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Geochemical prospecting for Copper in the Nuggihalli schist belt, Karnataka, India

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Abstract

Geochemical prospecting for copper in the Nuggihalli schist belt, Karnataka has indicated that the serpentinised dunites are moderately enriched in copper. The copper appears to have no structural control and the enrichment is not uniform in the dunite.

Introduction

Geochemical exploration methods for discovering mineral deposits are in use since long in different parts of the world, though application of these methods in routine mineral investigations have started only recently in India. Of the different types of geochemical exploration, viz. geochemical, geobotanical, soil-surveys, drainage pattern surveys and hard-rock geochemistry, soil and rock analyses are better methods, as they bear direct evidence to the hidden mineral in the rock beneath.

Ultramafic rocks contain significant amounts of basic elements like Cu, Pb, Zn, Pt apart from magnetite and chromite in the dunites. Geochemical prospecting for these basic elements in ultramafics of Nuggihalli has been taken up as a part of the project 'Geochemical prospecting for base and noble metals in ultramafics of Karnataka'. The occurrence of Copper sulphide in these ultramafics has been reported by Radhakrishna *et al*, (1973).

Geology of the area

The Nuggihalli schist belt (Fig. 1) is a linear and narrow band of metamorphosed basic and ultrabasic rocks and extends from Arsikere in the north to Jambur in the south. The belt is intensely folded and metamorphosed. It consists mainly of hornblende-schists and amphibolites of Precambrian age which are intruded by dunites, peridotites, amphibolites and pyroxenites. The dunites and peridotites show chromite and titaniferous magnetite. Talc-chlorite schists and actinolite-schists occur at many places and appear to be the alteration products of dunite and peridotite. Surrounding country rock is mainly Peninsular gneiss containing detached inclusions of amphibolites and dunites. Post-tectonic granites occur away from the schist belt. Quartz veins are plenty and cut across the schist belt. Two predominant dike sets occur in the schist belt trending NE-SW and NW-SE. They are olivine-dolerites and quartz-dolerites. The former post-date the latter (Satyanarayana *et al*, 1974). Dunites and peridotites appear to be younger compared to the amphibolites and pyroxenites. All the ultramafics belong to single magma (Divakara Rao *et al*, 1975). The ultramafics show discordant relationship to the enclosing hornblende schist.

Method of sampling and analyses

The area was divided into square grids with a grid interval of 250 metres. Sampling was done along the grid and extended far beyond on either side of the schist belt into the gneissic country. Where fresh rocks were not present, soil sampling was done taking care to collect the samples from 3 to 4 ft below surface to

