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PHELPS DODGE - METDIST MINING INDIA PVT.LTD.

**REPORT ON EXPLORATION
FOR COPPER AND ASSOCIATED MINERALS
IN THE
UDAIPURWATI RECONNAISSANCE PERMIT
JHUNJHUNU DISTRICT, RAJASTHAN STATE
INDIA**

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दस्तावेज क्रमांक.....
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भौतिक सर्वेक्षण विभाग
Geological Mapping Cell

I. INTRODUCTION

1.1 GENERAL

This is the final report on the exploration carried out by Phelps Dodge - Metdist Mining India Pvt. Ltd. (PD-M) on the Udaipurwati Reconnaissance Permit (RP), covering an area of 150 sq. km. (Fig.1), in Jhunjhunu District of Rajasthan State. This RP was originally granted to Metmin Finance and Holdings Pvt. Ltd. (Metmin) on November 20, 2001 and was later transferred to PD-M on January 17, 2003.

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 and a fine copper tube plant in Malaysia with an annual capacity of 100,000 tons and 24,000 tons respectively. In India, Metdist plans to set-up a 100,000 tonne copper smelter in the state of Gujarat. The Indian subsidiaries are Phelps Dodge Exploration India Pvt. Ltd (PDI) and Metmin Finance and Holdings Pvt.Ltd (Metmin), with PDI as the operator for the exploration activities.

Although the term of the Reconnaissance Permit was up to November 19, 2004, the entire RP area of 150 sq. km. was relinquished in September, 2003 as the results of exploration were not encouraging. However, the exploration expenditure was more than the amount committed.

1.2 EXPENDITURE

Against an expenditure commitment of Rs. 15 lakhs, the total expenditure by PD-M on exploration in the Udaipurwati RP was Rs.71.65 lakhs, as summarised below:

**TABLE I : SUMMARY OF EXPENDITURE ON PROSPECTING
IN UDAIPURWATI RECONNAISSANCE PERMIT**

ITEM	EXPENDITURE (Rs. in Lakhs)
Geological and Geophysical work (including field expenses)	47.20
Diamond Core Drilling	15.75
Percussion Drilling	5.35
Assays	2.65
Others (including PL Fees etc.)	0.70
TOTAL:	71.65

II. GEOLOGY AND MINERALISATION

2.1 PROPERTY AND ACCESS

The Udaipurwati RP covers a rectangular area of 150 sq. km, stretching 26 km NE from the town of Udaipurwati (Figs.1 & 2). The Khetri Copper Mines begin approximately 20-km northeast of the northern edge of the RP. Access is via road from either Nim-Ka-Thana in the east, or via one of several roads leading eastward from Mukandgarh and Nawalgarh in the west. These latter towns can be reached from the Jaipur-Sikar highway.

2.2 PHYSIOGRAPHY AND VEGETATION

The property straddles several major NE-trending faults that have separated the area into a western, flat, largely sand-covered half and an eastern, rugged, hilly terrain. Long linear ridges, dissected by narrow but steep ravines, characterize the eastern part of the area, with steep cliff faces more than 200 metres high. Kantli river and its tributaries form the main drainage system. However, the streams are dry almost throughout the year, except during the short monsoon period. Vegetation is scanty and tree cover is minimal.

2.3 GENERAL GEOLOGY

The stratigraphic setting of this part of Rajasthan has undergone a major revision lately. Originally mapped as part of the Ajabgarh Group, these rocks have recently been assigned to a new Group known as the Shyamgarh Group (GSI Map, 1997). The aeromagnetic map of this region (AMSE and AMD maps) clearly show a major NE-trending break between the area of the magnetically complex Ajabgarh Group in the east (ending in the Khandela – Nim Ka Thana area) and the subdued signature of the lithologies in the Udaipurwati area in the west.

Numerous granites occur throughout northern Rajasthan and the age and setting of these too have recently been questioned. Recent work by Knight et al (in press) has indicated that there is a young, post-tectonic granitic event dated at 750-850 Ma and an older, syn-tectonic event at 1500-1700 Ma. The younger, A-type, granites are coeval with the age of biotite alteration associated with copper mineralisation at Khetri and are thought to be an integral part of the Iron Oxide Copper-Gold mineralisation now recognised throughout northern Rajasthan. Several granites (i.e. Chapoli, Saladipura) occur in or near the southeast corner of the Udaipurwati RP but these appear to be pre- or syn-tectonic and are presumed to be part of the older suite.

