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STUDY OF THE DISTRIBUTION OF TRACE ELEMENTS IN THE ROCKS OF NUGGIHALLI SCHIST BELT, HASSAN DISTRICT, MYSORE STATE, INDIA

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ABSTRACT

Semi-quantitative spectrochemical analyses of the rocks representing the three major lithological units of the Nuggihalli schist belt, namely the ultrabasic rocks, the green schists, and the amphibolites have been done. Based on the distribution of elements like Cr, Ni, Cu, Co, V, Ti and B, the amphibolites of this region are considered to be ortho-amphibolites formed after the pre-existing igneous rocks of doleritic or basaltic composition. Further, by a comparison of the nature of distribution of these elements in the three major rock units, it is inferred that the green schists are derived from the alteration of ultrabasic rock and there has not been any differentiation in the rocks of this region.

INTRODUCTION

Attempts are being made in recent years to use the study of trace element distribution for solving geological problems. ENGEL and ENGEL [1951, 1953, 1962], EVANS and LEAKE [1960], SHAW and KUDO [1965], TUREKIAN [1965] are some of the people who have made important contributions in this field. Opinion is divided among geologists about the usefulness of this method. However, in certain cases where the conventional methods fail, this method of study is regarded as important. In the present investigation it is seen that rock units like ultrabasics, green schists, and amphibolites are being involved in a peculiar geological setting in Nuggihalli schist belt. By conventional studies it is rather difficult to establish the relationship existing between these rock units. Therefor, an attempt has been made to trace the relationship among these rock units of this region by a semiquantitative spectrochemical analyses and its interpretation.

GEOLOGICAL SETTING

The name Nuggihalli schist belt is given to a narrow strip of Dharwarian (Pre--cambrian) schistose rocks occurring in the vicinity of Nuggihalli, (Lat. 13° 1', Long. 76° 28'), Hassan District with NNW-SSE strike and varying amounts of dip. This schist belt is surrounded by granites and granite gneisses. The belt chiefly consists of *(a)* the ultrabasic rocks, represented by dunite, pyroxenite and serpentinite; *(b)* green schists made up of chlorite schist, talc chlorite schist, talc actinolite schist, talc kaemmererite schists, etc. and *(c)* amphibolites. In the field the ultrabasic rocks appear to intrude into the amphibolites. The green schists are between the amphibolites and the ultrabasics. Though the ultrabasics appear to grade on to the green schists, and no such gradation is seen between the amphibolites and the green schists, the field characters are not very clear to indicate the relationship among these rocks.

Thoroughly homogenized samples of 12 rocks representing all the three lithological units were subjected to spectrochemical analyses. The semiquantitative estimation of the lines were made using the charts prepared by KALININ *et al* [1952]. During the semiquantitative estimation elements like Si, Mg, Cr, Ni, Mn, Cu, Co, Al, V, Ca, Ti and B have given positive results whereas elements like Be, As, Ba, Ge, Sb, Pb, Sn, Pt, Mo, Ag, Cl, Zn, Bi and Se have given negative results. The results of the estimation are given in Table I.

A general survey of the results of the spectrochemical analyses given in Table I indicates that the trace element content in these rocks are slightly lower than the arithmetic mean of these elements in the basic igneous rocks reported by EVANS and LEAKE [1960]. However, they appear to fall well within the range of variations for the basic igneous rocks.

TABLE I

Trace element content of rocks from Nuggihalli schist belt

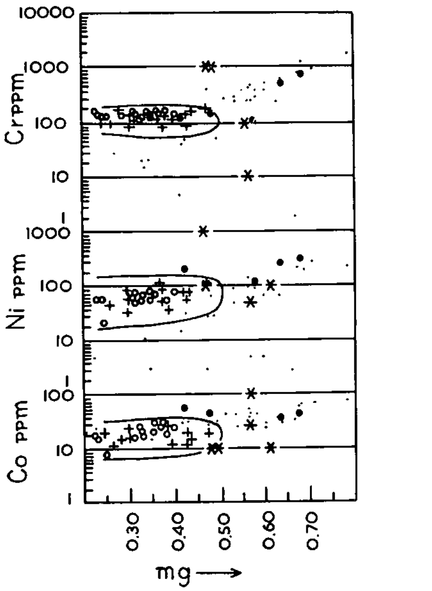
Elements	A_1	A_2	A_3	A_4	U_1	U_2	U_3	U_4	G_1	G_2	G_3	G_4
Si	6	6	6	6	6	6	6	6	6	6	6	6
Cr	2	1	—	1	2	3	1	2	2	5	—	1
Ni	3	2	2	3	4	4	4	3	3	4	2	3
Mn	4	3	3	4	3	4	4	4	4	3	2	1
Cu	2	2	2	2	1	1	1	2	1	1	1	1
Co	1	1	1	2	2	3	3	3	1	3	1	2
Al	4	4	5	4	1	2	2	3	3	5	6	5
V	1	1	2	1	—	—	—	—	—	—	—	—
Mg	6	6	6	6	6	6	6	6	6	5	6	6
Ca	5	5	5	5	2	1	1	5	4	2	4	3
Ti	1	1	2	1	—	—	1	1	1	5	2	1
B	1	—	—	—	1	2	2	1	1	2	1	—

