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PHELPS DODGE – METDIST MINING INDIA PVT. LTD.

EXPLORATION REPORT

ON THE

BALESHWAR RECONNAISSANCE PERMIT

SIKAR AND JAIPUR DISTRICTS, RAJASTHAN

INDIA

Author: Arun Kalra

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I. INTRODUCTION

1.1 BACKGROUND

Metmin Finance & Holdings Private Limited (Metmin) applied for a Reconnaissance Permit (RP) over 500sq.km. area in the Baleshwar Block, Sikar and Jaipur districts in March 2000. This area was applied as it was adjoining Metmin's Alwar PL(2143.75 sq.km). However, due to some pre-existing PL's, Metmin was granted an area of 228.318sq.km (Fig 1) on 13 March, 2001. The RP was subsequently transferred to the joint venture Company, Phelps Dodge-Metdist Mining India Pvt. Ltd on 20 November, 2001.

Phelps Dodge-Metdist Mining India Pvt. Ltd is a Joint Venture company promoted by Phelps Dodge Exploration Corporation, USA and Metdist Ltd. of UK. Phelps Dodge Corporation is the world's largest publicly traded copper producer and a world leader in continuous-cast copper rod and molybdenum production. Metdist operates a copper wire rod plant in Malaysia with an annual capacity of 100,000 tones. The Indian subsidiaries are Phelps Dodge Exploration India Pvt.Ltd (PDI) and Metmin Finance and Holdings Pvt.Ltd (Memin), with PDI as the operator.

1.2 EXPENDITURE

The expenditure commitment was Rs.3000 per sq. km for the first year, and Rs.10,000 to Rs 50,000 per sq. km in selected blocks for drilling and in case airborne surveys are undertaken, in the second and third years. However, the reconnaissance studies/ results did not indicate the necessity of any airborne surveys or drilling in the RP area. Thus, against a total expenditure commitment of about Rs.17 lakhs the actual expenditure has been Rs.18.25 lakhs.

II. LOCATION AND GEOLOGY

2.1 LOCATION AND ACCESS

The Baleshwar RP is located mainly in the Sikar and partly in Jaipur Districts of Rajasthan State (Fig. 1). It falls in the northeast corner of Survey of India (SOI) 1:50,000 scale map sheet, 45 M/14. The RP area lies midway between the towns of Kotputli on the Jaipur-Delhi Highway (NH-8) in the east and Nim Ka Thana in the west. There are a number of small villages scattered throughout the property (e.g. Ladi Ka Bas, Nanakwas, Dariba, Kalakhera) but no large towns. Access to the area is provided by one of several small roads leading south from the Kotputli – Nim Ka Thana road.

2.2 PHYSIOGRAPHY

The property is relatively hilly, with fairly narrow valleys lying between the rocky ridges and hills. The ridges for the most part trend north-south and rise to elevations of 500 to 780 m above Mean Sea Level (MSL), whereas the valley floors lie at about 400 m above MSL. Hillsides are covered with the typical scrubby, thorny bushes of northern Rajasthan, with only few trees.

2.3 GENERAL GEOLOGY

2.3.1 Stratigraphy

The north- northeast trending Aravalli- Delhi Belt of north-western India is over 750 kilometers in length and 200 kilometers in width. Three major units are recognized in the belt: the Archean Banded Gniessic Complex (3.5-3.0 Ga), the early Proterozoic Aravalli Supergroup (2.5-2.0 Ga) and the early- middle Proterozoic Delhi Supergroup (~ 1.8-1.0 Ga).

a) Raialo Group

Unconfomably overlying the pre-Delhi rocks and having a maximum thickness of 6 kilometres is the Raialo Group: It consists of a lower carbonate sequence with subordinate siltstone and sandstone, a middle conglomerate-sandstone with varying proportions of argillites, and mafic to felsic volcanics with associated intercalated sediments as the upper unit.

