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# COPPER MINERALISATION IN THE ULTRABASIC COMPLEX OF NUGGIHALLI, HASSAN DISTRICT, MYSORE STATE

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## ABSTRACT

The paper records an interesting occurrence of chalcopyrite and other sulphide minerals associated with the ultrabasic complex of Nuggihalli. Exploratory work carried out in the area for copper is described. The need for a closer observation of ultramafic and related rocks as potential sources for copper in the country is stressed.

## INTRODUCTION

The growing importance of base metals in industrial development has focussed attention on an intensive search for deposits of copper, lead and zinc. The recent publication of the Geological Survey of India (Misc. Publication 16, 1972) summarises the information on the base metal deposits in different geological formations of India ranging from the Archaean to Tertiary.

Although a variety of occurrences of copper have been described, they invariably fall within the category of hydrothermal lode deposits occurring as narrow linear zones in the Archaean and Proterozoic fold belts. Copper concentration as a result of crystallisation and differentiation of basic magma, similar to those of Sudbury and Bushveld has not been reported from India. Roy Choudhury and Venkatesh (1972, p. 66) who have attempted a summary of the regional controls of base metal mineralisation in India state: 'So far no copper deposits associated with the early stage of basic and ultrabasic activity is known in India'.

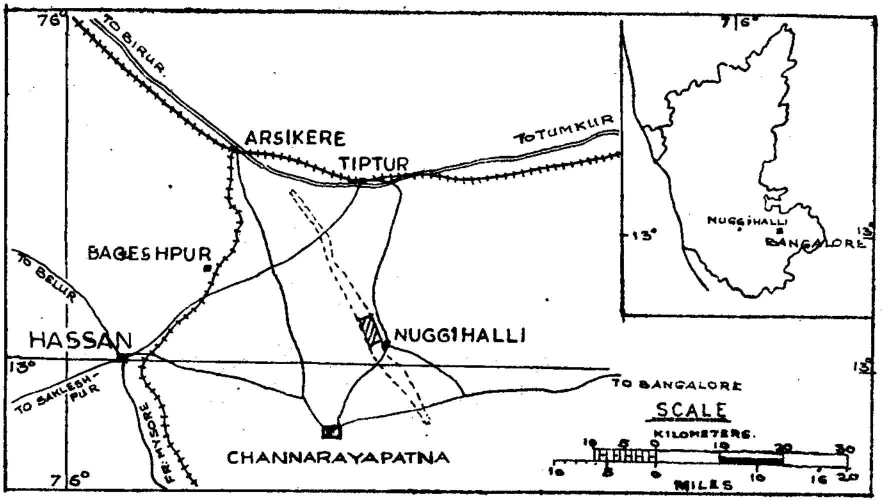
The Nuggihalli belt is a narrow belt of ultramafic rocks in Hassan District of Mysore State, extending in a NNW-SSE direction from near Arsikere (76°15′ : 13°18′) to Nuggihalli (76°28′ : 13°30′) for a distance of nearly 52 km (Location Map). It attains a maximum width of 2 km to the west of Nuggihalli. The schist belt is known for its rich accumulation of chromite lenses. (Sampat Iyengar, 1919, Radhakrishna, 1957). Apart from chromite, the schist belt is also noted for the occurrence of conformable beds of titaniferous magnetite, which are particularly conspicuous in the neighbourhood of Tagadur Ranganbetta △ 972, a prominent land mark in the almost featureless plain between Tiptur and Channarayapatna.

During the course of drilling exploration for vanadium bearing titaniferous magnetite near Tagadur (76°26′ : 13°21′30″) an interesting association of chalcopyrite in the amphibolitic and gabbroic parts of the complex came to light, and it is the object of the present paper to give details of this occurrence. The association of chalcopyrite in the gabbroic rocks incidentally points to the need for a more intensive exploration of other ultrabasic complexes in Mysore State for the occurrence of economically important deposits of copper.

## GEOLOGY

The ultrabasic rocks of Tagadur occur in the form of elongated lenses in which parallel bands of titaniferous magnetite are conspicuous. Black soil cover over a considerable extent of the area has made it difficult to trace the continuity of beds. Fig. 1 gives the details of the geology of the area under investigation.

