

DETAILED INFORMATION
ON
COPPER-LEAD-ZINC ORES
IN
MADHYA PRADESH-MAHARASHTRA
(INDIA)



GEOLOGICAL SURVEY OF INDIA
1994

PRICE : 1000 INR

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MADHYA PRADESH



INFORMATION DOSSIER ON BASEMETAL DEPOSITS AND OCCURRENCES IN MADHYA PRADESH

In Madhya Pradesh, basemetal deposits and occurrences have been recorded from Malanjkhanda granitoid belt, Bundelkhand granite complex and the Mahakoshal and Vindhyan Groups of rocks. Of these, the Malanjkhanda copper deposit is by far the best known. It is the largest single copper deposit known in Peninsular India.

A. Malanjkhanda Granitoid Belt:

Malanjkhanda copper deposit:

The Malanjkhanda (22°02' : 80°43' - 54 B/12) copper deposit located in the Balaghat district is presently under exploitation by open cast mining by M/s. Hindustan Copper Limited.

The zone of copper mineralisation is located in the approximately 2.6 km. long arcuate Malanjkhanda hill (elevation about 600 m. above m.s.l.). The rocks of the basement complex (Malanjkhanda granitoid) comprise granites and quartz reefs intruded by metabasics. The basement rocks are overlain by the upper Precambrian metasediments of Chilpi Ghat Series with an erosional unconformity. The granitic rocks range in composition from a biotite granite to quartz diorite and are highly kaolinised, sericitised and saussurised in the mineralised zone. The metasediments comprise conglomerates, grits, phyllites and shales.

The copper mineralisation is localised in the quartz reefs, associated with the granites.

Mineralisation is also seen within the granites near its contact with the quartz reefs. The intensity of mineralisation diminishes away from the quartz reefs. Shearing, crushing and mylonitisation are common both in the quartz reefs and the granites. The mineralised quartz reef is dissected by a number of cross-faults.

The sulphide minerals are mainly seen along the shear and fracture planes in the quartz reefs. The ore minerals in decreasing order of abundance are chalcopyrite, pyrite, magnetite, sphalerite, chalcocite, bornite, molybdenite and cobaltite. Chalcopyrite and pyrite make up over 95% of the sulphide minerals.

The mineralised zone is oxidised at the surface and is represented by limonite stains. The zone of oxidation extends to depths of about 40 to 100 m. from the top of the hill; the maximum being in the central part of the deposit. The zone of secondary enrichment is negligible and the oxidised zone is almost directly underlain by the primary ore.

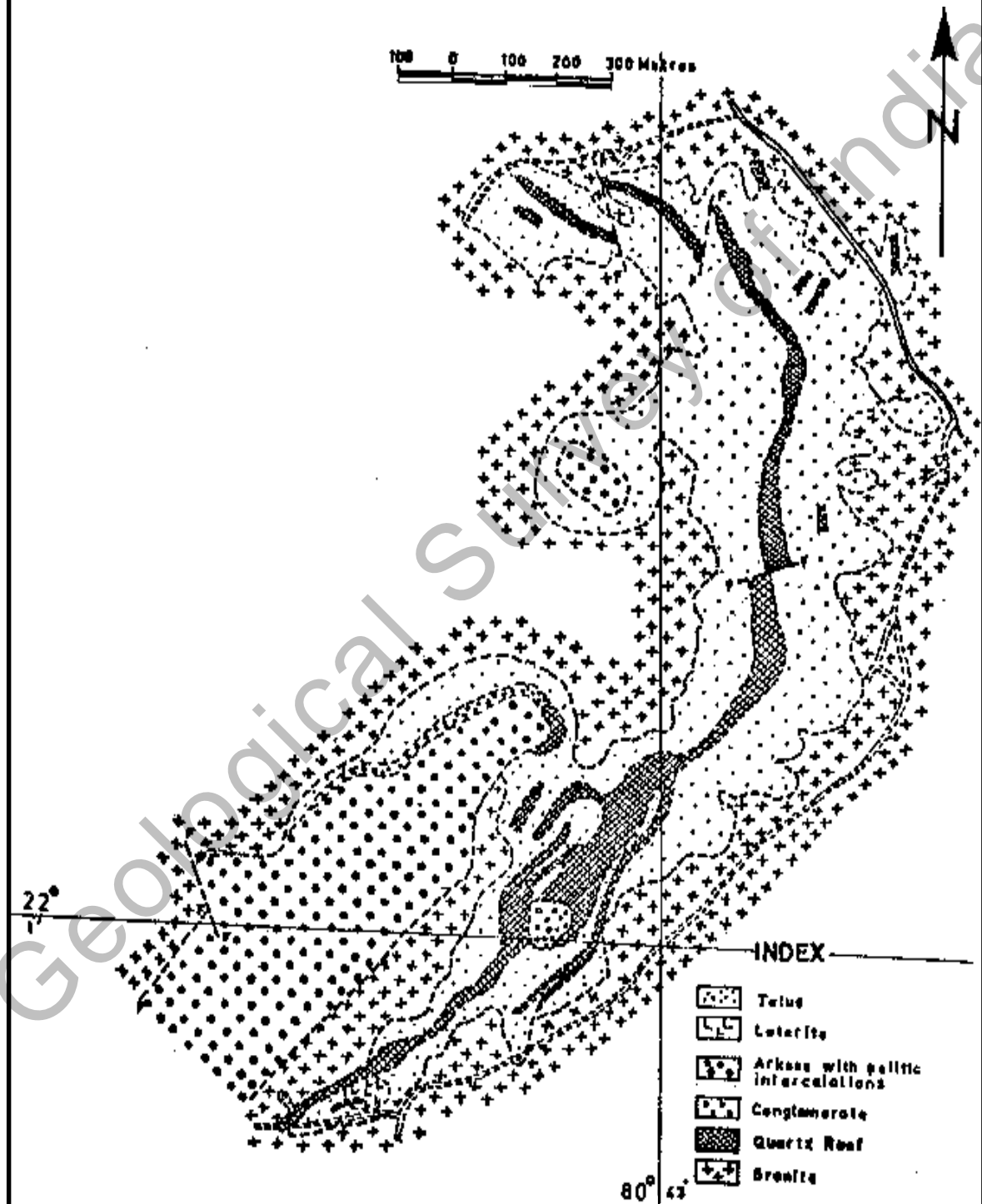
The ore zone extends over a strike length of about 1.9 km with an average width of about 65 m. and dips at an angle of about 60° towards east.

The deposit has been intensively investigated by the GSI and MECL. About 68,000 m. of drilling has been done along 27 cross section lines spaced 80 m. to 120 m. apart.

On the basis of the drilling carried out by GSI, MECL and the mine development by HCL, reserves available in the deposit upto -8 m. R.L. (i.e. about 600m below the surface) at a cut-off 0.45% copper are estimated to be as follows:

Proved	145.7	million tonnes
Probable	50.4	million tonnes
Possible	40.3	million tonnes
	<hr/>	
Total :	236.4	million tonnes of 1.28% copper.

GEOLOGICAL MAP OF MALANJKHAND COPPER DEPOSIT, MADHYA PRADESH



During open cast mining, low grade copper ore beyond the main ore body is also likely to be excavated. The quantity of such ore is estimated to be about 93.03 million tonnes with an average copper content of 0.29% (cut-off 0.2% copper). About 3 million tonnes of oxidised ores with 0.18% copper is also likely to be produced during mining.

Significant molybdenum values are associated with the ore. The copper concentrates are expected to yield 1.24 g/t of gold, 70 g/t of silver and 0.04% molybdenum.

Areas adjoining the Malanjhand copper deposit :

The areas with a similar geological set-up surrounding Malanjhand copper deposit have been investigated by reconnaissance geological mapping on 1:63,360 and 1:25,000 scales, detailed mapping on 1:2,000/5,000 scales, geochemical sampling and geophysical surveys and drilling in selected blocks. The work has not brought out any significant copper deposit, but a number of occurrences for copper have been recorded. They are :

- 1) Bhaunra Pahar (22°04' : 80°48') – Taregaon (22°03' : 80°51' – 56 B/16) area.
- 2) Parewa Dongri (22°02'35" : 80°45'30" – 64 B/15).
- 3) Bodapahadi (22°03' : 80°53" – 64 B/15).
- 4) Pathratola (22°00' : 80°55' – 64 C/13).
- 5) Manegaon (21°58' : 80°48' – 64 C/13).
- 6) Gidori (21°52' : 84°43' – 64 C/9), and
- 7) Dhorli (21°52' : 80°46' – 64 C/13).

Bhaunra Pahar - Taregaon area : In this area surface indications of mineralisation are seen over a strike length of 2 km. Geochemical surveys indicated a few values for copper but geophysical surveys did not indicate any significant anomaly. Four boreholes were drilled in the

area. Of these, 3 boreholes indicated only feeble disseminations of chalcopyrite and pyrite. In the fourth borehole, a 1.2 m thick mineralised zone with 0.94% copper was intersected at 52.03 m depth.

Parewa Dongri area : In this area quartz veins traversing granites have been traced over a strike length of about 3.2 km. Geochemical sampling did not indicate any significant anomaly but geophysical surveys indicated strong anomaly at two points. Test drilling at one of the geophysical anomaly points intersected only a few sporadic specks of pyrite and a zone of carbonaceous phyllite which could have been the causative body.

