

Application of Geochemical Technique in Exploration and Evaluation of Copper, Lead and Zinc Resources of Nepal.

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Abstract

Application of Geochemical technique in mineral exploration was used in Nepal during 1975-1985 by the Mineral Exploration Development Board (MEDB). Systematic drainage reconnaissance over 40,000 km² area resulted in the recognition of a large number of anomalies several of which are related to previously unknown mineralizations. The anomalies were categorized into 1 to 4 assessed on the basis of magnitude, homogeneity, area and potential hostrock. All anomalies of category 1 and 2 that were investigated by follow-up stream sediment and soil geochemistry of varying stages were finally found to disclose the mineralized sources. In all cases, detailed grid soil sampling results in conjunction with geologic observations enabled to ascertain the location, extent and continuity of sub-outcropping bedrock source with considerable precision, but it was not possible to make reliable estimate of grade.

It has been attempted to evaluate the base metal resource based on the data available of the MEDB work as well as Department of Mines and Geology (DMG) and others. Although no economic deposits have been discovered except Ganesh Himal Zinc Lead, about 20 base metal prospects have been drilled and tonnage and grade proved and estimated. Of these, Kalitar Copper and Wapsa Copper deposits are considered to be of marginal economic grade, while the rest are inventoried as deposits of subeconomic to non-economic grade.

Introduction

Geochemical exploration technique has been considered as a powerful tool in exploration of mineral deposits. It is rapid, efficient and cost-effective. It involves systematic sampling, chemical analysis and logical interpretation of stream sediment, soil and rock to detect abnormal concentration (i.e. anomalous) of trace elements related to the mineralization.

The cost effectiveness of an exploration geochemical programme depends on careful and systematic planning from conception of the programme through to fruition. Geochemical exploration consists

of 3 major phases: (i) Regional (broad-scale) geochemical mapping to eliminate ground of low mineral potential (ii) Geochemical drainage reconnaissance to locate anomalous concentrations of elements possibly indicative of mineralization, and (iii) Follow-up drainage sediment and soil sampling (progressively more detailed) to define the location of mineralized bedrock source, which is the prime target of economic geological studies including drilling.

In the present paper, focus has been laid on mineral exploration for copper, lead and zinc utilizing geochemical technique combined with geological mapping undertaken by MEDB during 1975-1985. It

has also been attempted to assess the base metal resources of the country based on the existing data accumulated largely by the work of MEDB and DMG.

General Environment

The area in general is strongly dissected with high relief. Elevations vary from less than 300 m to over 4,500 m. On average, slopes are 35°, commonly being terraced when less than 40° and rarely terraced when they exceed 50°. The drainage pattern is commonly dendritic and is strongly affected by geologic structure; major rivers generally following strike, shear/thrust zones and major transverse faults. The drainage density is about 2.5 km/km².

Despite the steep slopes, oxidation and weathering is deep often continuing to depths of more than 100m. Soils are generally skeletal with no discernible horizon development. The climate is monsoonal.

Regional Geologic Setting

The area covered by geochemical reconnaissance survey lies in between the gently dipping schuppen thrust zone separating the Central Crystallines (mainly gneisses) from the Lesser Himalayas in the north and steeply dipping Main Boundary Thrust (MBT) bounding the Siwaliks to the south. Within this zone, the rocks have been divided into two complexes; the less metamorphosed Nawakot Complex and relatively higher grade metamorphic Kathmandu Complex (Stocklin & Bhattarai, 1978). These are separated by a steeply dipping Mahabharat Thrust. In general, the arenaceous rocks tend to be impure and the argillaceous often gritty. Particularly in the north and the east, granitic gneisses, augen gneisses and migmatites are common and interlayer along strike with metasedimentary rocks. Basic rocks mainly metagabbros and amphibolites are intruded into the Nawakots concordantly particularly near the thrusts. Two-mica Ordovician granites are confined to the Kathmandu Complex.

Geochemical Procedures

Regional geochemical mapping

In order to define broad zones of elevated background within which mineralization (thus warranting reconnaissance scale mapping), stream sediments were collected from all streams along widely spaced traverses crossing various lithological units and major structural features as far as possible. Results were presented as rolling means of 4 unit module (MEDB/UN Report I) to smooth erratic variation and the resulting averages were grouped as shown in fig 1. No significant reconnaissance anomalies were located in the low mineral potential areas of the simulated regional geochemical maps and all priority (for further work) reconnaissance anomalies were in the high mineral potential areas.