b) Alwar Group

Resting unconformably on the Raialo Group, and in places directly on pre-Delhi rocks, the Alwar Group is predominantly an upward fining arenaceous sequence of conglomerate and sandstone with subordinate siltstone and wacke. The base of the Alwar is thought by some workers to be defined by the conglomerate which overlies the youngest basic flow of the Raialo Group. The Alwar displays pronounced thickness variation from 2,500 to 3,300 metres in grabens to 10 to 100 metres in uplands.

c) Ajabgarh Group

The Ajabgarh Group overlies the Alwar Group conformably in the axial parts of the individual grabens and unconformably along their flanks. It consists of five formations. The lower formation is characterized by stromatolitic and phosphatic carbonate facies in the west, sandstone-siltstone in the east and basic flows and tuffs throughout. The upper four formations are composed of psammitic-pelitic assemblages, with minor chert-breccia, tuff, argillites and carbonates.

2.3.2 Deformation Events

Structural investigations by GSI reveal atleast three phases of deformation during the Delhi Orogeny. This is preceded by a Pre-Delhi set of folds with NNW axial plane trend. The earliest Delhi folds are generally very tight, locally rootless and usually have sub-horizontal axes (Das Gupta, 1968. Mem. GSI. 98). The second generation folds, most dominating ones are normal, upright to inclined folds, with shallow to moderate plunge due NNE or SSW, being overturned towards east. The latest folds are open and broad-hinged with variable axial plunge, but their axial planes trend WNW - ESE. Interference of these fold systems has resulted in axial culminations and depressions and much structural complexities. Besides these folds, there are many longitudinal and transverse faults in the area trending NNE-SSW and NW-SE.(after GSI Geological Quadrangle Map, 45 M).

2.4 LOCAL GEOLOGY

Majority of the rock units in the Baleshwar RP area belong to the Ajabgarh Group. They comprise limestone and calcareous gneisses of the Kushalgarh Formation (GSI) and brecciated and ferruginous quartzite. The post-Delhi intrusives comprise granites and pegmatites.

Reconnaissance and mapping by PD-M have noted a number of interesting features in the area:

- Abundant scapolite in pelitic layers within the limestone formations.
- Locally abundant gypsum and halite clasts in red sandstones /quartzites.
- Intense calc-silicate alteration around margins of granite plutons.
- Local horizons of massive magnetite and hematite.

These features are mainly confined to the Ladi Ka Bas – Nanakwas area and as these features support the Iron- Oxide Copper Gold (IOCG) model, this area was taken up for detailed studies.

III. LADI KA BAS AREA

3.1 GEOLOGY

Ladi Ka Bas (27° 40' 50" : 75° 57' 10")

This area was taken up for detailed studies as it covers the main aeromag anomaly (see **Fig.6**) and was noted to have many features which support the IOCG model. Detailed geological mapping on 1:5,000 scale, covering an area of about 7.0 sq.km.(**Fig.4**) reveals that the anomaly is centered over a moderately magnetic, medium to coarse-grained equigranular granite, which has intruded a sequence of intensely deformed calc-silicate and ironstone strata (see **Plate 1**). This granite is mesozonal and is characterized by a highly magnetic contact metamorphic aureole comprising a schistose assemblage of biotite, magnetite, albite and scapolite developed in calc-silicate strata.

The compositional layering (S1) in this supracrustal sequence dips away from the granite contact, defining a regional domal culmination cored by granite.