The oldest rock type which can be recognised is a streaky amphibolite striking N20°W and dipping 70° east. Peridotite and serpentinite are confined to the eastern and western margins. Chromite veins and lenses are restricted to the altered serpentinite. The ultrabasics have marginally altered to actinolite-tremolite-chlorite schists. The peridotites pass upward into magnetite-gabbro with several enriched zones where magnetite has segregated to give rise to bands of titaniferous magnetite. These bands tend to come together when traced north and south giving a characteristic basin shape to the complex of ultrabasic rocks. A dolerite dyke about 15 m in width runs in the centre of the schist belt in NNW direction from △972 for a distance of nearly 2 km to the north.



Location Map

*Amphibolites:* Both massive and schistose varieties are common. Massive variety consists essentially of coarse plates of common hornblende, showing shades of yellow, green and blue pleochroism (X = blue, Y = green, and Z = yellow). The schistose amphibolite is streaky exhibiting pronounced schistosity with alternate bands of mafic and felsic minerals. Mafic band consists of elongated blades of blue green hornblende with subordinate chlorite. Irregular grains of magnetite are uniformly distributed (Pl. I, No. 1). The light coloured band is essentially composed of epidote and granular quartz. Minor amounts of clinozoisite and calcite are present. Sulphide mineralisation is observed mostly along the schistose planes. Westward, the amphibolite grades on to a rock rich in quartz, garnet and hornblende but shows no sulphide mineralization.

*Peridotite:* The rock is very much altered at the surface. Under the microscope it shows mainly altered aggregates of orthopyroxene and olivine. Intensive serpentinisation has obliterated the original texture (Pl. I, No. 2). There is no visible schistosity. Sulphide minerals are conspicuously absent. Chromite is irregularly distributed in the form of well developed euhedral crystals.