Reconnaissance stream sediment geochemistry

Geochemical reconnaissance drainage sediment sampling at a density of 1-2 samples/km² covered about 40,000km² of the Lesser Himalayan zone of the country. The reconnaissance data have revealed a large number of anomalies (717) throughout the area several of which are related to previously known old workings and occurrences while many have revealed the presence of previously unknown mineralization. All geochemical anomalies of category 1-2 that were followed up by more detailed investigations have disclosed the presence of mineralization. The base metal reconnaissance anomaly map (MEDB Phase-1) with discovered mineralizations is presented in figure 6.

The magnitude and areal extent of many of the anomalies appear to be related to the existence of broad zones of mineralization, which may contain much metal but are too widely distributed to represent an ore body. However, the reconnaissance composite anomalies distinctly depict the distribution pattern of the mineralizations in the region investigated.

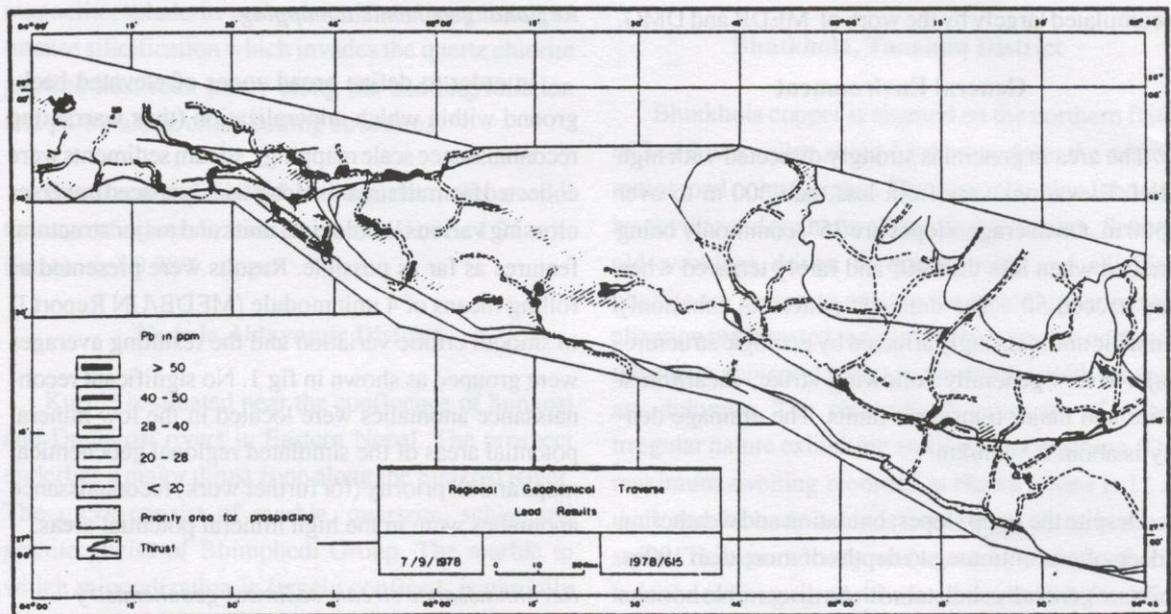


Fig. 1. Regional stream sediment geochemical results of lead.

Follow-up stream sediment and soil geochemistry

All reconnaissance anomalies were assessed and categorized for priority investigation on the basis of (i) magnitude (ii) homogeneity (iii) potential area of mineralization making allowance for (a) rock type, (b) erosional features and (c) contamination sources. Of the 717 reconnaissance anomalies, 169 anomalies were investigated by follow-up drainage sampling (PFU), 85 by ridge and spur soil geochemistry and 46 by detailed follow-up rectilinear soil grid (DFU). Thirty anomalies that proved most promising were subsequently investigated by economic geology/trenching and geophysical methods. In all cases, the rectilinear grids enabled the extent, continuity and location of the suboutcropping bedrock source to be determined with considerable precision. Those prospects that indicated mineralization of probable economic potential were finally tested by drilling to determine downdip continuity, grade and tonnage. Thus, 8 prospects were drilled and tonnage and grade were ascertained. For

example, the results of one of the drilled prospect Khairang has been presented in fig. 2,3,4&5 depicting geochemical anomalies at successive stages of exploration.