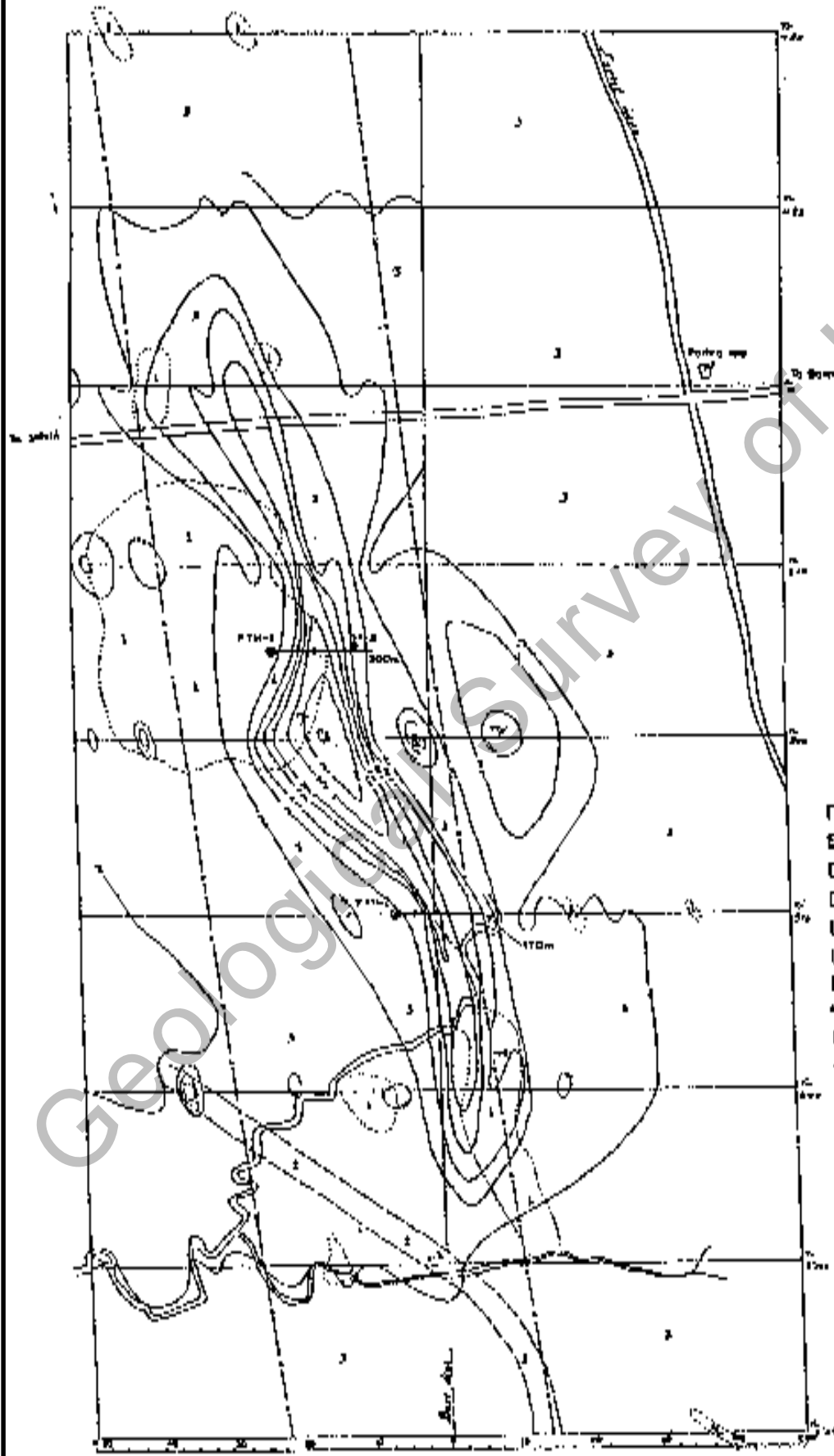
Bodapahad area : In this area basemetal mineralisation is seen in brecciated and fracture zones in granitoids traversed by quartz-carbonate veins. Some mineralisation is also noticed in thin quartz veins. The individual brecciated and shear zones range in width from a few cm to about 15 m and in strike length from 50 m to 250 m. The shear zones strike north-south to NNE-SSW and dip at steep angles towards west. A few boreholes drilled in the area have indicated a minor zone of copper mineralisation, ranging in width from 0.2 to 0.85 m with copper contents of 0.15 to 1.0% copper, over a strike length of about 500 m.

Pathratola area : In this area, the principal rock types are grey and pink granite intruded by carbonate veins, aplite dykes and minor quartz veins. Evidences of fracturing are noticed throughout the area. Individual fracture zones forming breccia are 0.5m to 15m wide and can be traced at places for more than 100 m. The fracture zones generally trend N 15°W to S15°E with steep dips. Slickensides are recorded from all over the area within the fracture planes in granites.

Surface indications of mineralisation comprise limonite, malachite stains and specks of chalcopyrite along the breccia and fracture zones filled with carbonate veins. Geochemical sampling indicated copper values of upto 450 ppm in some samples. Geophysical IP surveys

GEOLOGY AND GEOCHEMICAL ANOMALY FOR COPPER AROUND PATHARTOLA, RAJNANDGAON DISTT. M.P.

Scale - 1:4000



INDEX

- Soil Contour
- Road Road
- Drainage
- Inflow Channel
- Bur crop Line
- Boundary / Subdividedly
- Canal / Pipeline
- Contour of level Boundary in various size
- Pressure Line
- Name
- Railway Road
- Power Line
- Copper Anomaly ERSB
- Geographical Center (Copper value in ppm)
- Geographical Anomaly point
- Proposed 300m scale into Depth

have also outlined a moderate chargeability anomaly zone over a strike length of about 900 m. No drilling has so far been carried out in this area.

Manegaon area : In this area also the principal rock types are granitoids traversed by aplite dykes, quartz veins and basic dykes. Mineralisation is in the form of malachite and limonite stains and encrustations in fractured and brecciated granites and fractured aplite. Bed rock geochemical samples did not indicate any encouraging results but soil samples in the area adjacent to the Manegaon School yielded values ranging from 100 to 500 ppm in areas underlain by fractured granite and aplite. However, the anomalous zone appears to be a local one extending for about 100 m only in a NNW-SSE direction around a fractured aplite body.

Gidori and Dhorli areas : These areas are located along the same north-south lineament zone which hosts the Malanjkhanda copper deposit. The geological environment is also similar. The area comprise pinkish to grey hornblende granite traversed by quartz veins and basic dykes.

Basemetal mineralisation is seen in quartz veins traversing Malanjkhanda granitoid. In the area about 2.5 to 3 km ENE of Dhorli, two quartz veins located about 500 m apart have been investigated by geochemical sampling. The eastern vein trends roughly north-south with vertical dips. It extends over a strike length of about 350 m with a thickness of a few metres to 25 m. The western vein extend over a strike length of about 200 m with a thickness of 6 m to 25 m. Indications of mineralisation are feeble in the eastern vein. Analytical data of geochemical samples have indicated only local values of upto 200 ppm copper. Mineralisation is somewhat better in the Dhorli West vein. In this vein, limonitic box work malachite encrustations and occasional specks and blebs of chalcopyrite and galena are seen; galena being confined to the southeastern part of the vein. Geochemical soil samples

have yielded values of 200 to 625 ppm copper. One bed rock sample from the western vein has analysed 0.19% copper, 4% lead, 100 ppm silver and 150 ppm zinc and contains visible chalcopyrite and galena.

In the Dhorli area, three major quartz veins, namely Dhorli vein, Pipardhar north vein and Pipardhar south vein have been delineated. The Dhorli vein extends over 115 m with a width of 12 to 20 m in a NW-SE direction with sub-vertical dips, The Pipardhar north vein occurs to the northwest of the Dhorli vein after a gap of 140 m. It is 190 m long and 3 to 20 m wide.

The Pipardhar south vein is located 300 m SW of the other two veins. It extend over 275 m with 2 to 8 m width. Soil samples have indicated anomalous zones for copper with peak values ranging from 150 to 400 ppm. Two spot values of 1500 and 850 ppm have been obtained at the northwestern end of Dhorli vein and Pipardhar north vein respectively. The anomalous zones correspond to the trend of the quartz veins.

No drilling has so far been done in this area.

Khandapur (21°57' : 80°30'; 64 C/9), Balaghat district :

The area comprises Archaean rocks represented by quartz-sericite schist, quartz-mica schist with intercalations of hornblende schist, calc-schist and granite gneiss intruded by amphibolites and quartz veins. The Archaeans are overlain by Deccan Trap flows with laterite cappings. The schists and gneisses trend NNE-SSW with 35° dip towards WNW. The quartz veins occur as linear detached outcrops about 500 m long, in the NNE-SSW direction with a dip 35° due WNW. The quartz veins are sheared and fractured.

The surface indications of mineralisation in the quartz veins are in the form of specks, fracture and shear fillings of chalcopyrite and

GEOLOGY AROUND BRECCIA ZONE, NORTH OF MANEGAON, BALAGHAT, MADHYA PRADESH

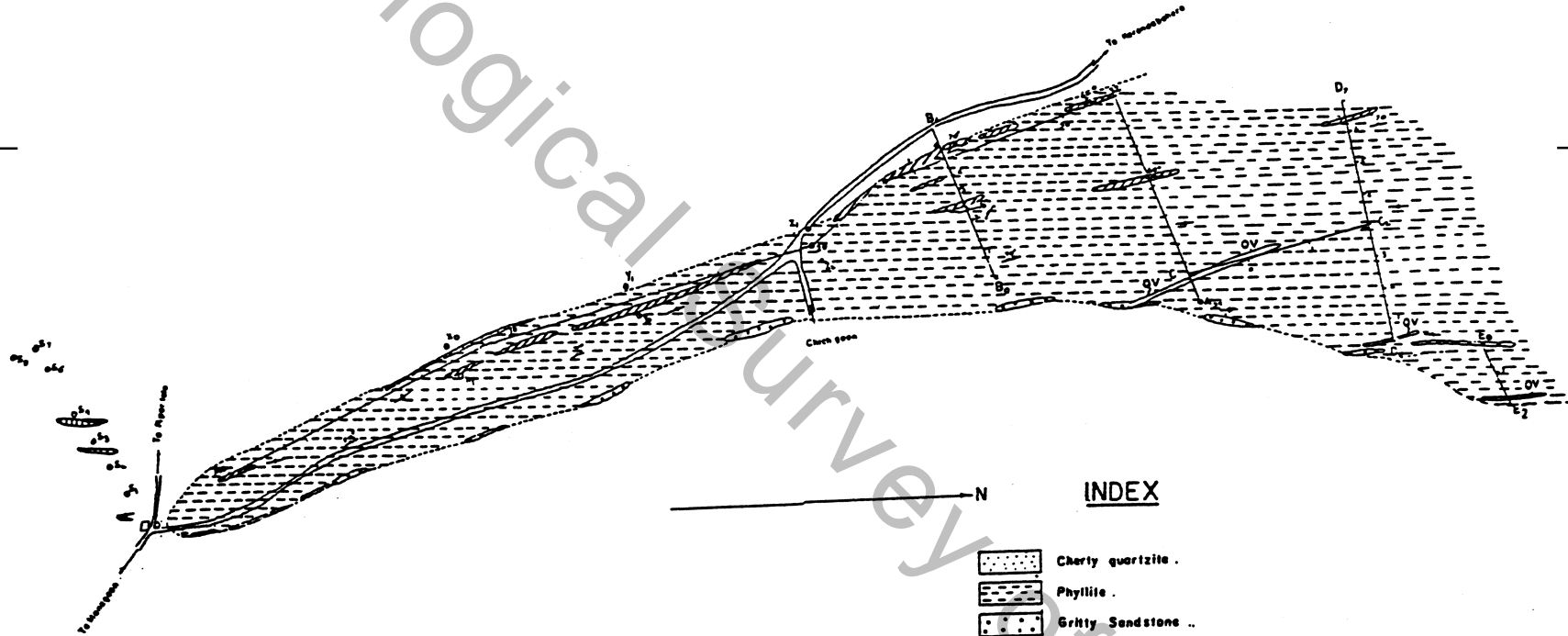
(Tape and compass map)
(Toposheet No-64C/13)