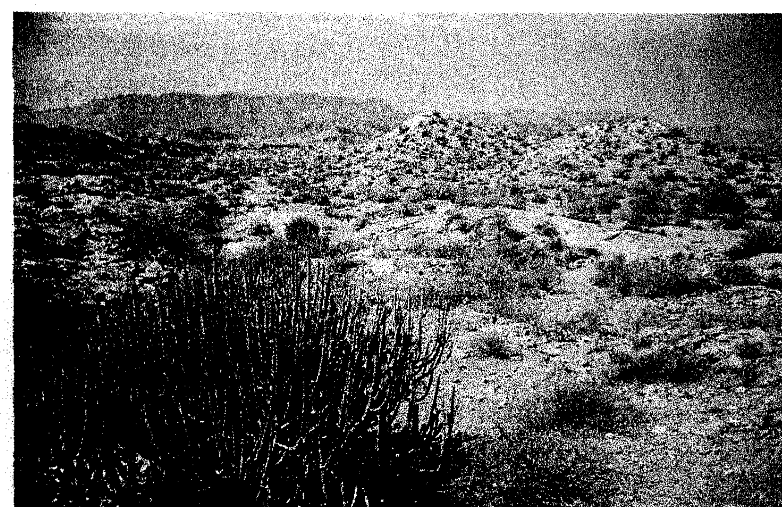

Plate 1: View (looking NW) of the Ladi Ka Bas prospect: The flatlands in the foreground are granite. The two small white-capped hills in the middle ground are also granite and have been transected by cogenetic magmatic quartz-albite veins/pegmatites. The low dark hill to the left in the middle ground is typical biotite-scapolite-magnetite calc-silicate country rock. (after O' Dea, Mark,2001)

This contact metamorphic assemblage is in turn transected by coarse-grained pegmatite dykes, which in turn have metamorphic/metasomatic haloes of actinolite, epidote, tourmaline, specularite, calcite, magnetite and albite (see **Plate** 2). Thick (≤3m wide) quartz-albite veins/dykes transect the granite.

Plate 2: Magmatic-derived quartz vein containing bladed specularite at Ladi Ka Bas. This vein is hosted by granite. (after O' Dea, Mark,2001)

At the abandoned **Nanakwas magnetite mine** (27° 44' 47" : 75° 56' 05"), magnetite mineralization is intimately associated with a highly deformed magnetite-biotite pegmatite body. Thick massive magnetite veins occur in the immediate footwall of this pegmatite, which are in turn structurally underlain by quartz-biotite-magnetite-scapolite schists. The hanging wall contact of the pegmatite is an intensely foliated quartzo-feldspathic, biotite magnetite schist. The magnetite-biotite alteration assemblages at Nanakwas are interpreted to be hydrothermal in origin and genetically related to the pegmatite.

3.2 DEFORMATIONAL, MAGMATIC AND METASOMATIC HISTORY

The granite is medium-to coarse-grained equigranular to porphyritic and is weakly to moderately magnetic. It is for the most part quite massive and unfoliated; however there are corridors of strong S2 foliation development throughout its core. This foliation is a solid-state fabric rather that magmatic. The surrounding supracrustal sequence has a much more complex deformational history, recording at least one phase of intense strain and transposition prior to granite emplacement. The granite therefore is interpreted to be late-syn-tectonic emplaced at the end of D2 or D3 deformation.

Along the east and west margins of the granite the supracrustal sequence dips away from the granite core forming a domal culmination. The margins of the granite are severely Fe and K-metasomatized to an assemblage of magnetite, scapolite, biotite, albite?, actinolite epidote, hematite, K-spar?, specularite, tourmaline, quartz, calcite. Different assemblages characterize different rock types. Regionally there is transition from higher temperature Fe-rich assemblages in the north to lower temperature Fe-rich assemblages towards the south. For example, to the south of the magnetic anomaly magnetite is replaced by specularite, albite is replaced by K-feldspar and locally, muscovite predominates over biotite. These cooler metasomatic assemblages broadly correlate with the small copper occurrences found in the area (see subsequent section).

Scapolite persists in compositional layers throughout supracrustal sequence and is by no means restricted to the margins of the granite. The strong compositional control on the distribution of scapolite is interpreted to reflect variations in the original/primary composition of the precursor strata (see **Figure** 5). The important point here is that different mineral assemblages are present in different layers which could simply reflect the original proportions of Fe, Mg, K, Na, Al in the precursor rock. This type of compositional control would indicate a closed system environment wherein components were immobile and did not exchange with the surroundings, and the composition of the fluid was at all times determined by the solid phases. In this type of system it is easy to imagine compositional layering being preserved and different mineral assemblages being characteristic of each layer.