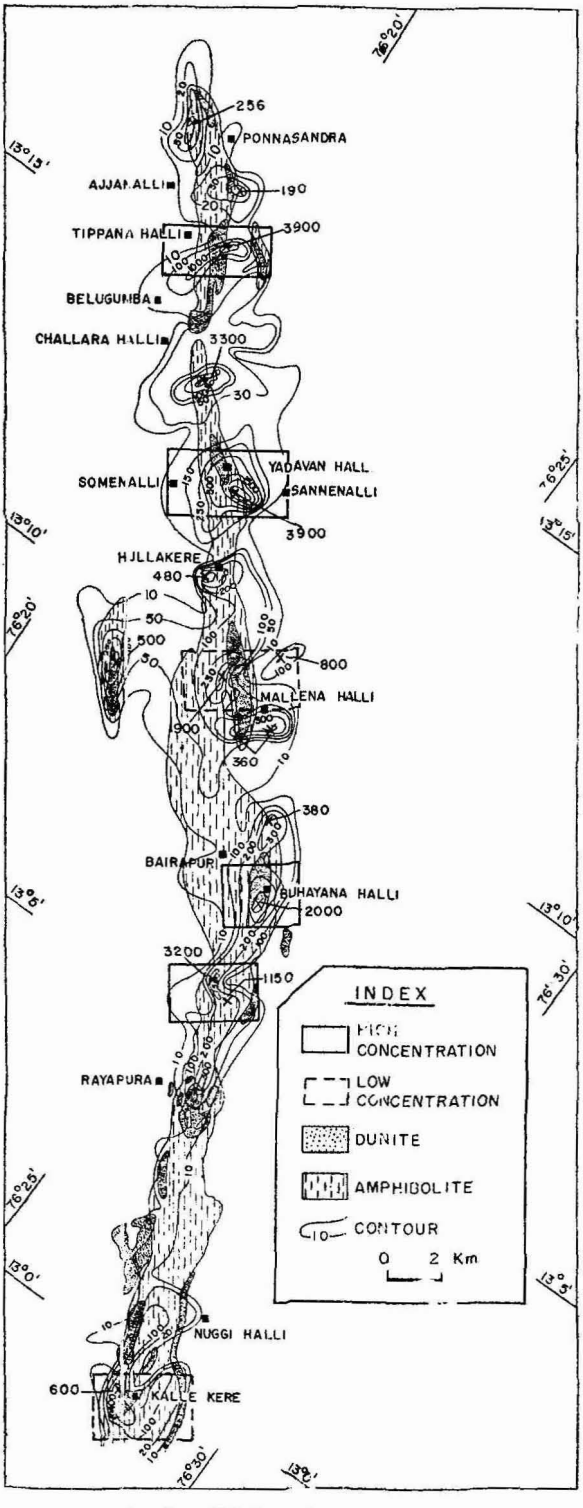

Figure 1. Simplified geological map and isoconcentration contour map of Nuggihalli schist belt, Karnataka (Geology after Varadarajan and Pande, 1969).

avoid contamination effects. A special auger was used for this purpose. Apart from grid samples nullah cuttings and vertical surfaces were also sampled to establish the three dimensional trend for the elemental concentrations. This however, could not be established due to less number of samples from vertical cuttings.

After powdering in pure stainless steel and agate mortar to –230 mesh, the samples were analysed for their copper concentrations on a Hilger and Watts large quartz littrow spectrograph using Indium as internal standard. Details of the standard and experimental set up are as follows:

Standards

Specpure copper standard imported from Johnson Mathew & Co, London, is mixed with graphite and internal standard to obtain the concentrations of 10,000, 4,640, 2,150, 1,000, 464, 215, 100, 46, 21, 10 ppm levels and calibration plates have been taken prior to estimation of copper in the samples.

Arc source: 6 Amps
Arc gap: 4 mm
Slit width: 10 μ
Electrodes: Johnson Mathey specpure carbon rods
Shape of the electrode: depth of cavity 3.397 mm
inner-diameter 3.048 mm
outer-diameter 3.404 mm
Wavelength of the copper line: 3273.96 A°
Exposure: 40 seconds
Plates: Agfa-Gevaert 'Scientia' No. 23056.
Plate calibration: 7 step sector
Internal standard line: In. 3039.36 A°
Charge: 32 mg (1 : 3 of graphite + sample)
Processing: 120 seconds at 20°C in developer;
20 seconds in water;
600 seconds in fixer; washed and dried.
Density measurements: Hilger and Watts automatic microphotometer with Honeywell recorder.

Each sample was analysed in triplicate under the same set of conditions and if the values differed more than $\pm 10\%$, analyses were repeated. Background values for the country rock were determined on similar lines and deducted from the sample values. The residual values were plotted on the surface grid map and isoconcentration contours were drawn with different contour intervals, as the change in concentration is erratic and vary much within short distances.

Discussion

Isoconcentration contours for copper (Fig. 1) follow very closely the lithology of the schist belt. It can be observed from the diagram that wherever dunite patches occur, there the concentration increases, though the level of enrichment is not uniform throughout and also the magnetite bearing gabbros appear to have good concentration of copper. There is slight displacement as between the concentration contours and the actual outcrop of the ultramafic rock, which may be due to the effect

of soil analyses where rocks are not available. Depending on the level of enrichment of copper, four zones of high concentration and two zones of low concentration are identified from the contour diagram (Fig. 1).

Zones of higher copper concentration: The four zones of high copper concentration are associated with magnetite bearing gabbro and the ultramafics and magnetite bearing gabbros near Belagumba, Yadavanahalli, Kembal and Bairapur. Low levels of concentrations are present at Mallenahalli and at Kallekere south of Nuggihalli.

It is observed from the lithology and the copper concentration levels that there does not exist linear relationship between the surface area of individual outcrop and copper content. It appears that like chromite which is selectively enriched in some of the serpentinised dunites (Bairapur), copper has also been selectively enriched. However, there seems to be no correlation between the chromite concentration and copper as both increase and decrease in different ultramafic patches erratically. Results of drilling on magnetite bearing gabbros suggest that these gabbros contain good amount of copper, though in the present work dunites also appear to show some enrichment.

The copper in these dunites appears to have no structural control as higher concentrations are obtained in those ultramafics which are not faulted or disturbed and the concentrations are low in places where there are faults (eg. Bairapur). The dikes in the schist belt also appear to have no control over the mineralisation. For most part, the ultramafic rock could be sampled directly. The enrichment pattern indicates that the serpentinised dunites contain copper. Zones of high concentration contain maximum of 3,000 ppm copper and these areas can be covered in detail by close grid sampling.

Copper concentrations are low in the hornblende schists (amphibolite at places) compared to the serpentinised dunite. The dolerite dikes too do not have significant copper concentration.

Conclusions

Detailed geochemical exploration for copper in the ultramafics of the Nuggihalli schist belt indicates that copper is confined to serpentinised dunites and there is no structural control. Four high anomaly zones and two medium anomaly zones are delineated which require further detailed investigations.

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