Scale - 1:5,000













80°
47'

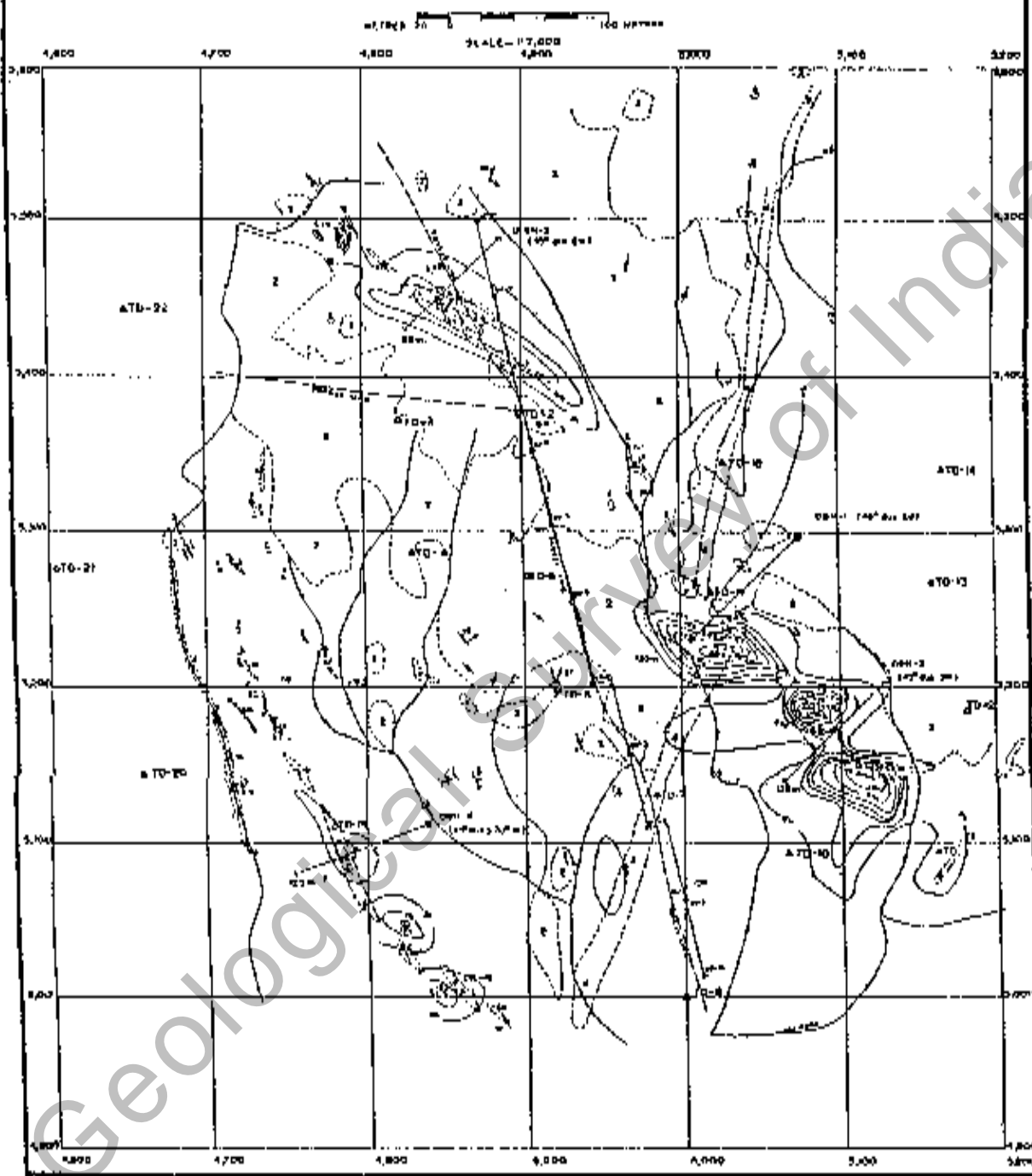
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GEOLOGY AND GEOCHEMICAL ANOMALY OF DHORLI BLOCK, BALAGHAT DISTRICT, M.P.



LEGEND

- 4 QUARTZ VEIN WITH COPPER MINERALISATION
(सो-मणुली वेन) (सो-मणुली वेन) (सो-मणुली वेन) (सो-मणुली वेन)
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(100' 400' SW)

pyrite with malachite encrustations and maroon to orange coloured limonitic material showing box work. The strike length of the mineralised zone is 300 m with a maximum thickness of 20 m (average around 8 m).

The results of geochemical samples, however, are not encouraging.

Deposits / occurrences in Mahakhosal Group :

The (lower proterozoic) Mahakhosal Group of metasedimentary rocks trend in a N60°E - S60°W direction over a length of about 300 kms in the Sidhi, Shahdol and Jabalpur districts. The principal rock types are shale/slate, phyllite interbedded with (cherty) dolomite and limestone, quartzite and conglomerate resting over greenstones and Banded Iron Formation. These are intruded by quartz-porphyry and basic dykes.

The rocks are folded into E-W isoclinal folds (overturned towards north) with superposed NNW-SSE cross folds. The sequence is traversed by a number of shear zones (mostly parallel to the strike) and faults. A number of basemetal occurrences mostly localised in the zones of shearing and faulting have been recorded from different parts of this belt.

Imalia (23°36' : 80°16'), Bhula (23°37' : 80°20'), Nawalia (23°39' : 80°28') area. Toposheet No. 64 A/6, Jabalpur district :

The major rock types in the mineralised areas are massive and bedded dolomites and dolomites intercalated with phyllite bands. NNW-SSE trending dykes of quartz porphyry carrying fluorite mineralisation are confined only to Imalia area. Mineralisation occurs as replacement/fissure filling in fractured/brecciated zones at right angles to the bedding of the host rock. All the mineralised zones, generally, trends N-S with steep (60°-75°) dip towards west.

In Imalia, two N-S trending mineralised zones have been identified. The Eastern zone is 1.15 km long with a width varying (on the surface)

from 1 - 2.5 m. The western zone includes 4 small shears having an aggregate strike length of 480 m. The individual shears are, however, small upto 125 m in length, and having widths of 0.6 to 1.17 m. The ore minerals are chalcopyrite, tetrahedrite, pyrite and magnetite with minor arsenopyrite, sphalerite and galena.

The Eastern zone has been tested by drilling (8 boreholes) to persist to a depth of 35 - 60 m below the ground level. A zone 400 m in length (with a poorly mineralised stretch of 160 m in the central part), has been established with Cu values ranging from 0.20% x 0.75 m (TW) to 1.04% x 2.07 m (TW). In the western zone persistence of ore zone was proved by drilling down to 35 m depth with the copper values ranging from 0.20% x 0.19 m (TW) to 0.83% x 0.78 m (TW) over a strike length of 480 m.

In Bhula area, 5 boreholes drilled to test a geophysical anomaly, did not indicate any mineralisation.

In Nawalia area, three test boreholes were drilled to test the depth persistence of several small mineralised veins; but no significant ore zones were encountered.

In the Imalia area 0.075 million tonnes of copper ore with 1.12% Cu over a strike length of 240 m have been estimated. Lower grade ore zones have been met with over this strike length. If these are also taken into consideration, reserves of the order of 0.12 million tonnes of 0.82% Cu will be available from the eastern zone of Imalia. In addition, 0.044 million tonnes of lead ore with 1.19% Pb, 6.58 tonnes of Ag metal at an average of 17.32 gm/tonne from 0.38 million tonnes of ore have also been estimated from this zone.

In addition, presence of bismuth and arsenic has also been established in the sulphide ores of Imalia block there by suggesting polymetallic nature of mineralisation. The drilling results have proved

the depth wise (60 m) extension of the silver mineralisation with a gradual widening of the zone with depth. Deeper drilling will be necessary to get a complete picture regarding the potentiality of the silver mineralisation.

**Bahera - Baheria Shear Zone (24°20' - 24°31' : 81°52' - 81°56' ; 63 H/15),
Sidhi district :**

The area exposes a sequence of quartzites, carbon-phyllites, phyllites and limestones resting over greenstones and banded iron formations with an intervening impersistent conglomerate zone, all isoclinally folded with axis trending ENE-WSW and overturned towards north. This sequence is traversed by a number of shear zones, mostly parallel to the strike. These zones are silicified and show malachite stains and goethite. There are number of ancient old workings in the shear zone.

The shear zone trends ENE-WSW with steep dips towards south and extend over a strike length of 11 km from Bahera in the east to Baheria in the west.

Sulphide mineralisation consists dominantly of pyrite with subordinate chalcopyrite and is associated mostly with sericite-carbon-quartz phyllite occurring between breccia zones. Oxidation continues to 80 - 90 m depth and the main zone of mineralisation has been intersected below 200 m depth in the boreholes. There are indications of a thin zone of supergene enrichment. Besides copper, lead, zinc, cobalt and nickel occur as traces in the mineralised zone. Few samples gave silver values of 1 to 50 ppm.

Out of a total length of 7 km tested by boreholes (spaced at intervals of 180 to 1200 m) only 2 boreholes intersected copper zones averaging 0.50% Cu viz., SD/1 - 0.50% Cu x 9.0 m and 0.51% Cu x 6.5 m; SD/6 - 0.50% Cu x 2.5 m. The remaining boreholes intersected zones averaging less than 0.2% Cu. The possible strike extension of the zone with +0.5% Cu is about 600 m.

Baragaon (23°41' : 80°25' ; 64 A/6), Jabalpur district :

The geological and geochemical studies carried out in Baragaon and Pondi areas indicate that the sulphide mineralisation occurs as irregular pockets and disseminations mainly of chalcopyrite, tetrahedrite and galena in quartz veins traversing white dolomite. The disposition of visible surface mineralisation is near the axial region of the Baragaon anticline. The geochemical soil surveys did not show any encouraging results.

Sunhera - Mohania area (23°41'30" : 80°27'20" - 80°30'16"; 64 A/6), Jabalpur district :

In this area the sulphide mineralisation is seen as irregular pockets and disseminations of galena, tetrahedrite, sphalerite, chalcopyrite and pyrite in quartz veins along the shears/faults/joint planes in the dolomites of Mahakhosal Group. To the east of Malan village, pebbles and boulders carrying stains of malachite/azurite are observed in a N-S shear zone.

The mineralised vein ranges in width from 1 to 20 m, with the length rarely exceeding 260 m. Old workings are seen over brecciated and gossanised quartz veins following NNW-SSE trending joints and fracture planes. Fluorite and wall rock alteration like sericitisation and kaolinisation is seen. In the old workings on the western bank of Mahanadi river, opposite to Sakrigarh village near Karuakup (Karuakup prospect described separately) one mineralised vein (oxidised) showed tetrahedrite and malachite over a width of 0.65 m to 1.20 m.