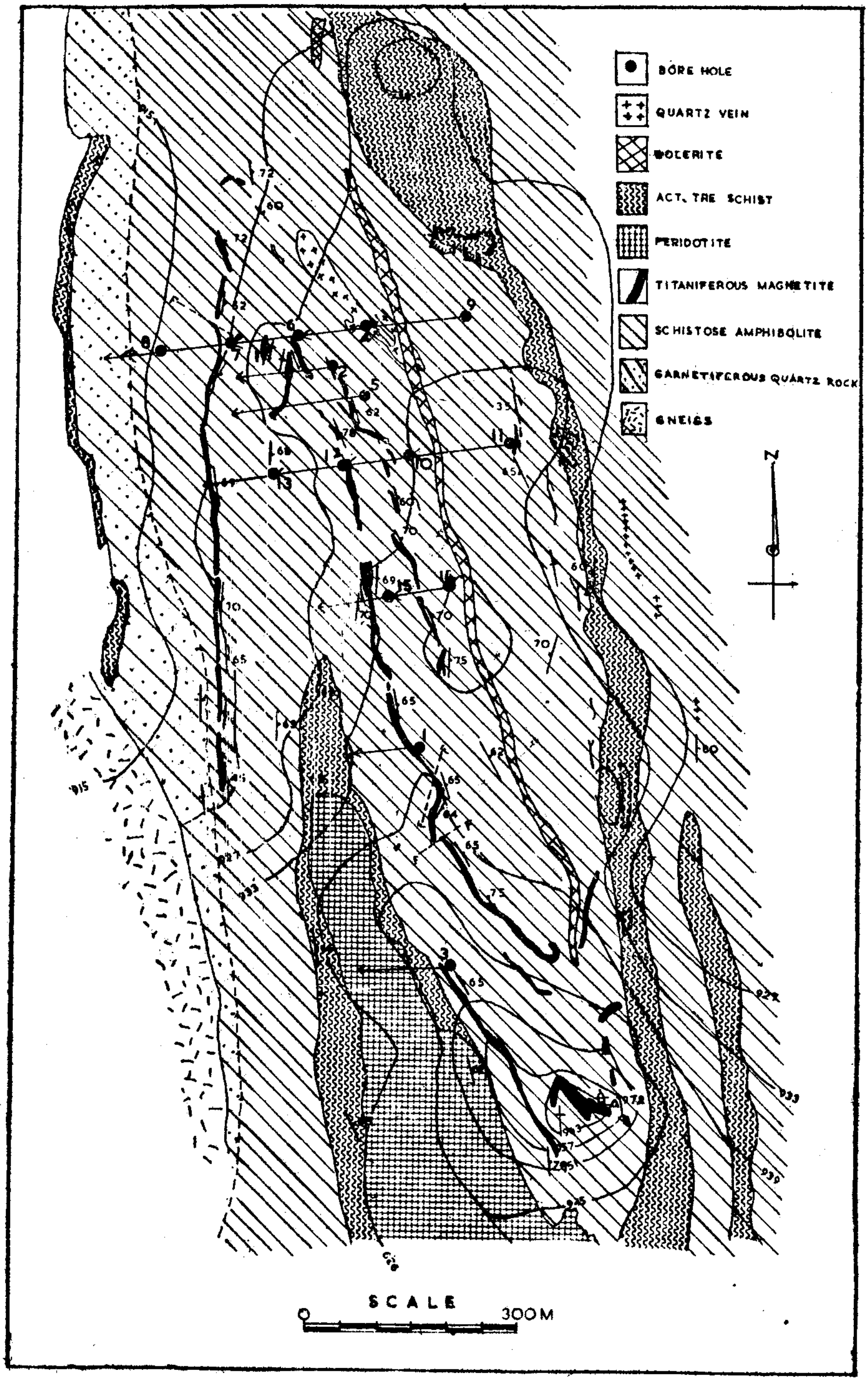


Figure 1. Geology of the Tagadur area.

*Actinolite-tremolite-chlorite schist:* Generally this rock type is seen on either side of titaniferous magnetite and gabbro. Acicular crystals of tremolite and actinolite with well developed cleavages make the bulk of the rock. Tremolite is colourless; actinolite shows pale green pleochroism. Tremolite and actinolite are altering to talc and chlorite (Pl. I, No. 3) which occur as scaly aggregates. Calcite is common in the form of veins cutting across schistosity (Pl. II, No. 1). Well developed octahedral grains of magnetite are many. Sulphide minerals occur both as crosscutting veins and parallel to schistosity. The rock sometimes gradually passes on to chlorite schist, and to serpentinite consisting of talc and carbonates.

TABLE I

CHEMICAL COMPOSITION OF BLEACHED MAGNETITE GABBRO

| Constituents | 1 | 2 |
|---|---|---|
| $SiO_2$ | 27.30 | 30.07 |
| $TiO_2$ | 5.20 | 5.55 |
| $Al_2O_3$ | 18.07 | 14.87 |
| $Fe_2O_3$ | 22.86 | 19.08 |
| $Cr_2O_3$ | — | Tr. |
| FeO | 14.45 | 17.31 |
| MnO | — | 0.16 |
| MgO | 1.69 | 2.95 |
| CaO | 8.73 | 5.32 |
| $Na_2O$ | 0.89 | 1.58 |
| $K_2O$ | — | 0.31 |
| $H_2O+$ | — | 1.61 |
| $H_2O-$ | — | 0.08 |
| $P_2O_5$ | — | 0.34 |
| $V_2O_5$ | 0.18 | 0.63 |
| S | 0.45 | 0.61 |
| L.O.I | 0.50 | — |
| Total | 100.42 | 100.47 |

1. Tagadur: Magnetite gabbro from Bore Hole No. 2 (435′6″), Analyst: S. J. Wesley, Dept. of Mines & Geology, Bangalore.
2. Coates magnetite gabbro, Western Australia, Analyst: D. R. Hudson, (Jour. Roy. Soc. Western Australia Vol. 150 Pt. 2 1967).

*Magnetite gabbro:* Outcrops of gabbro cannot be made out on the surface. These were recognised only in drill cores. Gabbro typically retains the original gabbroic texture. Plagioclase grains are equidimensional and occur as euhedral crystals. The fine dusty inclusions in the plagioclase impart a brownish clouded effect which is very characteristic (Pl. II, No. 2). Plagioclase is a labradorite ranging in composition from $Ab_{35}An_{65}$ to $Ab_{32}An_{68}$. Twinning is common but zoning is absent. Although plagioclase is saussuritized, original grain boundaries can still be made out. Plagioclase accounts for 49% of the rock. Rarely is it possible to identify original pyroxene because of intensive uralitization. No olivine could be made out. There is no hornblende which can be considered as primary. Biotite is absent. Quartz occurs as interstitial grains. Titaniferous magnetite occurs as euhedral to subhedral grains, and forms nearly 25% of the rock. The gabbro is therefore to be designated as magnetite gabbro. Magnetite grains locally get segregated to give rise to ore bands. Table I gives the chemical composition of the magnetite gabbro.

