zones but they can only help in geological mapping of the ultramafics from which the possible areas of mineralisation could be surmised for confirmation later by test drilling. The problem, therefore, is to trace the extensions of the litho-