The results of geophysical investigation in these areas are not encouraging.

Karuakup (23°49' : 80°39' ; 64 A/9), Jabalpur district :

In this area indications of mineralisation consist of a few chalcopyrite grains in sheared metadiorite, malachite stains in dolomite, 3 small pits and a linear (30 x 7 m) quarry. 4 boreholes drilled to test the mineralised zone indicated only poor disseminations of primary sulphides with less

than 700 ppm copper.

Amgaon (23°40' : 80°29' ; 64 A/5), Jabalpur district :

Copper mineralisation is localised in quartz veins traversing dolomite. The dolomite also contains sporadic disseminations of chalcopyrite. The mineralisation is poor and patchy.

Sleemanabad (23°38' : 80°13' ; 64 A/1), Jabalpur district :

In this area the mineralisation is mostly along faults, fractures/ joints trending N10° - 20°W to S10° - 20°E. Barytes veins and limonitic patches are noticed in the brecciated quartzites. Geochemical sampling showed poor results for copper.

BUNDELHKAND GRANITE GNEISS

Salaiya (24°40' : 79°45') - Jamtoli (54 P/10, 13 & 14) area. Chhatarpur district :

The area comprises medium to coarse grained granite/ granitoid traversed by quartz reefs and veins at a number of places. Quartz reefs are seen along considerably long silicified shear zones which are of complementary and conjugate type. These regional shears trend NNW-SSE and are considered to represent axial plane shears of NNW-SSE trending regional cross folds.

In the area, limonitic veins showing box work are seen at places in the shear zone. Sparsely disseminated fine specks of pyrite, chalcopyrite, covellite and stains of malachite occur in the quartz veins and reefs emplaced along the shear zones.

In course of geological mapping, 16 shear zones in Salaiya - Jamtoli area containing specks of chalcopyrite, pyrite, etc. were delineated.

Geochemical sampling in 3 of them indicated low anomalies. These zones were tested by 6 boreholes. The boreholes intersected zones with disseminations and stringers consisting predominantly of arsenopyrite, pyrite and subordinate chalcopyrite varying in thickness from 0.5 to 10.20 m. The copper values in the borehole cores varied from 50 to 500 ppm. The drilling also tested two moderate zones and one feeble anomaly zone brought out by the ground geophysical surveys in the area of aeromagnetic anomaly zone.

Analysis of samples from the mineralised zone did not also indicate the presence of gold.

Antri (26°03' : 78°15') and Bhageh (26°31' : 78°26') - Gijora (26°04' : 78°28') areas. Gwalior district :

A quartz reef 2000 m long and 20 m thick occurs 1.8 km due south of Antri. Pyrite, pyrrhotite, chalcopyrite and galena are noticed in quartz breccia zones within the quartz reef. The sulphide mineralisation is weak.

In the Bhageh-Gijora area, a quartz reef trending N35°E-S30°W and ranging in thickness from 50 - 500 m has been traced over a strike length of 5 km.

Disseminations of pyrite and chalcopyrite have been recorded from a 800 m long, 80 cm wide sheared and brecciated zone near Lakhnauti (26°02' : 78°26'), Near Andar (25°42' : 78°06'), Shivpuri district, sporadic galena is seen in the contact of a pink granite and the quartz reef.

BIJAMAR GROUP

Bagrodha (24°19' : 78°58' ; 64 L/15), Sagar district :

In this area sulphide mineralisation has been observed in chert breccia along narrow discontinuous shear zones in amphibolite in the vicinity of its contact with granitoid (Bundelkhand granitoid). Chert breccia

away from contact is devoid of mineralisation. Chalcopyrite, pyrite, covellite and malachite are found in chert breccia as grains, stringers, specks, etc. Detailed mapping and geochemical sampling showed that the mineralisation is limited.

Tigora (24°23' : 79°15' ; 54 P/3), Sagar district :

Mineralisation is in quartz vein intruding into the dolomite and ferruginous breccia of Bijawar Formation. Old working for copper are seen. Geochemical surveys showed that the occurrence is poor.

VINDHYAN GROUP

Kua (23°35' : 79°52') - Kondakhurd (23°34' : 79°50') area, (55 M/14), Damoh District :

Galena occurs on the western slope of the .1645 hillock NW of Kua and on the top of a hillock 250 m south of Kondakhurd. The structural control for the mineralisation of galena appears to be a metre wide shear zone trending N10°E - S10°W between the shale and Bhandar limestone at Kua. The other occurrence near Kondakhurd appears to be structurally controlled by a fault extending in a general N10°E - S10°W direction for over 500 m. Surface indications at this occurrence are poor. Geochemical prospecting carried over both the occurrences brought out secondary dispersion zones with values reaching upto >1000 ppm Pb.

Choraiya (24°25' : 79°34') - Banki (24°28' : 79°37') area (54 P/14) Damoh district :

Mapping has revealed that the host rocks for basemetal mineralisation are cherty dolomite and chert breccia occurring in the form of lenses within the Palkawan shale formation. The mineralisation is syngenetic and stratabound. The mineralised zone is highly irregular, pockety, subhorizontal and completely oxidised. Fresh sulphides are rarely seen

in the form of cubes of galena and pyrite. The mineralised zone ranges in thickness from few centimeter to about 10 m, the thickest and the richest being in the southeastern part of the Choraiya block. It is essentially a lead-zinc occurrence, with metal values of Pb ranging from 20 ppm to 0.32% and Zn 40 ppm to 0.40% in oxidised zone. The rest of the Choraiya block is poorly mineralised. There is a possibility of getting unoxidised sulphides in the area 1.5 km SE of Choraiya under the cover of Kaimur Group of rocks.

The test pit sunk in Bhartala block indicates that the host rock chert breccia has a maximum thickness of 2.5 m and is poorly mineralised. The test pit in Banki block showed that the mineralised / oxidised zone in cherty dolomite is about 4 m thick with poor mineralisation.

Other areas

Chichola (21°04' : 80°40'), Durg district :

Copper and fluorite mineralisation localised in silicified fault breccia, quartz vein and epidiorite has been recorded from this area.

Chandidongri (21°05' : 80°38'), Dura district :

Lead-zinc and fluorite mineralisation occurs in quartz veins, silicified fault breccia, pegmatite and epidiorite emplaced along N-S to N10°E - S10°W shear zones. The shear zone is traceable for about 20 km within a coarse to porphyritic hornblende granite (Dongargarh granite). The sulphides comprise galena, sphalerite, chalcopyrite and pyrite. Data of 6 boreholes indicate that the mineralisation is sporadic, patchy and sparsely disseminated. The maximum metal contents in core samples were 2.5% Pb, and 1.20% Zn (mostly traces to 0.5% Zn).

Bhawratekra Zinc deposit, Multai Tehesil, District Betul, M.P.

Bhawratekra, a small hillock near the village Kherlibazar lies between latitudes N21°57'40" and longitudes E78°21' - E78°22'30" in toposheet No.55 K/5. The area, forms a part of an isolated inlier of Precambrian rocks comprising impersistent bands of metasediments, metabasics and metamorphosed rocks of granitic composition. The metasediments consists of anthophyllite-cummingtonite schists, calc-silicate rocks and garnetiferous ± staurolite-biotite-chlorite schists with gahnite. Metabasics include metabasalts, showing pillowed structure at places and shallow level intrusives, all of which now occur as amphibolites. The granitic rocks show compositional range from granite to granodiorite and quartz monzonite. The general strike of the formations is ENE-WSW with moderate to steep dip towards south. The rocks show penetrative deformations, but large scale folds have not been found.

The work so far completed comprises : large scale geological mapping - 2.16 sq.km; 5286.70 m of diamond drilling and chemical analysis of 3431 Nos. of core samples. Surface indications of mineralisation are in the form of gossans, limonitisation and malachite stains. An open cast pit is also present in the area.

Massive sphalerite ore studded with chalcopyrite, galena, pyrite and pyrrhotite occur within the lensoid type of metasediments consisting of anthophyllite-cummingtonite schists and garnetiferous quartz ± staurolite-biotite-chlorite schists. In addition to the massive ores, stringers and blebs are also present. Considerable amount of zinc spinel (gahnite) is also found alongwith the sphalerite. The ores occur parallel to S_2 schistosity; but presence of ores along S_1 planes, deformed by F_2 folds indicate Pre- S_2 mineralisation.

Sphalerite, chalcopyrite, pyrite, pyrrhotite, galena and certain altered copper sulphides constitute the major ore mineral. They are associated with ilmenite, haematite, titanomagnetite and rutile. Tungsten minerals could not be identified. Sphalerite dominates over chalcopyrite and galena

forms a minor constituent. Pyrite and pyrrhotite content varies from small to appreciable amount. Sphalerite occurs as discrete subhedral to euhedral grains, as grain aggregates and in the form of intergrowth with other minerals. The mineral is yellowish brown, dark brown and dark reddish brown in transmitted light. These sphalerites may be very rich in iron content.