*Titaniferous Magnetite :* Titaniferous magnetite bands are essentially made up of accumulations of titaniferous magnetite crystals which account for nearly 80% of the rock. Colourless chlorite occupies the interstices between grains of titano-magnetite.

TABLE II

CHEMICAL COMPOSITION OF TITANIFEROUS IRON ORE

| Constituents | 1 | 2 |
|---|---|---|
| $SiO_2$ | 3.80 | 1.60 |
| $TiO_2$ | 11.20 | 16.40 |
| $Al_2O_3$ | 1.53 | 5.45 |
| $Fe_2O_3$ | 48.14 | 36.35 |
| $Cr_2O_3$ | — | 0.19 |
| FeO | 31.72 | 33.50 |
| MnO | — | 0.23 |
| MgO | 2.41 | 2.82 |
| CaO | Nil | Nil |
| $Na_2O$ | — | 0.03 |
| $K_2O$ | — | Nil |
| $H_2O+$ | — | 1.11 |
| $H_2O-$ | — | 0.13 |
| $P_2O_5$ | — | 0.05 |
| $V_2O_5$ | 0.34 | 2.49 |
| L.O.I. | 0.63 | — |
| Total | 99.77 | 100.35 |

1. Tagadur: Bore Hole No. 2 (201′9″) Analyst: S. J. Wesley, Chem lab—Dept. of Mines & Geology.
2. Bore hole samples (depth> 200′) from Kennedy's Vale (Analyst: P. Fourie, Soil Research Institute, Pretoria).

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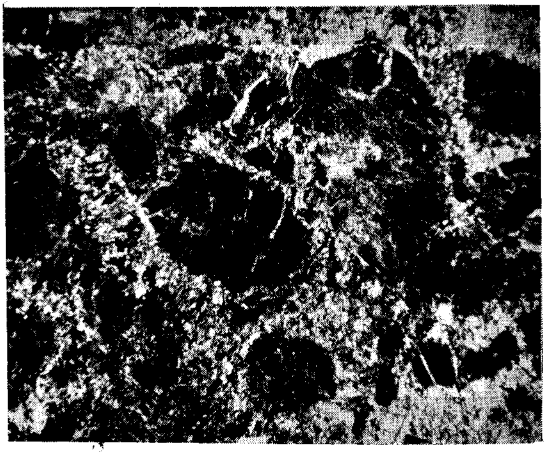
EXPLANATION OF PLATE I

1. Schistose amphibolite with alternate bands of quartz and epidote × 25 crossed nicols.
2. Serpentinised peridotite showing relict grains of olivine and orthopyroxene × 25 crossed nicols.
3. Actinolite crystals altering to chlorite × 25 crossed nicols.

1



2

3

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1

2

3

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*Dolerite:* Shows well developed subophitic to ophitic texture. Unaltered grains of olivine are occasionally seen. Augite and twinned plagioclase form the bulk of the mineral constituents (Pl. II, No. 3). Opaque mineral is mainly magnetite. Sulphide minerals are absent. During drilling exploration the dyke was intersected in bore hole Nos. 9 and 11. The study of the cores revealed that the dyke is dipping at 70°–80° towards east and is parallel to regional schistosity. Age of the dolerite is not known.

## DRILLING EXPLORATION

Drilling exploration by the Department of Mines and Geology was initially directed towards tracing the depthward continuation of the titaniferous magnetite ore bands and analysing the core samples for their vanadium content. During the course of this exploration, however, several wide zones of copper mineralisation confined to the gabbroic portions of the complex were encountered in most of the drill holes. The associated streaky amphibolites too showed disseminations of chalcopyrite to a lesser degree. Table III summarizes the results of drilling exploration with particular reference to copper mineralisation. The location of the bore holes is indicated in the accompanying map (Fig. 1).