2.4 GEOLOGICAL RECONNAISSANCE AND LANDSAT STUDIES

Landsat image interpretation (1:50,000) on the images obtained from NRSA was made. The available 'Operation Hardrock' aeromagnetic maps of the area were purchased from AMSE Wing of GSI and Atomic Minerals Division (AMD). The landsat image was of considerable use in demarcating the major faults in the area. However, the aeromagnetic pattern in the RP area is rather featureless and is of limited use. The regional aeromagnetic maps however, offer great insight into the major breaks between terranes in north-western Rajasthan.

2.5 LOCAL GEOLOGY AND MINERALISATION

The geology and topography of the Udaipurwati RP is in large part controlled by a series of NE-trending major faults. The break between the flat, sand covered western area and the eastern hills is marked by the regional scale South Khetri-Pallanpur fault. This is a broad corridor of young, brittle, oblique slip faults with components of right lateral and normal displacement (Mark O' Dea, 2001). The fault is marked by

Reconnaissance near Girawari village, around the old workings for copper, showed that the siltstone at this prospect is highly brecciated, silicified with extensive iron enrichment over considerable widths. This area was named as **Udaipurwati Prospect** and was selected for detailed examination.

III. UDAIPURWATI PROSPECT

The Udaipurwati prospect (27° 45' 06" 75° 31' 07") is situated on the NW margin of the central part of the South Khetri Belt. Topography on the prospect is extremely rugged, comprising a narrow valley surrounded by peaks of over 250 vertical metres from the valley floor. Cliff faces are widespread on the NW slopes making access, mapping and sampling difficult. A few historical copper workings occur in this valley, along with a widespread clay "alteration" zone. A multidisciplinary exploration program was conducted on this prospect to assess its potential for Iron Oxide Copper Gold (IOCG)? style mineralisation.

3.1 GEOLOGICAL MAPPING

Detailed geological mapping at a scale of 1:5000 was carried out over an area of 5.20 sq.km. Stratigraphy on the prospect consists of a sequence of thickly bedded, low-grade meta-siltstone strata interbedded with quartzite and phyllitic sequences. The thick sequence of siltstone has been pervasively hydrothermally brecciated, silica cemented and with extensive iron enrichment.

The clay alteration throughout the prospect is intense and pervasive, although locally patchy. According to PIMA studies it is of hydrothermal origin. It is possible that this clay zone is the product of advanced argillic alteration associated with acidic fluids localized along the South Khetri Fault Zone.

The highly altered siltstone has been mapped over a strike length of almost 1.0 km, over a width of 100 to 150 metres (Fig 6).

The prospect is transected by and bounded to the NW by one of the most prominent structural corridors in the Aravalli Mountains – the South Khetri Fault Zone. This fault strikes NE-SW and dips between 55° and 75° towards the NW. It is characterised by a broad corridor of open space filling textured quartz veins,

3.3 GROUND MAGNETIC SURVEY

Ground magnetic survey, using Scintrex Envi Geophysical System, was carried out over 13.60 line km, to cover the Udaipurwati prospect. The ground magnetic image (Fig. 8) shows that the alteration zone / copper mineralisation is not associated with any magnetic anomaly. Infact, there is a very weak magnetic signature over the altered siltstone, with only slightly elevated values towards NW over quartzite and phyllites.

3.4 INDUCED POLARISATION GEOPHYSICAL SURVEY

IP survey was carried out along one line (Fig. 7) over 1.1 Km. The equipment used for the survey was a Zonge system consisting of a GGT-10 transmitter and a GDP-32 multipurpose receiver with 8 channels. The equipment was hired from M/s Associated Cement Companies and the survey was carried out by Dr. Peter Elliott of Elliott Geophysics International Pty. Ltd., Australia.

An inversion model for line 1N, defines a strong IP source (>100 msec) in the central part of the section (Figs. 9 & 10). The high chargeability zone is centred on 900. Associated with the IP anomaly is a zone of very low resistivity (<2 ohm-m) also centred beneath line coordinate 900. There is outcropping black siltstone/ shale where the IP source comes to the surface so it is assumed the source to the IP anomaly is a layer of graphitic black shale. There is the possibility, however, that there may be sulphides at depth in the central part of the section. A possible location to test this concept would be station 650, where the IP source is modelled around 60 msec and is centred at a depth of about 200m. This location is downhill from the old copper workings. Alternatively, this anomalous response could be the down dip extension of the black siltstone/shale unit.