Evaluation of Copper, Lead and Zinc Resources

Copper, lead and zinc mineralization in Nepal shows a fairly wide distribution both geographically and with regard to host rock lithology. Considering 8 prospects drilled by the MEDB, Kalitar, Kurule and Khairang lie within the Kathmandu Complex, while Devrali, Wapsa, Dhusa, Pangum lie in the Nawakot Complex. Similarly, all prospects drilled by the DMG and GSI occur in low-grade metasediments of Nawakot Complex. Ganesh Himal Zn-Pb is confined to the tectonized zone of probably Central Crystalline. In total 28 prospects of copper and 11 prospects of lead and zinc throughout the country had been investigated up to economic geology study stage integrated with detailed soil geochemistry and geophysics. Of these,

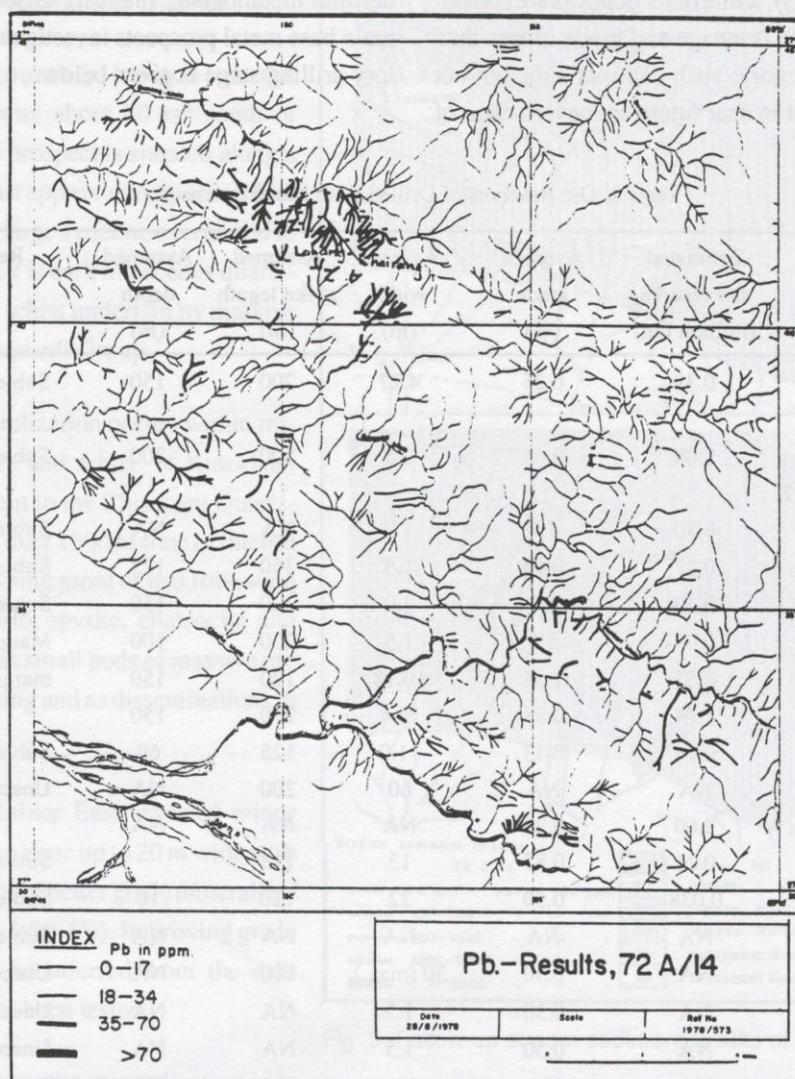


Fig. 2. Reconnaissance drainage results of lead, topo sheet 72A/14.

only those that were assumed to be most promising were tested by drilling to determine the possible extension, tonnage and grade.