Hole Nos. 1, 2 and 3 were initially taken at random in order to understand the type of mineralisation at different locations within the complex.

*Hole No. 1* was an angle hole drilled at an angle of 70° to intersect titaniferous magnetite bands at depth. It is this hole which first gave an indication of copper mineralisation in association with magnetite gabbro.

*Hole No. 2* taken 565 m N13°W of bore hole No. 1 gave better results. Copper mineralisation was strong in the schistose amphibolite, actinolite-tremolite schists bordering the gabbro and in the bleached gabbro itself. Mineralisation averaged over 0.5% copper over a width of 20 m. Higher values were noted over narrower widths.

*Hole No. 3* was located in the peridotite zone and did not indicate any copper mineralisation.

*Hole No. 4* was the deepest hole drilled in the area and was taken to a depth of 351.74 m. Mineralisation was seen to extend from 101.0 m to 307.92 m with intervening narrower bands of barren ground.

*Hole Nos. 6, 7 and 8* were all located in one line at intervals of 100 m apart. 6 and 7 showed mineralisation associated with magnetite gabbro and schisted amphibolite over widths of 100 to 300 cms with values ranging from 0.30 to 0.50. Hole No. 8 which was the westernmost, did not show any copper mineralisation.

*Hole No. 9* was taken 150 m east of No. 4. This too proved to be out of the mineralised zone. Apart from intersecting a dolerite dyke, it did not indicate any mineralisation.

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### EXPLANATION OF PLATE II

1. Actinolite-tremolite-chlorite schist with calcite veins × 25 crossed nicols.
2. Euhedral grain of twinned plagioclase in magnetite gabbro, showing saussuritisation × 25 crossed nicols.
3. Dolerite exhibiting ophitic texture × 25 crossed nicols.

## TABLE III

## DETAILS OF THE COPPER BEARING ZONES INTERSECTED IN EACH BORE HOLE

| Intersections | | Width in cms | Cu % | Lithology |
|---|---|---|---|---|
| From | To | | | |
| 1 | 2 | 3 | 4 | 5 |
| BORE HOLE 1 (inclined 70°W) depth: 91.44 m | | | | |
| 58.44 | 59.44 | 100 | 0.34 | Magnetite gabbro |
| 65.71 | 66.39 | 68 | 0.20 | Schistose amphibolite |
| 73.89 | 82.29 | 840 | 0.23 | Magnetite gabbro |
| BORE HOLE 2 (inclined 60°W) depth: 137.77 m | | | | |
| 70.91 | 72.04 | 113 | 0.32 | Schistose amphibolite |
| 74.65 | 81.00 | 635 | 0.94 | Actinolite-tremolite-schist |
| 98.75 | 110.03 | 1128 | 0.73 | — do — |
| 112.85 | 116.13 | 328 | 0.29 | Titaniferous Magnetite |
| 118.41 | 119.40 | 99 | 0.25 | Schistose amphibolite |
| 129.77 | 130.77 | 100 | 0.20 | Gabbro |
| 136.26 | 137.16 | 90 | 0.20 | Gabbro |
| BORE HOLE 3 (inclined 60°W) depth: 130.44 m<br>No copper bearing zone was intersected | | | | |
| BORE HOLE 4 (inclined 60°W) depth: 351.74 m | | | | |
| 111.00 | 111.99 | 99 | 0.20 | Magnetite gabbro |
| 118.54 | 122.51 | 397 | 0.30 | — do — |
| 140.10 | 141.09 | 99 | 0.11 | — do — |
| 160.63 | 161.18 | 55 | 0.16 | Titaniferous Magnetite |
| 165.35 | 169.32 | 397 | 0.32 | Schistose amphibolite |
| 172.61 | 175.71 | 310 | 0.32 | — do — |
| 195.96 | 197.96 | 200 | 0.14 | — do — |
| 200.86 | 201.77 | 91 | 0.14 | — do — |
| 213.38 | 215.62 | 224 | 0.29 | Actinolite-tremolite-schist |
| 238.78 | 239.78 | 100 | 0.88 | Schistose amphibolite |
| 274.57 | 276.55 | 198 | 0.39 | Gabbro |
| 279.93 | 280.72 | 99 | 0.15 | Schistose amphibolite |
| 285.16 | 286.15 | 99 | 0.39 | Actinolite-tremolite-schist |
| 289.63 | 293.44 | 381 | 0.47 | Schistose amphibolite |
| 306.93 | 307.92 | 99 | 1.20 | — do — |
| BORE HOLE 5 (inclined 60°W) depth: 196.90 m | | | | |
| 53.55 | 54.45 | 90 | 0.83 | Schistose amphibolite |
| 62.55 | 63.70 | 115 | 0.20 | — do — |
| 74.39 | 80.85 | 646 | 0.23 | Magnetite gabbro |
| 94.00 | 97.66 | 366 | 0.22 | — do — |
| 101.21 | 103.65 | 244 | 0.34 | — do — |
| 108.81 | 110.15 | 134 | 0.33 | — do — |
| 112.62 | 115.74 | 312 | 0.65 | — do — |
| 119.40 | 131.49 | 1209 | 0.14 | — do — |
| 143.10 | 145.64 | 254 | 0.64 | — do — |
| 157.89 | 170.80 | 291 | 0.30 | — do — |
| 186.94 | 196.90 | 996 | 0.15 | Titaniferous magnetite |