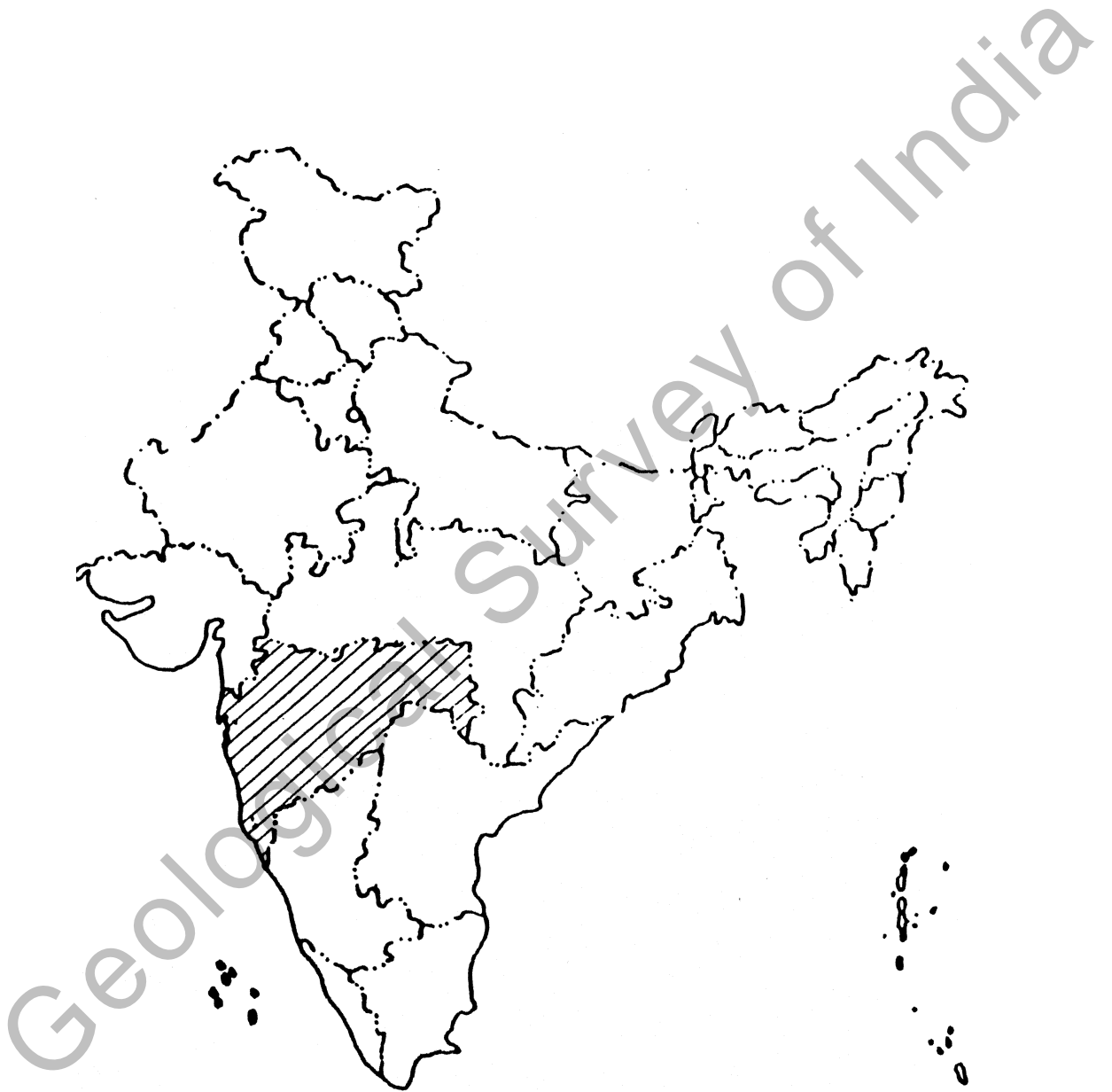
The mineralised zone has been established over a strike length of 265 m only. The oxidised zone is limited to a depth of 20 m from the surface (690 m R.L.). The ore bodies have been intersected around 660 m R.L. Six lodes varying in length from 50 m to 265 m have been delineated, which show pinching and swelling character both in grade and width along the strike as well as along the depth. The lenses attain a maximum width of 8.27 m. The grade varies from 2 to 16% Zn. Zinc is the predominant metal with minor Cu, Pb, Cd, Ag and W. Cadmium and tungsten values increase with the increase of Zinc values and silver values increase with Pb values and attains maximum of 115 ppm. Ag in one sample of 50 cm length. Tungsten occurs mainly along with sphalerite rich zones and a maximum value of 0.19% W was recorded in one sample of 50 cm length. The reserves estimated at 2% and 4% Zn cut off upto a depth of 180 m are as follows :-

1. At 2% Zn cut-off of 5.10 m average width - 1.58 million tonnes
of 4.52% Zn,
85 ppm Cd
3.5 ppm Ag.
2. At 4% Zn cut-off of 5.83 m average width - 0.85 million tonnes
of 6.48% Zn,
120 ppm Cd
3.4 ppm Ag.

SUMMARY AND CONCLUDING OBSERVATION

1. Apart from the Malanjkhand copper deposit, (the largest so far known in the country) which is being exploited by opencast methods by M/s. Hindustan Copper Limited, only two other deposits, Bhawratekra zinc deposit in Betul district and the copper deposit near Imalia are so far known from Madhya Pradesh.
2. The deposit in the Bhula area are too small (Reserves 0.075 million tonnes with 1.12% Cu) to be of possible economic significance.
3. The Bhawratekra deposit (Reserves 0.85 million tonnes of 6.48% Zn) can perhaps be exploited on a small scale of about 150 - 200 t.p.d. But since a part of the zinc values are in the form of gahnite, ore beneficiation aspects will have to be critically evaluated, before decisions regarding feasibility of mining the deposit can be taken.
4. Exploration to search for Malanjkhand type of deposits in the areas adjacent to Malanjkhand have indicated only sparse mineralisation. But some of the mineralised quartz reefs have sizeable widths and strike lengths. Considerable scope for further search in the Malanjkhand belt as also other belts exists.

MAHARASHTRA



74°

76°

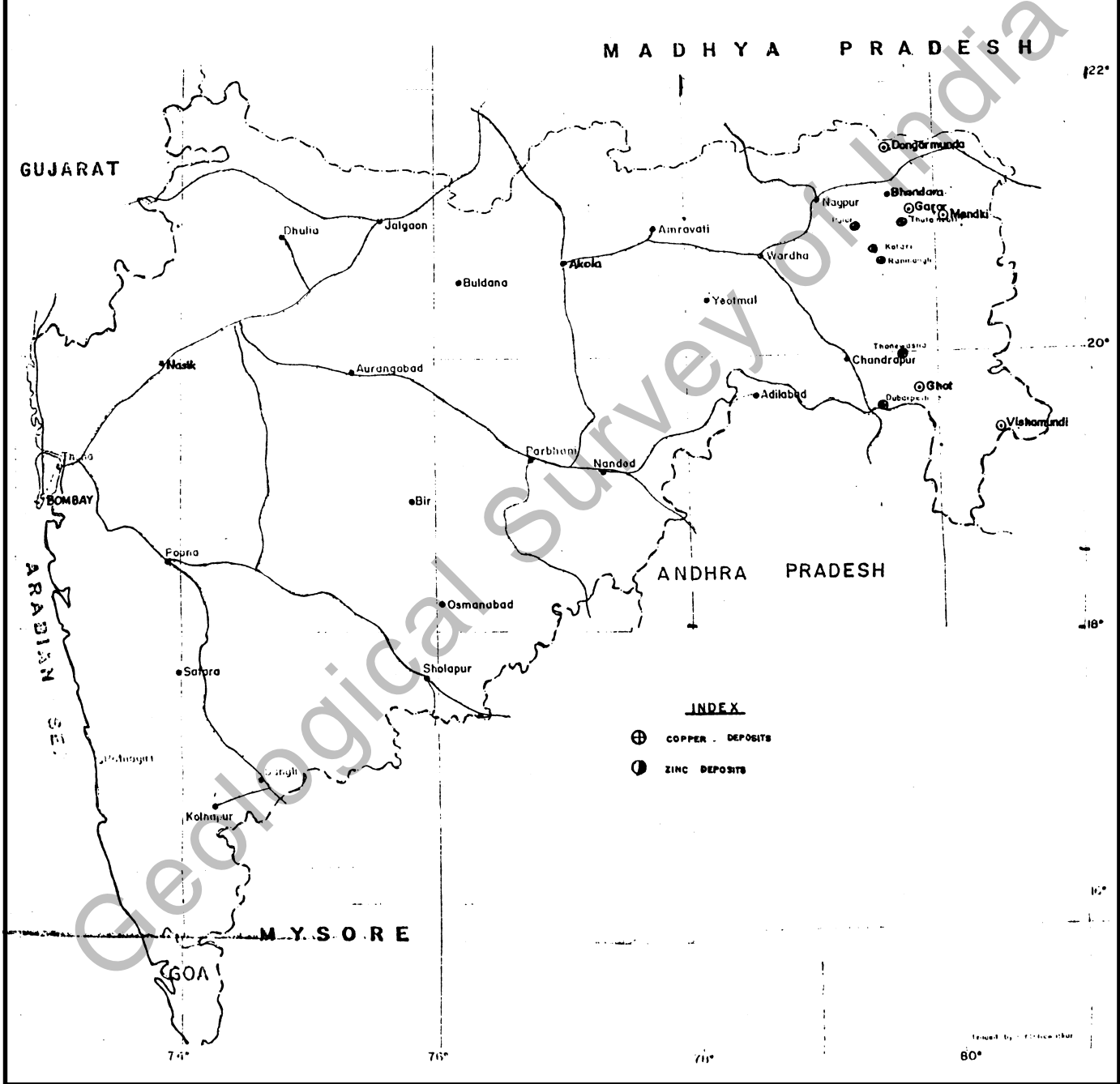
GOVT. OF INDIA

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BASE METAL DEPOSITS OF MAHARASHTRA

SCALE 12,250,000



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INFORMATION DOSSIER ON BASEMETAL DEPOSITS AND OCCURRENCES OF MAHARASHTRA

Introduction :

In Maharashtra 5 small to medium grade copper deposits and one fairly large zinc deposits are so far known, besides a number of occurrences. No distinct mineralised belts have been demarcated though most of the deposits and occurrences are from the Chandrapur, Nagpur and Bhandara districts.

Four of these deposits viz., Kolari Zone III (zinc), Pular-Parsori, Ran-Mangli and Thutanbori (all copper) occur in the meta-sedimentaries of the Middle Proterozoic Sakoli Group, the Thanewasna (copper) deposit occurs in Archaean rocks and the Dhubarpet (copper) deposit occurs in a shear zone at the contact of the Archaeans with the Puranas.

Kolari (Zone-III) Zinc deposit, Nagpur district :

Location :

The Kolari (Zone-III) zinc prospect is located at 2 km S57°W of Kolari Village (20°48' : 79°31', 55 P/5) about 75 km from Nagpur on State Highway No.78; in Umrer Tehsil, Nagpur district, Maharashtra.

Quantum of work done :

	Nature of work	Total work done
1.	Geochemical Sampling (soil samples on grid 75 m x 30 m, 150 m x 30 m, 300 m x 30 m in blocks A, B, C; 60 m x 20 m and 240 m x 30 m in D and selected rock samples)	6.46 sq.km
2.	Geological mapping and sectional survey (1:2000)	2.52 sq.km
3.	Geophysical surveys (EM, Mag, I.P. & S.P.)	2.52 sq.km
4.	Exploratory drilling	3451.25 m in 17 boreholes

Geology and Structure :

The area comprises Lower to Middle proterozoic Sakoli Group of rocks represented by (a) chloritoid mica schist \pm garnet, andalusite and magnetite, (b) banded garnet amphibole chert (BGA) and (c) grey phyllite with tuffaceous material, thin layers of basic schist and quartz tourmaline schist. Gabbro-diorite suite of rocks are intrusive into the dominantly argillaceous assemblage. In addition, vein quartz and quartz tourmaline veins are also present. The rock units strike NNW-SSE with steep to vertical northeasterly dip.