Thus, during base metal exploration programme of the country since early sixties, exploratory drilling was carried out at 7 prospects by the DMG, at 8 prospects by MEDB, at 4 prospects by GSI under Technical Cooperation programme and at 1 prospect by private Indian company. The list of drilled prospects with

estimated tonnage and grade is given in table 1 (Jawali et al., 1992). Out of these prospects, Ganesh Himal Zinc-Lead of Rasuwa district is an economic deposit which is under development and implementation by Nepal Metal Co. Ltd. to mine and mill 400 tons of ore per day (UNDP 1992). Two deposits namely Kalitar copper and Wapsa copper are near economic or marginal economic (these deposits would not be economic to mine at present time, but may be economic in future with changing technology, costs, prices and govt. poli-

cies (Shrestha, 1981)), while other deposits are considered as subeconomic (tonnage and grade of less than marginal-grade category; such deposits although not of economic interest in near future are nevertheless of

definite metallogenic interest). Brief descriptions of main base metal prospects investigated up to exploratory drilling stage is given below.

Table 1. Ore Reserves of Drilled Base Metal Prospects.

Drilled Prospect	Estimated ore reserve (million ton)	Average grade (%)	Average width (m)	Assumed strike length (m)	Assumed depth (m)	Remarks
Devrali Cu	0.38	0.25	4.27	200	150	Sub-economic
UNDDH-22&28						
Dhusa Cu	1.08	0.65	3.5	500	200	Sub-economic
UNDDH-15,16, & 17.						
Kurule Cu	0.30	1.0	1.0	NA	NA	Sub-economic
Kalitar West Cu	0.27	0.50	1.5	350	175	Sub-economic
Kalitar East Cu	0.40	1.0	3.0	300	150	Sub-economic
	0.09	1.5	1.5	200	100	Marginal-economic
Wapsa Cu	0.55	1.54	10.18	120	150	marginal-economic
	1.74	0.88	14.4	270	150	
Bamangaoin Cu-W	0.16	0.43	11.0	125	60	Sub-economic
Kandebas Pb-Zn	NA	NA	60	200	NA	Uneconomic
Bhutkhola Cu	2.60	0.24	NA	NA	NA	
Nadra Block	0.21	0.87	13	118		Sub-economic
Pandav Khani Cu	0.038	0.50	22	120	10	Sub-economic
Okharbot Cu	NA	NA	NA	NA	NA	Sub-economic
Chhirling Khola Cu	NA	0.50	30 (max.)	100	NA	Uneconomic
Bhorle Cu	NA	0.30	1.5	NA	NA	Uneconomic
Ningre Cu	NA	0.50	1.5	NA	NA	Uneconomic
Rukumkhani Cu	NA	NA	NA	NA	NA	Sub-economic
Khairang Pb-Zn	2.0	4.0	1.60	900	450	Sub-economic
-Labang	0.2	6.0	0.75	400	200	Sub-economic
Pangum Zn	0.16	0.79	5.99	50	175	Uneconomic
Siddikhani	NA	NA	NA	NA	NA	Drilling unsuccessful uneconomic
Ganesh Himal Zn-Pb	0.698	15.88	NA	NA	NA	Economic
Phulchoki Pb-Zn	0.11	3.37	1.0	3.00	NA	Sub-economic
Damar Pb-Zn	NA	NA	NA	NA	NA	Drilling unsuccessful.

* NA- Data not available.

Kalitar, Makwanpur District

This is favourably located on the Tribhuvan Highway about 80 km south of Kathmandu. The prospect is situated along a shear fault or thrust approximately coincident with the axis of a large syncline overturned to the south. Bedrock is dark micaceous quartzite and two-mica schist underlain by massive quartzite of Bhimphedi Group.

Copper mineralization occurs within micaceous quartzites and schist of Kulekhani Formation adjacent to the Chisapani Quartzite. It is related to over 1300 m zone of intense shearing and crushing more or less following the bedding. Chalcopyrite, chalcocite and magnetite occur as small pods of massive ore of up to 1 meter long and as disseminations in weathered rocks.

Drilling at Kalitar East revealed minor mineralization in a zone up to 20 m wide with limited (2m) zones of better grade mineralization (average 1.0-1.5% Cu). Improving grade across fault can be inferred from the drill results but has not been tested.

At Kalitar West, the mineralization is in arenaceous rocks which have been strongly altered and bleached to considerable depth. Drilling intersected only the mineralization in the oxidation zone, but all the evidence would indicate that it is similar to, but of little lower grade than, that in the argillaceous rocks in Kalitar East.