TABLE III *(Contd.)*

| Intersections | | Width in cms | Cu % | Lithology |
|---|---|---|---|---|
| From | To | | | |
| 1 | 2 | 3 | 4 | 5 |
| BORE HOLE 6 (inclined 60°W) depth: 213.66 m | | | | |
| 34.89 | 36.02 | 213 | 0.15 | Gabbro |
| 55.39 | 56.39 | 100 | 0.39 | Schistose amphibolite |
| 59.86 | 60.85 | 99 | 0.10 | Magnetite gabbro |
| 76.70 | 77.85 | 115 | 0.10 | — do — |
| 79.86 | 79.78 | 92 | 0.10 | — do — |
| 88.52 | 89.30 | 78 | 0.19 | Actinolite-tremolite-schist |
| 99.21 | 101.90 | 269 | 0.43 | Titaniferous magnetite |
| 113.81 | 116.74 | 293 | 0.17 | Schistose amphibolite |
| 154.94 | 155.93 | 99 | 0.31 | Actinolite-tremolite-schist |
| 176.07 | 180.75 | 468 | 0.30 | Titaniferous magnetite |
| 194.41 | 195.17 | 76 | 0.30 | Actinolite-tremolite-schist |
| 197.00 | 200.56 | 356 | 0.18 | Titaniferous magnetite |
| 203.75 | 204.74 | 99 | 0.41 | Schistose amphibolite |
| BORE HOLE 7 (inclined 60°W) depth: 188.37 m | | | | |
| 37.00 | 38.35 | 135 | 0.20 | Magnetite gabbro |
| 51.48 | 52.42 | 94 | 0.25 | — do — |
| 62.76 | 63.75 | 99 | 0.25 | — do — |
| 64.74 | 65.88 | 114 | 0.25 | — do — |
| 77.29 | 78.13 | 84 | 0.25 | — do — |
| 79.01 | 79.68 | 67 | 0.50 | Titaniferous magnetite |
| 80.59 | 81.51 | 99 | 0.50 | Schistose amphibolite |
| BORE HOLE 8 (inclined 60°W) depth: 64.00 m<br>Schistose amphibolite and garnetiferous quartz rock.<br>No copper bearing zone was intersected. | | | | |
| BORE HOLE 9 (inclined 60°W) depth: 248.48 m<br>Only traces of Copper in Schistose amphibolite | | | | |
| BORE HOLE 10 (inclined 45°W) depth: 180.44 m | | | | |
| 42.62 | 44.55 | 193 | 0.31 | Schistose amphibolite |
| 50.97 | 55.85 | 488 | 0.17 | Magnetite gabbro |
| 56.84 | 58.97 | 213 | 0.30 | Schistose amphibolite |
| 76.40 | 80.44 | 404 | 0.15 | — do — |
| 85.39 | 86.56 | 117 | 0.43 | Titaniferous magnetite |
| 88.75 | 92.30 | 355 | 0.38 | Magnetite gabbro |
| 107.77 | 108.60 | 83 | 0.69 | Titaniferous magnetite |
| 114.86 | 115.71 | 85 | 0.69 | — do — |
| 119.22 | 125.17 | 595 | 0.33 | Magnetite gabbro |
| BORE HOLE 11 (inclined 45°W) depth: 252.98 m<br>(Chemical analysis is under progress) | | | | |
| BORE HOLE 12 (inclined 45°W) depth: 195.37 m<br>Drilling under progress | | | | |
| BORE HOLE 13 (inclined 45°W) depth: 124.18 m<br>Has revealed several zones of mineralisation with disseminated sulphides.<br>Chemical analysis under progress. | | | | |