Mineralisation :

Zinc mineralisation is restricted to a finely banded garnet-amphibole rock showing alternation of essentially (a) garnet + sphalerite and (b) quartz + biotite + amphibole \pm feldspar layers. Garnet in the rock is essentially spessartite with subordinate almandine and grossularite.

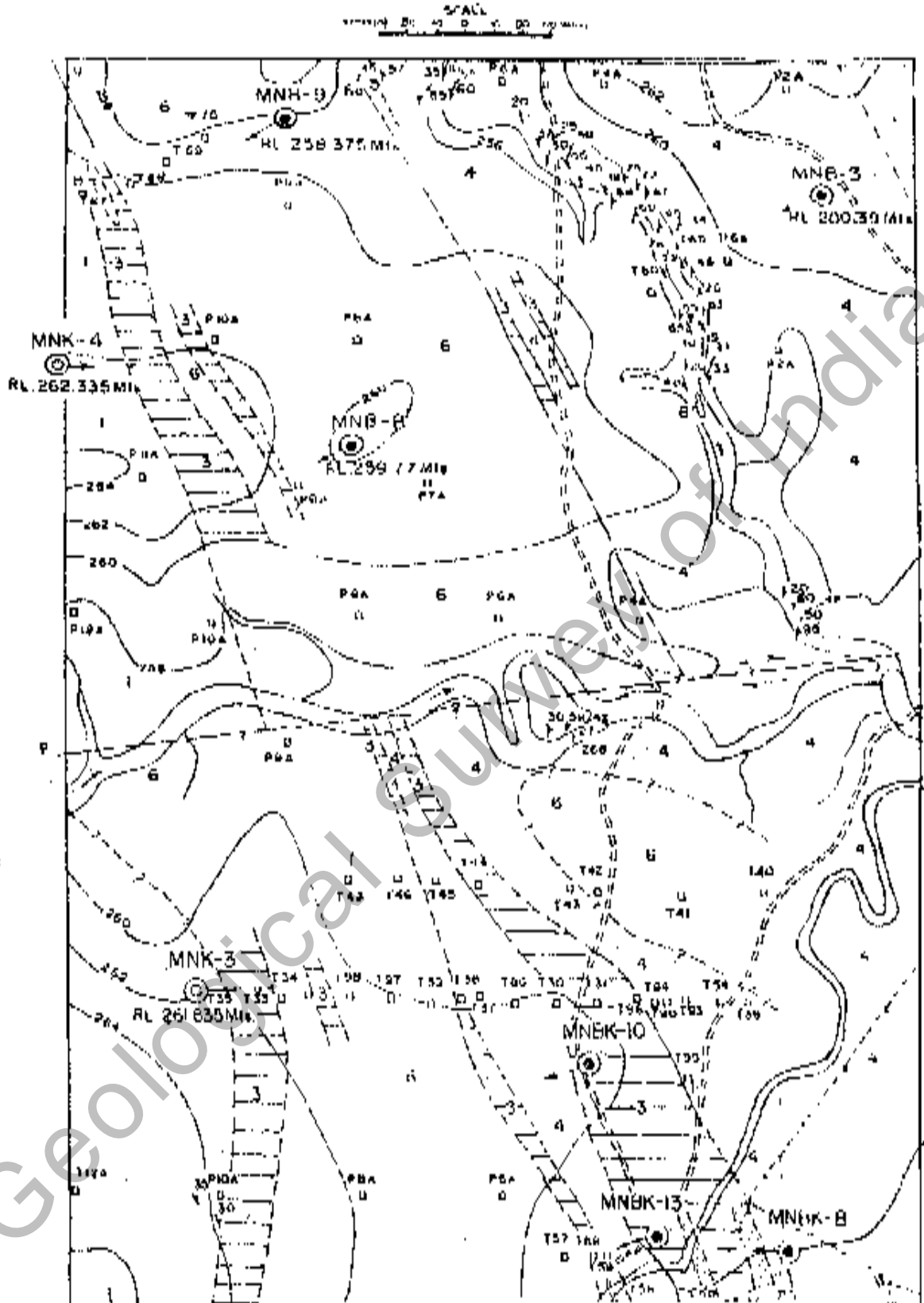
Four main horizons of banded garnet amphibole rock designated 3A, 3B, 3C and 3D occupying different tectonic stratigraphic levels have been established.

1. 3A - at the contact of the chloritoid-mica schist and meta diorite-gabbro suite of rocks.
2. 3B - within the meta diorite-gabbro.
3. 3C - at the contact of the meta diorite-gabbro with grey phyllite, and
4. 3D - within the grey phyllite.

The band 3B carries the richest lode as discontinuous lenses within the meta-diorite gabbro.

The zinc mineralisation is stratiform and stratabound. The sphalerite rich laminae parallel to the compositional banding (S_0) of BGA constitute the principal mode of zinc, though later remobilisation syn-to post dating D_1 deformation is noticed at places.

GEOLOGICAL MAP OF ZONE III, KOLARI ZINC INVESTIGATION, NAGPUR DISTRICT, MAHARASHTRA



I N D E X

- | | | | |
|-----------|--|---------|---|
| [0] | Van Quartz | [3a] | Banded Garnet Amphibole Biotite Mica, mineralised Altered |
| [7] | Quartz Trinitite Rock | [2] | Meta Basic Schist |
| [6, 6a] | Meta Quartz Granite-Gabbro (Granite Gabbro Dyke) | [1] | Quartz Chlorite Mica Schist, Tuffaceous at Places |
| [5] | Meta Gabbro - Amphibole | [(C)] | Borehole Drilled by A.M.S.E. with Bearing and R.L. |
| [4, 4a] | Meta Gabbro - Amphibole Banded Phyllite Tuffaceous at Places | [(D)] | Borehole Drilled by D.M.S., C.B.D. |

Sphalerite is the most dominant ore mineral with which pyrrhotite and pyrite are associated together with minor amounts of chalcopyrite and traces of galena. In the zone of oxidation, however, goethite, pyrolusite, haematite and very rarely fine specks suspected to be of gold are associated with sphalerite. Sporadic scheelite mineralisation is associated mainly with the altered basic rock, BGA and zones of alteration.

Ore bodies :

Exploratory drilling revealed the following dimensions of the ore bands.

Band 3A : The cumulative length of the band is 2 km of which 1.3 km was tested by drilling, establishing ore body for 690 m length, with four intersections in the second (50 - 100 m) and one at the third level (100 - 150 m) (Datum : 265 m R.L.).

Band 3B : The strike length explored is about 700 m with 7 second level (50 - 100 m) intersections and two each in the third (100 - 150 m) and fourth (150 - 200 m) levels indicating depth persistence. But the total length of the zone is difficult to assess due to paucity of outcrops.

Band 3C : The total strike length of the band is 1.8 km of which about 800 m has been explored by 3 intersections each in the first (0-50 m) and second (50 - 100 m) and one each in the third (100 - 150 m) and fourth (150 - 200 m) levels.

Band 3D : Out of the total strike length of about 780 m of this band about 500 m has been explored by three intersections in the first level (0 - 50 m) only.

Ore Reserves : Ore band wise insitu reserve estimates are summarised below :-

Ore band designation	Cut-off grade Zn %	Ore reserves (M.T)	Average grade Zn (%)	Average thickness (m)
C-1 Category				
3A		0.378	6.46	4.72
3B		1.100	7.80	5.13
3C		0.335	4.38	3.06
3D		0.058	5.27	2.58
Unclassified		0.096	5.16	2.51
	Total	1.967	6.76	—
C-2 Category				
3A		1.432	6.71	4.96
3B		2.857	8.29	6.65
3C		1.139	4.48	3.50
3D		0.277	5.16	2.65
Unclassified		0.600	5.13	2.64
	Total	6.305	6.80	—
Gross Reserves (C1 + C2)		8.272	6.79	—

Pular-Parsori Copper deposit :

Location :

Pular (20°51' : 79°30'; 55P/9) and Parsori (20°50' : 79°33'; 55P/9) are located about 30 km to the east of Umrer, a Tehsil headquarters of Nagpur district, Maharashtra.

Quantum of work done :

Nature of work	Total work done
1. Geological mapping on 1:31680 scale	110 sq.km
2. Large scale mapping on 1:15840 scale	79 sq.km
3. Large scale mapping on 1:2000 scale	3.66 sq.km
4. Geochemical sampling on 100 m grid	524 soil and bed rock
5. Geophysical surveys (electromagnetic/IP, SP)	98.25 Line Km
6. Exploratory drilling	12128.87 m in 93 boreholes 663.25 m by DMG (74-75)

Geology and structure :

The prospect falls in the southwestern part of the Sakoli-Synclorium and comprises Lower to Middle Proterozoic Sakoli Group of rocks represented by quartz-chlorite schist with bands of amphibolite, phyllite with carbonaceous partings and impersistent lenses of quartzite, amphibolite, granite, hornblendite, pegmatite, quartz veins, quartz-tourmaline veins.

Fault breccias are also present.

The area shows superposed folding. The foliation (S_1) strikes between $N20^\circ W-S20^\circ E$ to $N40^\circ E-S40^\circ W$. The strike of S_2 is generally $N70^\circ E-S70^\circ W$ with steep northerly dip. A major fault has been traced along $N70^\circ E$ trend from Tarna to Karondia.

Mineralisation :

The indications of sulphide mineralisation in the Pular-Parsori ridge include gossan, old pits, slag dumps, malachite, azurite stains etc, seen over a strike length of about 3 km. The primary minerals are chalcopyrite, bornite and sphalerite. Pyrite and to a minor extent pyrrhotite is also

associated with chalcopyrite. Zinc in the range of 0.05 to 0.20% is present in most of the core samples. The sulphide occur as irregular patches.

The mineralisation is mainly confined to brecciated quartz veins or quartz which are found distributed in the country rock in an en-echelon pattern. The length of these brecciated quartz veins varies from a few meter to 15 m and width is generally less than 3 m.

Drilling has revealed the presence of five mineralised zones as detailed below :-

		Strike length (m)	Probable reserves of +0.5% Cu ore over 0.8 m. swidth (tonnes)	Average grade (% Cu)
Pular Sector	Zone-I	140	2,350	1.20
	Zone-II	280	9,190	1.80
Parsori Sector	Zone-III	430	87,650	1.86
	Zone-IV	180	12,290	1.35
	Zone-V	360	7,540	1.56
Total			1,19,020	1.76

As the mineralised zones occur as small, lensoidal bodies; and are irregularly distributed, the reserve estimates are very approximate. The best mineralised zone is Zone-III in Parsori sector which extends over a strike length of 430 m.

Analysis of 42 borehole samples for gold by fire assay method, reveal that more than 50% of the samples carry more than 1 gm/tonne of gold. Two samples analysed as much as 9.8 and 12.3 g/t.