Based on the drilling results in conjunction with geochemical and geophysical data, copper resource of 1.39 million tons of 0.5% Cu with 90,000 tons of 1.5% Cu has been estimated at Kalitar (Shrestha, 1981).

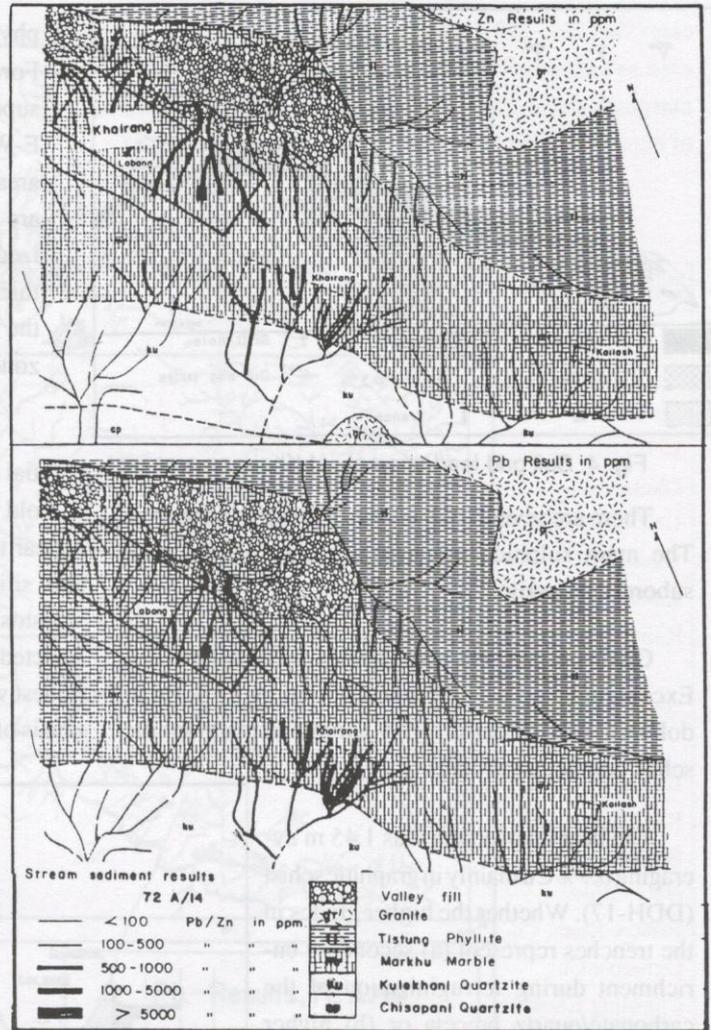


Fig. 3. Follow-up stream sediment results of Labang-Khairang.

Dhusa, Dhading District

The prospect is located about 5 km south of Charaundi, a place on Kathmandu-Pokhara Highway in central Nepal.

The area lies on the northern limb of a major syncline and is immediately north of the thrust separating the Kathmandu and Nawakot Complexes. The rocks present are units of upper Nawakot Group represented by calcareous phyllite, dolomite, graphitic slates and quartzites with inter-fingering meta-dabase bands.

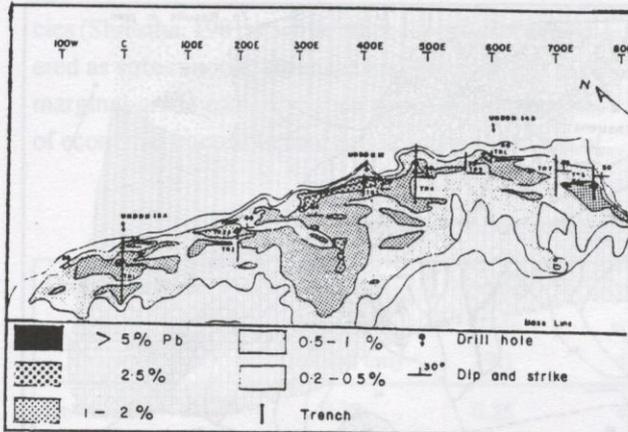


Fig. 4. Soil grid lead anomaly of Khairang prospect.