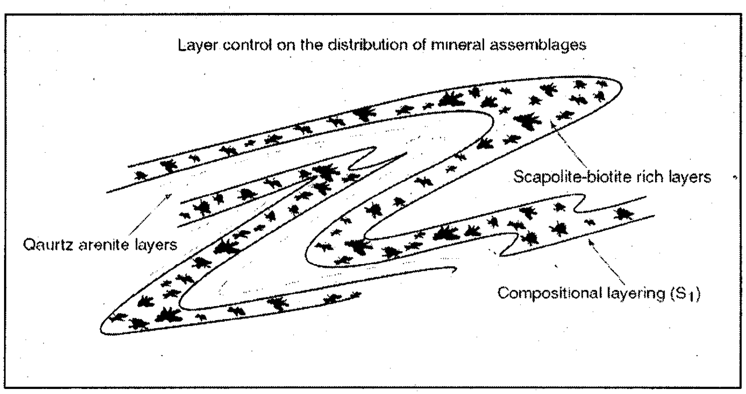

Figure 5: Schematic cross section illustrating the pronounced layer controls on the distribution of scapolite and biotite interpreted to reflect variations in the original/primary composition of the precursor strata. Width of sketch is approximately 1 metre. (after O' Dea, Mark,2001)

Similarly, deformed lenses of massive magnetite and hematite occur throughout the sequence and are not particularly concentrated adjacent to the granite contact. Based on timing relations it is believed that this generation of magnetite along with the scapolite represent an early metasomatic assemblage that predated the emplacement of the granite. It is possible that this is an extension-related metasomatic assemblage that developed during a period of basin development. Such a model has been proposed for the early widespread metasomatism in the Mary Kathleen Fold Belt of the Mount Isa Inlier (see Oliver et al. 1992, 1994).

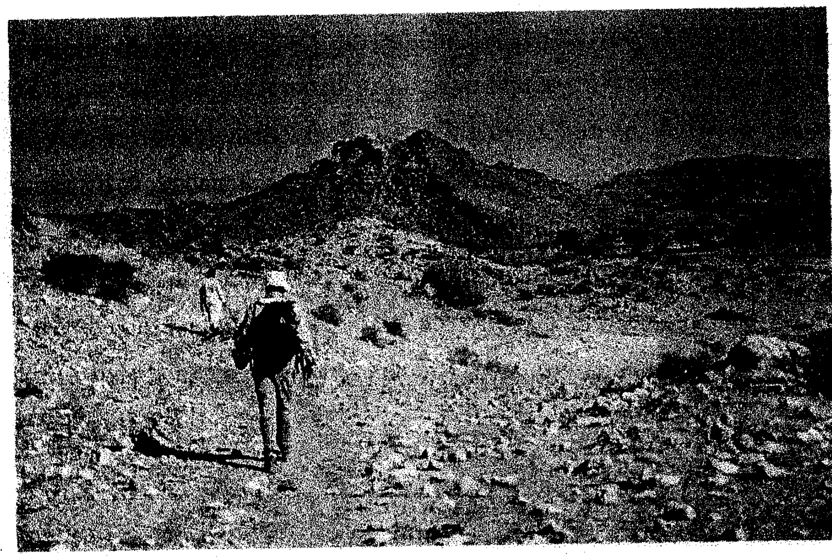

Plate 3 : Ladi Ka Bas area (looking East). Note the black dip slope in the centre of the photo dipping towards the South. This is a massive hematite replacement zone along compositional layering. (after O' Dea, Mark,2001)

3.3 GROUND GEOPHYSICAL SURVEY

A study of the Aeromag data of AMSE/GSI shows that the corridor between Nanakwas and Ladi Ka Bas is characterized by high amplitude magnetic anomalies. These magnetic highs are roughly N-S trending and correspond to zones of massive magnetite.

To better define the magnetic anomaly in the Ladi Ka Bas area, a ground magnetic survey was conducted. About 9.0 line km of ground magnetic data were collected along 4 lines that were spaced approximately 500m apart. This survey revealed corridors of highly magnetic supracrustal rocks adjacent to a weakly to moderately magnetic granite.

The contacts between the granite and the supracrustal sequence are marked by a dramatic increase in magnetic response, corresponding to sudden increases in metasomatic magnetite. These contacts are also marked by coincident K-highs, corresponding to increases in biotite content.