The probable reserve in the best zone-III works out to 87,650 tonnes of 1.86% Cu for a vertical depth of 25 m on either side of the level of intersection which is generally between 60 m and 80 m. In other zones the reserves are much less.

On the evidence now at hand, the deposit will have to be regarded as sub-marginal as the ratio of mineralised strike length to barren stretches is high.

Ran-Mangli Copper deposit :

Location :

Ran Mangli (20°48' : 79°27'; 55P/5) prospect corresponding to AEM intercept 88-8042-445 (5-ch) lies at 58 km from Nagpur on State Highway No.78 in Nagpur district, Maharashtra.

Quantum of work done :

Nature of work	Total work done
1. Geochemical sampling	401 Nos.(Soil-379; rock-32)
2. Geological mapping and sectional survey (1:2000)	7.8 sq.km
3. Geophysical surveys (EM, Mag, I.P. & S.P.)	
4. Exploratory drilling	5201.15 m in 22 boreholes (4.3.83 to 10.9.87)

Geology and structure :

The Ran Mangli prospect is occupied by a sequence of volcano-sedimentary rocks with pre- and post-tectonic intrusives and effusives and post tectonic quartzo-feldspathic influx, belonging to the Lower to Middle Proterozoic Sakoli Group.

The rock formations comprise chloritoid mica schist \pm garnet \pm magnetite \pm andalusite with lensoid bodies of quartz chlorite/specularite rock; acidic volcanics (felsic lava and tuff); and mica schist/phyllite with intrusives of altered basic rock/epidote-chlorite schist and intercalated lithologies of carbonaceous and/or magnetite phyllite, tourmalinite and epidote-quartzo-feldspathic rock. The formations trend NW-SE to WNW-ESE with 65° to 80° NE dip.

Mineralisation :

(1) The northern contact of the main acidic volcanic unit with the chloritoid mica schist defines a zone of hydrothermal veination/alteration carrying significant copper mineralisation. This zone contains linear old workings and corresponds to a copper anomaly zone of 1200 m length and a magnetic discontinuity.

Chalcopyrite is the main sulphide occurring as stringers clots, vein fillings and disseminations within the generally concordant hydrothermal veins. Chalcopyrite is associated with pyrite and minor sphalerite, galena, pyrrhotite, bornite, chalcocite and occasional cobaltite, safflorite, skutterudite-chloanthite-lollingite, antimonite-bortherite assemblages, bournonite, tetrahedrite, ilmenite and rare magnetite. The gangue minerals include quartz, tourmaline, muscovite, chlorite, epidote, calcite, garnet, chloritoid in varying proportions.

(2) The southern contact of the main acidic volcanic unit with the phyllite is marked by a zone of brecciated chert and silicification. The phyllite with associated basic units (epidote-chlorite schist, amphibolite) contains zones of pneumatolytic/hydrothermal veination/alteration carrying sporadic Zn-Pb-Cu sulphides. A zone of Zn and Pb anomaly has been demarcated for about 1200 m length and 240 to 360 m width associated with geophysical anomalies, chargeability high supported by resistivity low and EM anomaly. In this zone sphalerite, galena, pyrite, pyrrhotite,

chalcopyrite and rarely bornite occur in clots, stringers and disseminations associated with veins of barite-quartz-fluorite \pm carbonate \pm tourmaline; epidote-quartz-mica-scheelite; quartz-tourmaline \pm apatite \pm scheelite and pegmatite veins within the phyllite, garnet-amphibole-quartz and quartzofeldspathic portions of altered basic rocks.

(3) Scattered lensoid bodies of quartz-chlorite \pm magnetite within the magnetite phyllite and chloritoid-mica schist, grouped into a zone of 1000 m x 120 m extent, carry visible malachite and associated sulphide mineralisation, in the northwest section of the prospect.

Ore bodies :

(1) In the copper anomaly zone exploratory drilling of 2,533.48 m in 10 boreholes (200/164 m strike interval) testing the hydrothermal alteration zone bearing copper mineralisation, established copper ores for a strike length of 1128 m at depths of 235 m R.L. to 162 m R.L. (datum 280 m R.L.) in the First series (200 m R.L. \pm 30 m) and a cumulative length of 364 m at depths of 140 m R.L. in the Second series (140 m R.L. \pm 30 m) confirming a small copper deposit. Based on the lithostratigraphic position, a main copper ore zone designated vein-I and a minor zone 1A above, and another IB below it could be correlated. Ore reserves have been computed between 260 m R.L. and 110 m R.L.

(2) In the Zn and Pb anomaly zone, exploratory drilling involving 1541.35 m in 7 boreholes at 200 m strike intervals, revealed impersistent and poor Pb-Zn-Cu ore zones ranging from 0.29 m to 8.42 m with 0.12 to 3.18% Zn, traces to 0.49% Pb and traces to 0.16% Cu at different lithostratigraphic levels which are uncorrelatable. Hence no reserves have been computed.

(3) Exploratory drilling of 641.90 m in three boreholes testing the zones of hydrothermal alteration associated with quartz-chlorite \pm magnetite bodies in the north-west contiguity of the prospect, did not indicate any significant mineralisation.

(4) Geophysical anomalies, viz. (1) an E.M. conductor associated with resistivity low within the phyllite and (2) a significant magnetic anomaly within the chloritoid mica schist \pm magnetite, tested by drilling 484.65m in two boreholes, did not reveal any significant sulphides.

Ore reserves : Possible (ore C-category) copper ore reserve estimated in the Ran Mangli prospect are as follows :-

Cut-off % Cu	Minimum width (m)	Ore reserves (mill. tonnes)	Average grade (Cu%)	Average width (m)
0.40	1.00	0.829	0.81	1.77
1.00	1.00	0.344	1.25	1.73

Thutanbori Copper Prospect

Location :

Thutanbori (20°51' : 79°35'; 55-P/9) prospect is located at about 15 km on the fair weathered road from Pauni, the Tehsil town, Nagpur district, Maharashtra. It forms the northern contiguity of Khapri (20°51' : 79°34'; 55-P/9) prospect.

Quantum of work done :

	Nature of work	Total work done
1.	Geochemical samples	Selected samples only.
2.	Geological mapping and sectional survey (1:2,000)	2.5 sq. km
3.	Geophysical surveys (Magnetic, I. P. resistivity, SP, E.M. and Mise-a-la-masse method)	2.5 sq. km
4.	Exploratory drilling	6,526.50 m in 26 boreholes (21.9.1987 to 31.5.1990)

Geology and Structure :

The prospect exposes a volcanosedimentary sequence of the Sakoli Group (Lower to Middle Proterozoic) comprising chlorite mica schists constituting the main lithotype, which often contain magnetite, garnet, andalusite and chloritoid, with subordinate lensoid bodies of acidic volcanics (felsic tuffs and lavas), garnet-quartz rock, quartz-chlorite rock and polyphase quartz veins. Phyllites associated with basic rocks and banded garnet-quartz rocks occur to the east of the prospect. The rock units strike ENE-WSW with subvertical southerly as well as northerly dip.

Mineralisation :

Sulphide mineralisation occurs as disseminations, stringers or massive zones, generally stratabound, associated with (i) garnet-quartz and quartz-chlorite rocks and quartz veins, within mica schist and (ii) within acidic volcanics conformable zones containing magnetite megacrysts are devoid of significant sulphides. Alteration zones in the vicinity of mineralisation include chloritisation, silicification, sericitisation, chlorite-muscovite alterations, garneti-ferous zones, quartzo-feldspathic impregnations.

Chalcopyrite is the main ore mineral with associated chalcopyrite-covellite, pyrite, pyrrhotite, tenorite, cuprite, minor shreds of native copper, rare galena and sphalerite. Quartz feldspar, garnet, chlorite, mica and magnetite constitute the chief gangue minerals.

Ore bodies :

Thutanbori prospect of 2.8 km length was explored by drilling of 6,525.50 m in 26 boreholes.

(1) In order to test the copper mineralisation associated with garnet-quartz and quartz-chlorite rocks and quartz veins within mica schist, 13 boreholes totalling 3,402.10 m were drilled at 100/200 m intervals testing a total strike length of 1,000 m; and exploring copper ore zones between 233 m R.L. and 6 m R.L. below datum (260 m R.L.). The main ore zone, designated Zone-I (+1A+1B+1C) could be correlated at 150 m, 120 m, 60 m and 0 (zero) m. R.L. with five intersections in the first, two in the second and one each in the third and fourth levels, establishing extrapolated ore zone length of 200 m, 115 m, 100 m and 100 m at the respective levels. Ore reserves were estimated between 240 m R.L. (20 m below datum) and (-) 30 m R.L.

(2) The copper mineralisation associated with the acidic volcanic rocks (felsic lava and tuff) has been explored by 11 boreholes at 200 m intervals testing a strike length of 1500 m and exploring the ore zones between 140 m R.L. and 55 m R.L. below datum (assumed at 240 m R.L.). Three discontinuous ore zones of varying lengths, designed I, II and III (+IIIA+IIIB) could be distinguished and correlated based on stratigraphic position. Ore reserves were estimated zonewise, between 220 m R.L. and 70 m R.L.

(3) The northern continuity of ore veins intersected in two boreholes in the Khapri prospect has been explored over a stretch of 420 m in the Thutanbori prospect by two boreholes totalling 411.50 m. Only one of

these boreholes intersected a submarginal zone of copper ores at a different tectono-stratigraphic level and hence no reserve has been computed.

Ore reserves :

Possible (C-category) ore reserve estimates in the Thutanbori prospect are as follows :-

Cut-off %Cu	Minimum width (m)	Ore reserves (Mill. tonnes)	Average grade (Cu%)	Average width (m)
A. Copper ores associated with garnet mica schist				
0.40	1.0	0.747	1.84	4.58
1.00	1.0	0.469	2.73	3.23
B. Copper ores associated with acidic volcanics				
0.40	1.0	1.162	0.76	2.03
1.00	1.0	0.376	1.64	1.35
A+B				
0.40		1.909	1.18	
1.00		0.845	2.24	

Thanewasna Copper Deposit

Location :

Thanewasna (19°51' : 79°44'; 56-M/9), Chandrapur district.

Quantum of work :

Geological mapping	:	295 sq. km (1:31,680 scale) 10 sq. km (1:15,680 scale) 1.44 sq. km (1:2,000 scale)
Drilling	:	GSI 5,682.65 m (1971-79) DGM 241.40 m (1961-62)
Sampling	:	1,170 Nos.