There are several old workings present in the area. The main sulphide minerals are chalcopyrite with subordinate pyrite.

Grades in the drill holes hardly exceeded 1% Cu. Exception is in DDH-15 where 19 cm of 1.4% Cu in dolomite and 18 cm of 1.3% Cu at breccia/graphitic schist contact was found.

The best intersection was 1.45 m averaging 0.9% Cu mainly in graphitic schist (DDH-17). Whether the higher grades in the trenches represent (a) secondary enrichment during ferruginization of the carbonate/quartz breccia or (b) higher grade primary mineralization along a flexure controlled "ore" shoot is not determinable. However, detailed investigation of Dhusa copper prospect has indicated a total resource of 1.1 million tons of 0.65% Cu in a 4.5 m wide and 500 m long zone.

Wapsa, Solukhumbu District

Wapsa Khani (mine) is situated on a spur between the Rue and Gue Kholas on the left flank of the Dudh Koshi River. The area is underlain by quartz chlorite

phyllites and chloritic quartzites of the Kuncha Formation. A domal structure formed by the superposition of a N-S anticline upon an important E-W anticlinal structure is present. In the mine area only chlorite schists or phyllites appear; these are locally strongly silicified and in part mineralized. The zone of silicification about 25 m to 30 m thick is apparently concordant with the foliation of the schists and probably represents a strike-fault zone.

Numerous old workings as well as a substantial number of trials exist in the Wapsa area. Most old workings are oriented approximately N-S and appear to have followed richer shoots on mineralized and silicified planes either conformable with the schistosity or at a smaller angles to it. On the basis of selected channel sample Adit no. 6 is found to be the richest with average grade of 6% Cu. The mineralization is of pyrite/chalcopyrite type: lenses, pods, string-

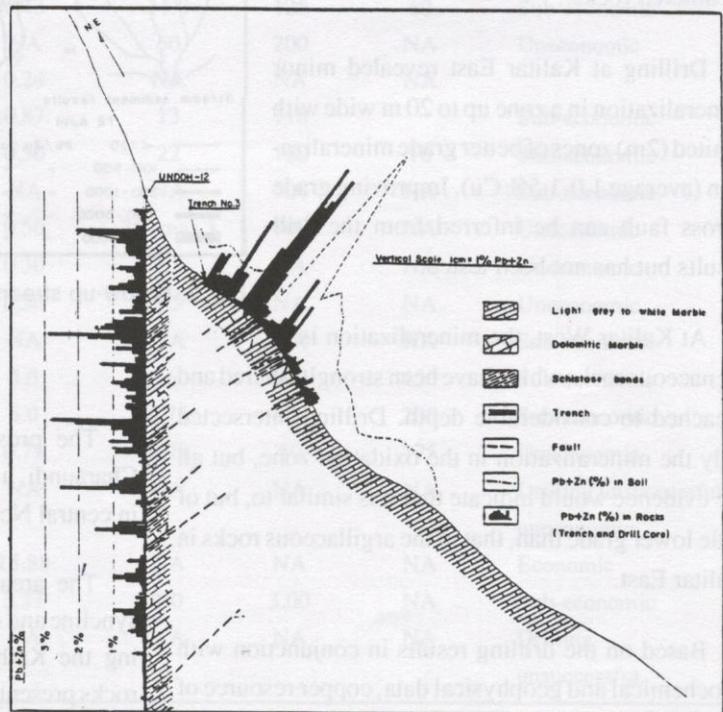


Fig. 5. Lead and Zinc results of soil, rock-channel and drill-core, Khairang Pb-Zn prospect.