3.5 DRILLING

Drilling was proposed to test the altered and brecciated shale horizon at the Udaipurwati prospect. As the proposed drill-sites were in forest area, necessary forest permission was obtained for the same.

3.5.1 Percussion Drilling

Two inclined holes, URC-1 and URC-2 (Figs. 6, 11 & 12) were drilled through Pashupati Nath Tubewells of Bhilwara. A cyclone fitted on the drill collar was used for collecting the drill-cuttings, which were sampled at approximately 2m intervals. Due to the extremely fractured and clayey formation, bentonite clay was used to stabilize the walls. Despite this, there was frequent wall-collapse before the casings could be lowered, due to which the drilling progress was rather slow. URC-1 could be drilled only up to 141.80m and URC-2 up to 82.30m.

URC-1 intersected a zone of highly altered, clayey, silicified siltstone, with strong iron (hematite) alteration, with 24.45m @ 0.13% Cu (including 6.10m @ 0.25% Cu) towards the end of the hole (Fig. 11).

The summarised logs are given below, while the detailed drill-logs, with assays are given at Annexure-III.

3.5.2 Diamond Core Drilling

As the percussion hole, URC-1 intersected the fringe of the targetted mineralized zone below the old workings, a diamond hole, UDH-1 was drilled by backing-up 7m from URC-1 (Fig. 11). The drilling work was assigned to Mining Associates of Asansol, who deployed one Long Year-44 equivalent, wire-line diamond core drill. Considering the highly fractured and clayey formation, the hole was commenced in PX size and was drilled in HQ size up to almost 200m and thereafter in NQ size up to the end of the hole. Bentonite clay and other additives were used to minimise wall-collapse and caving. Due to these measures the hole could be drilled up to 320m. However, despite using triple-tube core barrels, with

bottom-discharge bits, from 30m downwards, the average core recovery up to the lower limit of oxidation - 110m was only about 30%. However, after crossing the clay zone from 110 to 132m, the recovery improved to 60-70%. Wherever the core recovery was poor, sludge was also collected.

UDH-1 intersected a zone of highly altered shale, which is strongly brecciated /fractured, silicified, with clay alteration and extensive iron (hematite) enrichment.

The summarised log, with mineralised zones intersected is given below, while the detailed drill-log, with assays is given at Annexure-III.

DRILL LOG SUMMARY

PERCUSSION HOLE URC-1

COORDINATES: 27 45 00 : 75 31 16

INCLINATION: - 60 :

AZIMUTH: 330

TOTAL DEPTH: 465Ft (141.80 metres)

LOGGED BY: Pranjal Bhatnagar, Bharat Dave, Prashant Laharia

CONTRACTOR: PASHUPATI NATH TUBEWELLS

DEPTH (Feet)			LITHOLOGY
From	To	Interval	
0	10	10	Overburden
10	300	290	Altered Silicified Shale with ferruginous (hematite) coating and few thin quartz veins.
300	360	60	Clay Zone in silicified shale; with few quartz veins.
360	465 EOH	105	Silicified Shale with minor pyrite, malachite and trace chalcopyrite.

MINERALISED ZONE:

117.35 m to 141.80 m = 24.45 m @ 0.13% Cu,

including 6.10 m @ 0.25 % Cu.

REMARKS:

Due to the extremely fractured formation, bentonite was used with drilling fluid and casing lowered progressively. However, due to hole collapse at 465ft (141.80m), the hole was abandoned.

DRILL LOG SUMMARY

PERCUSSION HOLE URC-2

COORDINATES: 27 44 57 : 75 31 13

INCLINATION: - 60 :

AZIMUTH: 325

TOTAL DEPTH: 270Ft (82.30 metres)

LOGGED BY: Pranjal Bhatnagar, Bharat Dave, Prashant Laharia

CONTRACTOR: PASHUPATI NATH TUBEWELLS

DEPTH (Feet)			LITHOLOGY
From	To	Interval	
0	30	30	Overburden
30	270 EOH	240	Altered Silicified Shale with clay and iron (hematite) alteration and few thin quartz veins.