A_1 to A_4 — Amphibolites
U_1 to U_4 — Ultrabasics
G_1 to G_4 — Greenschists

6 — X0.00%
5 — X.00%
4 — X.00—0.X0%
3 — 0.X0—0.0X%
2 — 0.0X—0.00X%
1 — 0.00X%

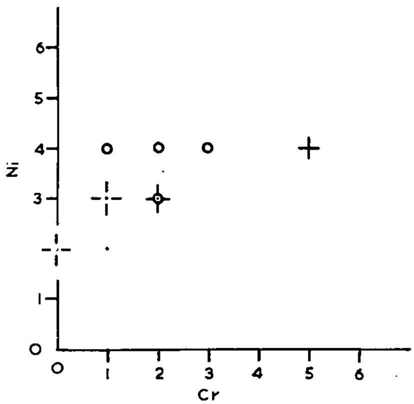
In the amphibolites there is no variation in Si, Cu, Ca, Mg, Cr and V. Cr is poor in all the types and is absent in one of the amphibolites. Significantly B is absent in all the amphibolites except in one which has a slightly different setting than the other amphibolites. This amphibolite A_1 makes a direct contact with the ultrabasics in the field.

LEAKE [1964] has made use of the elements like Cr, Ni, Co and Cu in amphibolites for distinguishing ortho-from para-amphibolites. By plotting Mg against Cr, Ni, Co and Cu for the Karroo dolerites, ortho-amphibolites, pelites, etc. LEAKE (op. cit.) has demarkated fields for rocks of igneous parentage. This figure is reproduced in *Fig. 1* with the plots for the amphibolites from Nuggihalli. It is seen in this figure that the plots for the amphibolites from Nuggihalli correspond to Karroo dolerites and Langy ortho-amphibolites, thereby suggesting that the amphibolites under study are ortho-amphibolites probably formed after the pre-existing igneous rocks of doleritic or basaltic composition.



o-CONNEMARA PELITES +-LITTLETON PELITES
· KAROO DOLERITES
•-LANGØY ORTHO-AMPHIBOLITES
✱ AMPHIBOLITES FROM NUGGIHALLI SCHIST BELT

FIG: I



THE PLOTS OF Ni AGAINST Cr IN AMPHIBOLITES, ULTRABASICS & GREEN SCHISTS IN NUGGIHALLI SCHIST BELT

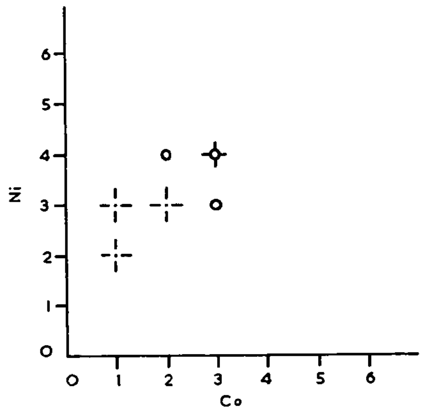
FIG: 2

Among the ultrabasic rocks one specimen of dunite, two specimens of serpentinites and one specimen of pyroxenite have been analysed (Table I). In these rocks, Cr, Ni, Mn, Cu, Co and Al vary from rock to rock. Vanadium is absent in all the rocks. Boron which is absent in the amphibolites except in one, is present in all the ultrabasic rocks. The content of B is more in the two serpentinites. This may be due to the formation of serpentinites from dunite through autometamorphic processes.

In order to know whether there is any trend of differentiation among these rocks and also among the rocks of the other lithological units of this area, the value of Cr, Ni and Co are plotted against each other and shown in *Figs. 2* to *4*.

In these figures it can be seen that not only the plots for the ultrabasic rocks are scattered but also the plots for the rocks of the three major rock units are non--aligned. This shows that there is no differentiation among the rocks of this area.