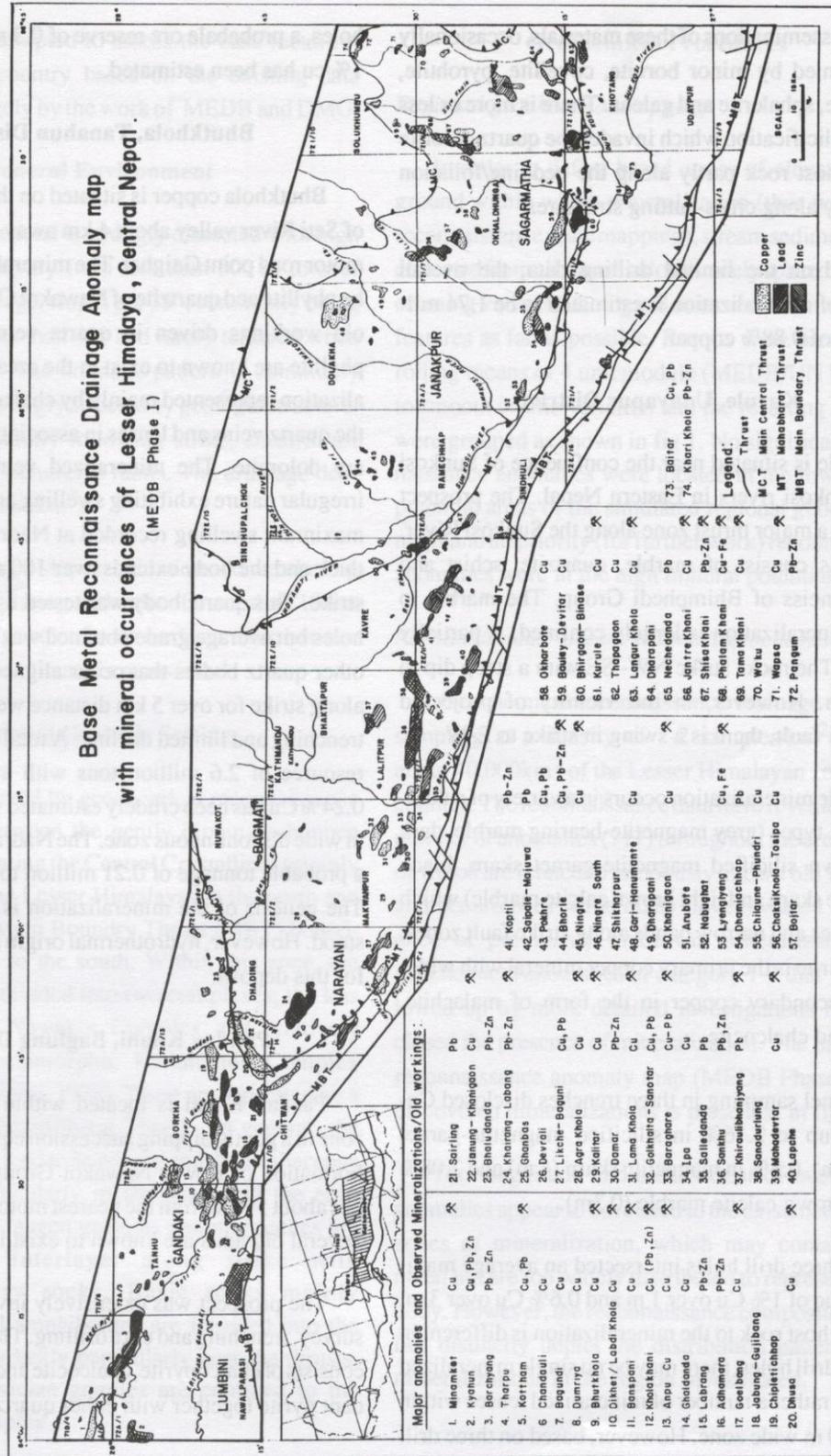


Fig. 6. Base metal reconnaissance drainage anomaly map with observed mineralizations.

ers and disseminations of these materials, occasionally accompanied by minor bornite, covellite, pyrothite, magnetite, sphalerite and galena. There is more or less intense silicification which invades the quartz chlorite phyllite host rock partly along the bedding/foliation and partly along cross-cutting structures.

Based on the limited drilling data, the overall tonnage of mineralization is estimated to be 1.74 million tons of 0.88% copper.

Kurule, Udayapur District

Kurule is situated near the confluence of Sunkosi and Dudhkosi rivers in Eastern Nepal. The prospect underlies a major thrust zone along the Sunkosi River. The rocks consist of marble, quartzite, schist and granite gneiss of Bhimphedi Group. The marble to which mineralization is largely confined, is partially skarned. The rocks strike NW-SE with a steep dip to the south. However, in the vicinity of projected Dudhkosi fault, there is a swing in strike to E-W.