Geology and Structure :

The main rocks exposed in the area are hornblende granite/gneisses, metapyroxenites, granulites with younger granites, pegmatites and quartz veins (Archaean). A major NNW-SSE trending zone of shearing and brecciation runs for over a length of 30 km. It has a dip of 60° - 70° due WSW. Part of this zone is marked with intermittent sulphide mineralisation, accompanied by chert and quartz veins which are generally restricted to the southern part. The northern portion of the shear zone is characterised by sulphide phase of mineralisation with one notable deposit of barytes ore at Phutana.

The mineralisation is essentially structurally controlled by closely spaced NNW trending fractures and foliation developed in metapyroxenite (chlorite—epidote schist). However, the silicified chlorite epidote rock is comparatively better mineralised.

Mineralisation :

The mineralisation is well established over a strike length of 2.2 km. Chalcopyrite, arsenopyrite and pyrite constitute a simple assemblage of sulphides. The gangue consists of magnetite, specularite, baryte and calcite.

Ore Zones and Grade :

First level (60 m vertical depth) drilling by 14 boreholes established the ore zone over a strike length of 1.96 km. Three separate lenticular bodies were delineated, viz. northern, southern and intervening ore bodies. They have a strike length of 465 m, 975 m and 520 m, an average

width of 6.0 m, 8.8 m and 1.2 m and a grade of 0.88% Cu, 1.15% Cu and 0.80% Cu respectively.

The second level drilling (110 m depth) by 13 boreholes, showed a general improvement in grade as well as in width in the northern and intervening part of the shear zone. However, in the southern part of the shear zone, comparatively richer shoots (0.8% to 1.0% Cu VE) over 3 to 4 m width were intersected corresponding to the 1.15 m wide zone over 500 m strike length intersected at the first level of intersection. The northern ore body has depth persistence at 2nd level over a limited length of about 300 m while the intervening ore body does not persist upto second level.

Reserves and grade :

Total reserves of 4.7 million tonnes with a copper content of 0.8% have been estimated to a depth of 135 m over a strike length of 1.9 km and an average width of 5 m. Geochemical surveys in the remaining parts of the Thaneswana shear zone indicated only very low order anomalies.

Dhubarpeth Copper Deposit :

Location :

Dubarpeth (19°40' : 79°30'; 56-M/10), Chandrapur district. The mineralised zone is parallel to the Thanewasna zone.

Quantum of work done :

Geological mapping	:	259 sq. km (1:5,000) GSI 1978-79 100 sq. km - Regional 1.28 sq. km - Large scale DGM 1973-75
Geochemical sampling	:	441 Nos. (GSI in 1978-79)
Drilling	:	1,009.45 m (GSI) 188.56 m DGM Maharashtra - 1973-75
Pitting	:	2,222.06 cu m DGM Maharashtra 1973-75

Geology and Structure :

Gneisses with inclusion of pyroxenite and amphibolite (Archaean) and the Purana Formations (Precambrian) comprising conglomerate, quartzitic sandstone and limestone are exposed. The contact between the two is demarcated by a prominent NNW-SSE trending shear zone. The mineralisation is confined to silicified metabasic rocks and the vein quartz intruding them along or near to the sheared contact of Archaean and Purana Group and coincides with a megalineament picked up from landsat imagery.

Mineralisation :

Surface evidences of mineralisation are seen over a 5 km strike length of the shear zone extending between Dubarpeth in the south and Kharanji in the north. Geochemical anomaly for copper was pronounced over this zone. Copper mainly occurs as disseminations and stringers of chalcopyrite in association with pyrite and arsenopyrite.

Reserves and grade :

About 1.96 million tonnes with 1.0% copper and 1.38 million tonnes with an average grade of 1.19% copper over a strike length of 1,437 m with an average width of 3.52 m have been estimated.

Khapri (20°51' : 79°34'; 55-P/9) area, Bhandara district :

This area is adjacent to the Thutanbori copper deposit and comprises rocks of the Sakoli Group. Sulphide mineralisation in association with vein quartz and in impersistent lensoid bodies of garnet-quartz rocks. Two out of 7 boreholes intersected copper mineralisation (1.35 m x 0.57% Cu and 1.65 m x 0.57% Cu in MBK-3 and 1.10 m x 0.54% Cu, +0.20% Zn in MBK-4). The zone in MBK-4 also contains appreciable scheelite. Some gold values 0.10 to 4.45 g/t (average 1 g/t x 1.00 m) were also obtained in MBK-4 in a zone occurring above the copper zone. The boreholes did not indicate any persistent zone of mineralisation.

Garara (21°02' : 79°47') - Nerala (20°55' : 79°44') area, Bhandara district :

The area comprises metamorphosed felsic and basic volcanics and associated pelitic schists and lenses of Banded Iron Formation traversed by quartz veins (Sakoli Group).

Pyrite-chalcopyrite mineralisation with occasional molybdenite is observed mainly in quartz veins within meta-rhyolite. These quartz veins are mostly aligned parallel to F_2 fold axes. In the Garara block 6 anomaly zones for copper have been delineated over an area of about 2 sq. km. These zones range in strike length from 150 to 700 m and in width from 20 m to 200 m. In Nerala block, en echelon anomalous zones for copper have been traced over a strike length of about 2 km.

Dongarmunda (21°54' : 79°20'; 55-P/5), Nagpur district :

Rocks of the Sakoli Formation comprising phyllites, schists and intercalated bands of quartzite constitute the long ridge extending for about 10 km between Dongarmunda in the east and Dani (20°52' : 79°23') in the west. Intense brecciation and silicification are observed. Disseminations of chalcopyrite, pyrite and minor galena, sphalerite and tetrahedrite are observed in quartz veins traversing the breccia zones. Two boreholes were drilled by DMG Maharashtra. Values of 0.30 to 0.45% Cu and 0.02% Zn are reported from core samples.

Ghot area (19°46'-19°57' : 79°52' - 80°00" ; 56-M/13), Chandrapur district :

The area exposes Precambrian Banded Magnetite Quartzite, hornblende schist, garnetiferous biotite schist and massive cherty quartzite. Of the Bengpal Group, Acid and basic rocks (metavolcanics?) are also present.

Sulphide mineralisation in chert bands associated with the metavolcanics is seen intermittently over a 6 km long zone. A 1.5 km long parallel zone is also seen in the southeastern part. The mineralisation is along fractures/shears developed along NNW-SSE trending faults. Surface sampling in the Ghot zone indicated a zone of 600 m strike length with one sample analysing 1.05% Cu and other samples upto 1000 ppm Cu.

Four boreholes drilled by the DWG indicated only minor zone of copper. Scheelite mineralisation in quartz veins and silicified metabasics was also intersected in two boreholes.

**Vishamundi-Jinjgaon Kothi area (19°20'30" - 19°32'35" :
80°26' - 80°37' ; Gadchiroli district :**

The area exposes Bengal-Surajgarh (Archaean-Proterozoic) Group of rocks, viz. biotite and hornblende gneiss, quartzite, metabasics and meta-ultramafites, Chalco-pyrite, pyrite, rare galena and sphalerite occur associated with sheared cherty quartzite. The mineralisation is sporadic and randomly distributed.

Mendki (21°03' : 80°09'; 64-C/4), Bhandara district :

Geology and Structure :

The rocks exposed in the area belong to the Sakoli and the Dongargarh Groups. Sakolis comprise granite gneisses, hornblende schists, quartzites and mica schists intruded by basic rocks and quartz veins. Dongargarh Group is represented by feldspathic and gritty quartzite, conglomerates and andesite flows, granitoids, etc. The two groups are separated by a conspicuous and persistent fault zone trending N20°E-S20°E occupied by brecciated and sheared cherty quartzite and quartz veins. At Mendki, the Sakoli Group lies to the west and Dongargarh Group to the east.

Mineralisation :

The shear zone and the andesitic flows display disseminations of chalcopyrite, pyrite and galena. At a few places molybdenite is also reported. To the south of Mendki, copper mineralisation (0.15-0.50%) occurs in cherty quartzite and quartz veins occupying the shear zone over a strike length of 1 km in a N20°E-S20°W direction. Individual lenses are 100-500 m in length with 1-10 m width.

The silicified shear zone occurring 1.5 km east of Bhusaritola (21°12' : 80°11') is mineralised and the sulphides are represented by disseminations of galena with minor chalcopyrite and rare sphalerite. This zone trends N30°E-S30°W and extends for 900 m with a width of 10 m. Another zone is traced 2.5 m NNW of Bhusaritola.

Mineralised zones with disseminations of chalcopyrite and galena are also located 2.5 km west of Mendki shear zone and 0.5 km NE of Kojbi (21°06' : 80°09'). They are 100-250 m long, 2 to 10 m wide, trending in N-S and N30°E-S30°W directions.

The andesitic flows at Duggipur also exhibit sporadic disseminations of pyrite and chalcopyrite.

Regional drilling consisting of two boreholes have been drilled in Kojbi area. The two boreholes have intersected disseminated zones of sulphides in the andesitic flows and brecciated quartzites. One borehole has gone through the oxidised zone (in brecciated quartzites) between 30 and 51.0 m depth. The two boreholes drilled at the Mendki hill also showed sparse copper mineralisation corresponding to the mineralised exposures.

Summary and Concluding Observations :

1. Five copper deposits and one zinc deposit have so far been delineated in Maharashtra as summarised below :

Deposit	Reserves million tonnes	Grade %	Average thick- ness (in m)
1. Kolari Zone III	8.272	6.79% Zn	2.51-6.65 m
2. Thutanbori			
0.4% Cut-off	1.909	1.18% Cu	2.03-4.58 m
1.0% Cut-off	0.845	2.24% Cu	1.35-3.23 m
3. Ran Mangli			
0.4% Cut-off	0.829	0.81% Cu	1.77
1.0% Cut-off	0.344	1.25% Cu	1.73
4. Pular Parsori	0.119	1.76% Cu	
Total 2-4 (1.0% Cut-off)	1.308	1.47% Cu	
5. Thanewasna	4.7	0.80% Cu	5.0
6. Dubarpeth	1.38	1.19% Cu	3.52
Total 5+6	6.08	0.89% Cu	

2. The reserves and grade of ore in the Kolari Zone III deposit appear to be adequate enough to sustain economically viable operations on a scale of over 500 tonnes per day.

3. The Pular-Parsori, Ran Mangli and Thutanbori deposits are located close to each other and to the Kolari Zone III zinc deposit. The combined reserves in these deposits works out to 1.308 million tonnes with 1.47% Cu. They can perhaps be mined as a group of small deposits, on a scale of 200 - 300 tpd. especially if a common infrastructure can be established

for all the four deposits, viz. Kolari, Pular - Parsori, Thutanbori and Ran Mangli.

4. Similarly the Thanewasna and Dubarpeth deposits also occur close together in adjacent parallel zones. The combined reserves at 6.08 million tonnes are fairly large, but the grade (0.89% Cu) is marginal. The feasibility of mining them will largely depend on economic considerations.

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