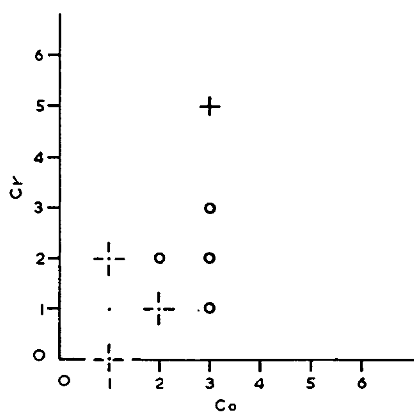
In the green schists there is considerable variation in the content of Cr, Ni, Mn, Co, Al, Ca, Ti and B. Vanadium, which is present in the amphibolites, is absent here. Except in talc schist G_4, B is present in the other three. Since the green schists are developed in between the amphibolites and the ultrabasic rock, it is possible that they might have been formed after either of the two. EWANS and LEAKE (op. cit.) have selected elements like Cr, Ni, Co, Cu, Zr, Se, Sr and B as characteristic elements which would show a pronounced variation in their content in rocks depending upon the parent material from which the rocks are derived. The content of these elements in rocks of the three lithological units are represented in histograms in *Fig. 5.* An



THE PLOTS OF Ni AGAINST Co IN AMPHIBOLITES, ULTRABASICS & GREEN SCHISTS IN NUGGIHALLI SCHIST BELT

•-AMPHIBOLITES O-ULTRABASICS + GREEN SCHISTS

FIG: 3



THE PLOTS OF Cr AGAINST Co IN AMPHIBOLITES, ULTRABASICS & GREEN SCHISTS IN NUGGIHALLI SCHIST BELT

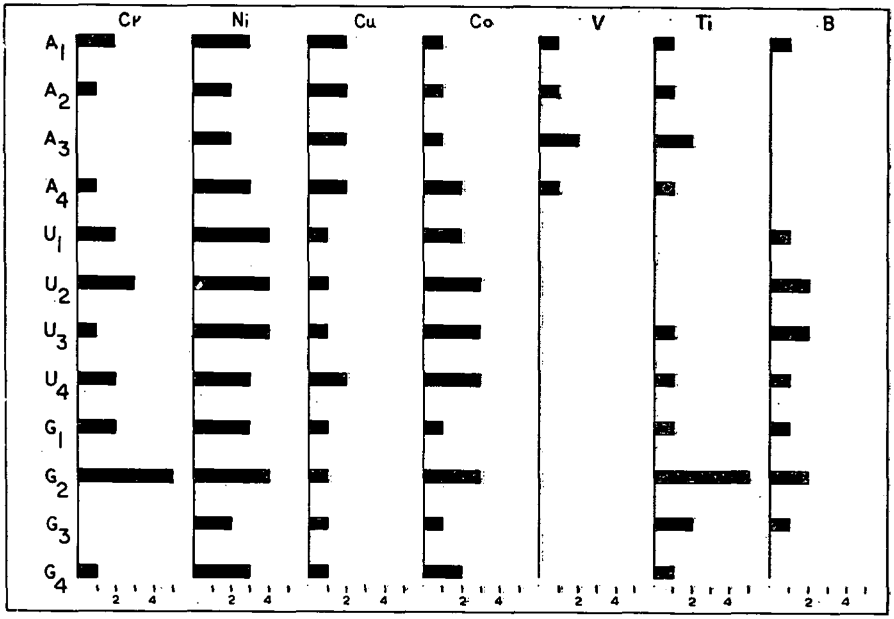
FIG: 4

inspection of the histograms shows a marked similarity in the distribution of the characteristic elements in ultrabasics and the green schists and these in turn are dissimilar to the distribution in the amphibolites. From this it can be inferred that the green schists are formed after the ultrabasics.

CONCLUSION

From the present study it can be concluded that the distribution pattern of the trace elements in the rocks of Nuggihalli schist belt conform to the pattern of distribution of these elements in basic igneous rocks reported by EVANS and LEAKE (op. cit.). Based on this distribution it is also concluded that the amphibolites of this region are ortho-amphibolites formed after the pre-existing basic igneous rocks of doleritic or basaltic composition. The study shows that there is no differentiation, either among the rocks of individual lithological units or among the members of the major lithological groups. Further, the study indicates that the amphibolites have no genetic relationship with the ultrabasic rocks and the green schists, while green schists appear to have been derived from the ultrabasics.

HISTOGRAMS REPRESENTING THE DISTRIBUTION OF CERTAIN CHARACTERISTIC TRACE ELEMENTS IN THE MAJOR ROCK TYPES OF NUGGIHALLI SCHIST BELT



1 = < 0.001%. 2 = 0.001 - 0.01 %. 3 = 0.01 - 0.10 %. 4 = 0.10 - 1.00 % A = AMPHIBOLITES
U ULTRABASICS G GREEN SCHISTS

FIG: 5

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