About 200 m south of the line of bore holes representing 9, 4, 6, 7 and 8 another series represented by Drill hole Nos. 10, 11, 12 and 13 were drilled. Excepting No. 11, the rest of the holes have indicated wide zones of mineralisation. Analysis of cores is in progress.

The drilling exploration so far carried out has indicated persistence of copper mineralisation over an area measuring 600 m × 200 m. Although occasional high values have been obtained over narrow widths, the overall grade appears to be about 0.4%.

Drilling exploration by the Geological Survey of India further south near Nuggihalli also appears to have shown copper mineralization.

The possibility of improving the grade of ore through simple magnetic separation was tested on a few samples of titaniferous magnetite showing disseminations of chalcopyrite.

The magnetic and non-magnetic portions in the samples were separated and analysed for their copper content. The results which are tabulated below indicate that the grade can be improved through magnetic separation. Further experiments at beneficiation are being continued

TABLE IV

| Bore Hole No. | Depth (in Mts) | | Average Sp. gravity | Cu% in the whole rock | % of Magnetic portion | % of Non-magnetic portion | Cu % in Magnetic portion | Cu % in Non-magnetic portion |
|---|---|---|---|---|---|---|---|---|
| | From | To | | | | | | |
| BH. 2 | 101.73— | 102.73 | 4.23 | 0.03 | 75 | 25 | Nil | 1.10 |
| | 112.86— | 113.86 | | 0.25 | 84 | 16 | Nil | 0.41 |
| | 113.86— | 114.86 | | 0.23 | 80 | 20 | Nil | 0.69 |
| | 114.86— | 115.86 | | 0.23 | 81 | 19 | Nil | 0.88 |
| | 115.86— | 116.86 | | 0.23 | 78 | 22 | Nil | 1.02 |

Should these trials at concentrating the low grade ores through preliminary magnetic separation followed by flotation were to succeed, the deposit may well prove to become an important source for the scarce metal copper.

## MINERALOGY OF THE ORES

Oxides: Among the oxide minerals titanomagnetite, magnetite and haematite have been identified under the ore microscope.

*Titanomagnetite* occurs as euhedral to subhedral crystals showing grey to greyish brown colour. It contains a number of inclusions of ilmenite. Under high magnification of the order of 500 × globular inclusions of chalcopyrite and pyrrhotite are observed. Titanomagnetite is slightly anisotropic, due to the presence of ilmenite. It has a sharp contact with pure magnetite. Titanomagnetite amounts to nearly 80% in the ore.

*Ilmenite* occurs in two forms (1) as independent grains around titanomagnetite, and (2) as inclusions in magnetite. It is greyish white in colour and exhibits reflection pleochroism. The shape of the ilmenite inclusions in titanomagnetite varies widely. Ilmenite occurring independently is rounded to subrounded.

*Magnetite* occurs as islands in sulphide minerals (particularly in chalcopyrite), has grayish brown colour and is euhedral. It is isotropic.

*Haematite* is seen only in surface samples of titanomagnetite undergoing martitisation. It is greyish white in colour and exhibits distinct anisotropism.

Sulphides: minerals identified in the ultrabasic complex are chalcopyrite, pyrite, pyrrhotite, pentlandite and cubanite. Sulphide minerals are mainly confined to gabbro and titaniferous magnetite and to a lesser extent to the schistose amphibolite.

*Chalcopyrite* is the chief sulphide mineral in the order of abundance. It occurs as anhedral grains and as inclusions in magnetite. It is yellow in colour and shows distinct anisotropism. It often exhibits twinning. Inclusions of pyrrhotite are common. Cubanite is commonly seen in association with chalcopyrite.