Within the magnetic aureoles surrounding the granite, there are pronounced magnetic lows (troughs) that correspond to massive lenses of inversely polarized magnetite. These massive magnetite bodies are highly deformed and boudinaged and are interpreted to predate the granite emplacement and associated magnetic aureoles. An interesting consequence of having two generations of magnetite development, with different remnant polarities, is that the cumulative magnetic response is extremely complex, consisting of a sharp trough within a broad high (see **Figure 8**) This geometry explains the complex contour pattern seen in the airborne geophysical data over the Ladi Ka Bas area.

IV. GEOCHEMICAL SURVEY

4.1 WATER WELL SAMPLING

In order to broadly delineate areas/zones with elevated copper, the copper content of water in the wells was tested. The testing was done with the help of portable field kits. This was especially done to cover areas with scanty outcrops, such as fields and ground covered by sand/alluvium.

Initially, the water well sampling was done at a reconnaissance distribution level of 400-500 m. In the next phase, sampling was done at closer interval around wells with >990 ppb Cu (**Fig 9**). The details of water well sampling with Cu values are given in Annexure-I. It may be noted that a cluster of water well Cu highs is associated with the main magnetic anomaly in Ladi Ka Bas block (**Fig 10**). However, except for rare malachite stains, no signs of copper mineralisation were noted in this block.

V. COPPER MINERALISATION

5.1 NIM KA THANA COPPER BELT

According to the GSI classification, copper mineralization in this area falls under the Nim Ka Thana Copper Belt. This belt is located to the east of the Khetri Copper Belt. Copper mineralization occurs in rocks of the Delhi Super Group along parallel, northeasterly trending shear zones between Mothoka (27° 48' : 76 ° 05') in the north to Ahirwala (27° 37' : 75 ° 53') in the south, over a length of about 35km.

Within the Baleshwar RP area, copper mineralization occurs at Dariba prospect, while the Baleshwar prospect is just west of the RP boundary. A few other copper occurrences/ showings are noted, such as a small old working east of Ladi Ka Bas and at Kalakota.

5.2 DARIBA PROSPECT (27 41' 22": 75 54' 23")

The main lithological units of the area are calc-gneiss, calc-schist, dolomite/ limestone, carbonaceous phyllite and brecciated quartzite of the Ajabgarh Group. The sequence is folded into an isoclinal anticline plunging 40° due SW (after GSI). The limbs of the fold strike NNE-SSW, with 60° to 80° westerly dips.

GSI investigations of the Dariba prospect comprised detailed geological mapping (2.25 sq km on 1:1,000 scale), geophysical surveys (SP, Resistivity, Magnetic and EM), 1100 bed rock and soil samples and drilling (509.75 m in 1 completed and 2 suspended boreholes).However, only sporadic disseminations of pyrite and pyrrhotite were intersected in the boreholes.

At the Dariba prospect there is a series of narrow old workings hosted in limestone/ dolomite. The copper mineralization, in the form of disseminated malachite, is associated with quartz - carbonate veins, along narrow shears. The veins display evidence of ductile deformation (boudinage).

There is an old slag heap at Dariba village, in which appreciable remnant malachite is noted in several slag pieces, assaying up to 2.2 % Cu, 0.09 g/t Au and 110 ppm

Cobalt (**Annexure II**).However, as copper mineralisation is confined only along narrow shears, the prospect appears to have limited ore reserve potential.

5.3 COPPER WITH BARYTES (27° 44': 75° 55')

About 4.0 km north of the Dariba copper old workings there are some abandoned baryte mines occuring in biotite schist over a strike length of about 500m. Minor copper mineralization (malachite and chalcopyrite disseminations) is associated with baryte veins over a width of about 50m. Rare malachite is also noted in amphibole schist. However , the copper mineralization here is not of any significance.