REMARKS:

Due to the extremely fractured formation, bentonite was used with drilling fluid and casing lowered progressively. However, due to hole collapse at 270 ft (82.30 m), the hole was abandoned.

DRILL LOG SUMMARY

DIAMOND HOLE UDH-01

PROPERTY: UDAIPURWATI R P
 HOLE NO: UDH-01
 COORDINATES: 75° 31' 59.5", 27° 44' 59.5"
 INCLINATION: -60°
 AZIMUTH: 330°
 TOTAL DEPTH: 320m
 CASING: 3.00m
 LOGGED BY: Pranjal Bhatnagar, Bharat Dave, Prashant Laharia
 CORE SIZE: PX/HX/HQTT/NQTT
 CONTRACTOR: MINING ASSOCIATES

DEPTH (Metre)			LITHOLOGY
From m	To	Interval	
0.00	26.50	26.50	Weathered grey shale
26.50	110.00	83.5	Silicified grey shale, lightly fractured, strongly ferruginous (hematite) alteration and same clay alteration. Lower limit of oxidation is 110.10m
110.00	132.00	22.00	Clay alteration zone; white to off-white clay with small quartz pieces/veins; clay is most likely along a fault zone.
132.00	155.00	23.00	Silicified grey shale, fractured and quartz veins; with minor pyrite (<1.0 %) and rare chalcopyrite; chalcocite (?) from 138.40 to 154.70.
155.00	177.00	22.00	Black (carbonaceous), silicified shale –fractured with clay alteration and pyrite 1-2 % and trace chalcopyrite disseminations along fractures.
177.00	320.00 EOH	143.00	Silicified grey shale with black shale bands, minor clay alteration; <1.0 % pyrite from 223 to 233m; from 242 to 252 m more of black shale with 1.0-2.0 % pyrite; lesser (<0.5 %) pyrite from 267 to 276 m; from 276 to 281 m more of a black shale with 2-3 % pyrite and trace chalcopyrite; pyrite content decreases from 302m.

SUMMARY:

Lithology:

The borehole UDH-01 intersected a wide zone of highly altered shale, which is strongly fractured/ brecciated, silicified, with clay alteration and extensive iron(hematite) enrichment.

Mineralisation:

Although sulphides-mainly as pyrite-are present over an appreciable width, only minor copper mineralisation was intersected: traces of chalcocite, as fracture filling from 138 to 154 metre; rare to trace chalcopyrite with pyrite along thin silicified /quartz veins.

The following three weak mineralised zones were intersected:

1. 139.20 to 171.05 m. = 31.85m. @ 0.1 % Cu, including 5.90m. @ 0.23% Cu (core recovery 44%)
2. 205.15 to 209.20 m. = 4.05m @ 0.12 % Cu (core recovery 68%)
3. 278.00 to 302.65 m. = 24.65m. @ 0.15 % Cu, including 4.10m. @ 0.30% Cu (core recovery 72%)

CONCLUSIONS

The Udaipurwati RP area is transected by and bounded to the NW by one of the most prominent structural corridors in the Aravalli ranges - the South Khetri Fault Zone. This fault zone strikes NE-SW and is characterized by a broad corridor of open space filling textured quartz veins, silica-hematite/goethite cemented hydrothermal breccias and vein arrays, and discrete slip planes. Based on field evidence this fault is interpreted to be an oblique slip fault with a component of right lateral and normal displacement.

This major fault, along with the sub-parallel faults are marked by extensive development of epithermal-style quartz veins which locally contain copper mineralisation, most notably at Satkui. However, as the mineralisation is localised along a narrow shear zone, the Satkui prospect has only limited size potential.

Detailed reconnaissance and geological mapping in the Girawari area/Udaipurwati prospect, where a few copper old workings are located, shows that there is a convergence of 2-3 faults in this area. The faults bound a fairly thick sequence of siltstone which has been pervasively hydrothermally brecciated, silica cemented and with extensive iron (hematite) enrichment. Drilling intersected a zone of > 150m of this highly altered siltstone, which however, has only weak copper mineralisation.

It was concluded that the Udaipurwati RP area may host other small copper deposits like Satkui (2- 4 million tonnes of around 1% Cu) but does not appear to have the potential of hosting large deposits of + 1% Cu.