*Pyrite* which is next in order of abundance, occurs as euhedral grains and is sometimes highly fractured. Occurrencc of pyrite is common in all the rock types, and it is seen mainly along fissures and cavities in the rock.

*Pyrrhotite* is pale yellowish brown in colour and is next to pyrite in abundance. It occurs both as inclusions in chalcopyrite and as discrete grains. It has distinct reflective pleochroism varying between cream yellow to reddish brown and is distinctly anisotropic. Under high magnifications (of the order of 500 × ) pyrrhotite shows lamellae of pentlandite.

*Cubanite* is observed in two forms: (a) as irregular patches and (b) as exsolution lamellae in chalcopyrite. It is usually seen along the margins of chalcopyrite grains. Cubanite is similar to pyrrhotite but is more yellowish in colour. Reflection pleochroism is not distinct, but anisotropic effect between crossed nicols is distinct. The colour varies between rose brown to bluish grey.

*Pentlandite* occurs only as lamellae in pyrrhotite; has creamy yellow colour. It is distinguished from the associated pyrrhotite by its typical isotropism.

## DISCUSSION

Association of sulphide minerals particularly chalcopyrite, pyrrhotite and pentlandite in ultrabasic rocks has been recorded from different parts of the world. Canadian nickel sulphide deposits are classic examples of sulphide mineralisation directly related to magmatic activity. Souch *et al* (1969) think that the sulphides in Sudbury are the products of crystallisation of sulphur rich silicate magma. Comagmatic nature of the sulphide minerals related directly to the ultrabasic activity is known from Stillwater complex of Montana. Page (1971, p. 19) opines that the sulphides have resulted from an immiscible sulphide liquid. Wager and Mitchel (1957) attribute the occurrence of sulphides in Skaergaard intrusion to the process of fractionation of immiscible sulphide liquid. Rensberg (1969, p. 122) from a study of the Bushveld igneous complex concludes that the sulphide associated with titaniferous magnetite is of orthomagmatic type. Yudin and Zak (1971) refer to a number of localities in Kola peninsula, eastern part of the Baltic shield, where the sulphide minerals particularly chalcopyrite and pyrrhotite are associated with titaniferous magnetite and gabbroic rocks. They consider two types (1) segregational and (2) hystero-magmatic. The former is typified by disseminated ores with relatively low amount of $TiO_2$; hysteromagmatic type forms economically valuable deposits where titanomagnetite has precipitated in the initial stages of crystallisation of melts developed during differentiation in a closed system.

Review of literature points to two important types which are characteristically associated with igneous rocks of high mafic content. These are (1) ores rich in chromite, and (2) iron-nickel-copper sulphide ores often stated to contain notable quantities of the platinoids (Stanton, 1972, p. 305). While chromite is concentrated in rocks having affinities with peridotites, dunites and pyroxenites, the sulphide ores are associated with gabbroic rocks.

The sulphide ores of Tagadur described in the present note fall in the second category, being characteristically associated with coarse grained gabbros with a high content of titaniferous magnetite. Chromite is conspicuously absent within the gabbroic complex although it is found in the periodotites which are found at the margin of the complex.

Since exploration has not sufficiently advanced, it is not possible to make any conjecture as to the shape of the ore body. Evidence too is lacking as to whether the gabbros are later intrusives into the schistose amphibolites.

The gabbros are the main host rocks for sulphide mineralisation, though minor amounts are found in association with amphibolites and actinolite-tremotite schists.

The mineral assemblage pyrrhotite, pentlandite, chalcopyrite and cubanite in the Nuggihalli schist belt definitely speaks of high temperature of formation resembling the other magmatogenic copper deposits.

The present study has brought to light occurrence of chalcopyrite, pyrrhotite, pentlandite as primary magmatic minerals in the ultrabasic rocks of Nuggihalli. The source of these sulphides appear to be the ultrabasic magma itself.

The identification of copper mineralisation in association with the ultrabasic complex at Nuggihalli, points to the necessity for undertaking a closer examination of the ultrabasic complexes showing gabbroic variants in other parts of Mysore for the location of economically workable deposits of copper.

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