5.4 LADI KA BAS BLOCK

The Ladi Ka Bas block has many of the essential geological, geochemical and geophysical characteristics commonly associated with Iron Oxide Copper Gold (IOCG) systems. However, with the exception of two minor historic copper showings and a small copper occurrence hosted in quartzite, no copper mineralization of any significance was discovered on the Ladi Ka Bas prospect. Despite widespread Fe, Na and K-metasomatism, late-syn tectonic granites, and reactive host rocks, it appears that the hydrothermal system at Ladi Ka Bas was not endowed with much copper. It is possible that the hydrothermal system was too hot and immature at Ladi Ka Bas and that exploration should be focussed in more distal, "cooler" areas, farther away from the granite contact.

5.4.1 Copper Old Working (27° 40' 31" : 75° 58' 00")

There is only one small ,isolated historic copper working in the Ladi Ka Bas area. It consists of a small, partly in-filled pit , 4m long x 2m wide x 2m deep. It is located 150m to the SE of the granite contact and is hosted in biotite-scapolite-calc-silicate schist. The host strikes 070° parallel to the granite contact and dips steeply to the south, away from the granite.

Mineralization consists of 3-5% malachite, which occurs within a folioform 0.5m wide silicified and potassically altered replacement zone. However, no malachite staining occurs along strike from or adjacent to the mineralized replacement zone. A grab sample from this showing returned a copper value of 0.97% Cu and 20 ppb Au.

With the exception of the copper mineralization, the schistose, calc-silicate host rocks appear identical to those found throughout the Ladi Ka Bas area. In fact there appears to be nothing particularly unique about the mineralized strata that distinguishes it from unmineralized areas. Strata adjacent to the copper showing however, are unique to this area. For example:

- ~50 metres to the south of the showing is a 75m wide zone of quartz-muscovite schist. While biotite is common throughout the Ladi Ka Bas prospect, this is the only occurrence of muscovite-bearing schist, suggesting lower temperature metamorphic/metasomatic conditions.
- A massive (unfoliated) dolerite dyke occurs along the contact between the granite and the supracrustal sequence, approximately 100-150m to the north of the copper showing.
- A 0.5m wide pegmatite dyke strikes N-S for about 200m towards and adjacent to the copper showing. It consists of quartz, pink feldspar, oxidized sulfides, tourmaline and specularite.

5.4.2 <u>Mandaka</u> (27°39'27" 75°57'20")

Approximately 3 km south-west of Ladi Ka Bas, there is a highly strained quartzite unit which hosts 2-3% folioform malachite. This quartzite is in contact with magnetite-hematite bearing calc-silicate strata.

Mineralised samples of this quartzite assayed up to 0.31% Cu and 0.12 ppm Au. (Annexure II). However, this is only a minor copper showing, with malachite disseminations and stainings visible only over a limited extent of 5m x 2-3m.

5.4.3 <u>Kalakota</u> (27° 38' 28": 75° 56' 10")

About 2 km south of Mandaka, minor copper mineralization is noted in small, filled old workings at Kalakota (**Fig 2**). Biotite gneiss and amphibolite schist with malachite are exposed in old workings, samples of which have assayed only 0.24 % Cu.

CONCLUSIONS

Reconnaissance surveys in the Baleshwar RP area identified that the Ladi Ka Bas – Nanakwas block has many of the essential geological, geochemical and geophysical characteristics commonly associated with Iron Oxide Copper Gold (IOGC) systems. The evidence is in the form of widespread Fe, Na and K- metasomatism, late-syn tectonic granites and reactive host rocks. However, from the lack of copper showings in this block, it appears that the hydrothermal system was not endowed with much copper. It is possible that the hydrothermal system was too hot and immature and that exploration should be focused in more distant cooler areas, further away from the granite contact.

No significant copper mineralization was noted in the entire RP area. The only copper occurrence of minor significance is the Dariba prospect, where some ancient workings are present. Although copper mineralization is seen intermittently, between Dariba and Baleshwar, over about 6km length, the mineralization is controlled by narrow shears and does not have much width or ore reserve potential.

In general, the reconnaissance studies did not reveal the possibility of a sizeable copper ore deposit in the Baleshwar RP area. In fact, no anomalies/ targets were even considered worthy of testing by drilling.