Kurule mineralization occurs in a variety of calcareous rock types (grey magnetite-bearing marble, dark grey-brown silicified magnetite-garnet skarn, black magnetite skarn and light brown calcite marble) which form lenses and narrow bands along strike fault zones. Chalcopyrite is the primary copper mineral with widespread secondary copper in the form of malachite, azurite and chalcocite.

Channel sampling in three trenches disclosed Cu-contents up to 2.16% in silicified magnetite-garnet skarn (1 m), 0.5% in magnetite skarn (4 m) and 2.08% in light brown calcite marble (0.3m).

The three drill holes intersected an average maximum value of 1% Cu over 1 m and 0.6% Cu over 3 m. Since the host rock to the mineralization is different in the three drill holes, there may be no single mineralized zone, but rather a number of mineralized lenses within a 30 to 50 m wide zone. However, based on three drill

holes, a probable ore reserve of 0.3 million tons with 1% Cu has been estimated.

Bhutkhola, Tanahun District

Bhutkhola copper is situated on the northern flank of Seti River valley about 4 km away from the nearest motor road point Gaighat. The mineralization is hosted by phyllite and quartzite of Nawakot Complex. Several old workings driven in quartz veins and silicified phyllite are known to exist in the area. Copper mineralization represented mainly by chalcopyrite occurs in the quartz veins and lenses in association with secondary dolomite. The mineralized veins are of rather irregular nature exhibiting swelling and pinching. The maximum swelling recorded at Nadra Khani is 12 m thick and the body extends over 100 m along bedrock strike. This quartz body was tested by a series of drill holes but average grade obtained was 0.45% Cu. Nine other quartz bodies that occur aligned approximately along strike for over 5 km distance were also tested by trenching and limited drilling. A total probable copper resource of 2.6 million tons with average grade of 0.24% Cu has been crudely estimated within this 10-20 m wide discontinuous zone. The Nadra block indicated a probable tonnage of 0.21 million tons of 0.87% Cu. The genesis of the mineralization is not well understood. However, hydrothermal origin is more probable for this deposit.

Pandav Khani, Baglung District

Pandav Khani is located within a NW-trending zone in a gently dipping succession equated to Nourpul Formation of Lower Nawakot Group. This prospect lies about 50 km from the nearest motor road point Riri. Several old adits are known to exist in the area.

The prospect was extensively investigated by IP-survey, trenching and core drilling. The mineralization consists of chalcopyrite, chalcocite and relatively abundant pyrite together with either quartz or calcite veins

and is associated with beds of hematite which are clearly sedimentary. The sulphide and associated vein material are evidently epigenetic with respect to the hematite beds, and it is suggested that mineralization took place as a result of mobilization and concentration of trace metals present in the hematite bands or interbedded phyllites. There is no apparent relationship between mineralization and a NE-dipping thrust north-east of the mineralized zone.

The sulphide mineralization is distributed in the entire prospect area and beyond without high concentration ore body. The mineralized body tested by drilling at Bhangkhani-Kalkhani area is lenticular in shape and has a strike extension of 120 m with width 22 m and depth 10m. The probable reserve of ore is estimated to be 38,685 metric tons with average grade of 0.5% Cu.

Bamangaon Copper Prospect, Dadeldhura District

It is located about 15 km east of Dadeldhura in Far Western Nepal. Chalcopyrite, scheelite-iron sulphide with some molybdenum and tin occur in the greenish siliceous phyllite and phyllitic quartzite lying at the exocontact of Dadeldhura granite of Ordovician age. Copper-tungsten mineralization in Bamangaon is epigenetic, mesothermal to hypothermal with replacement veins and disseminations. Detail prospecting traced a 2.5m to 71m thick and about 800m long chalcopyrite-scheelite-iron sulphide band with a maximum of 1.72% Cu and 2000 ppm W in channel samples. On the basis of surface exploration, the total possible reserve is estimated as 1.54 million tons with 0.24% Cu.

Three test drill holes in the central part (within a 210 m distance) confirmed sulphide mineralization up to a depth of 91m. However, there was no significant increase in the amount of chalcopyrite and tungsten except in few mm thick veinlets. The core samples obtained from different depths revealed upto 0.9% Cu,

2200 ppm W, 600 ppm Bi, 200ppm Mo, 19.6 ppm Ag, 0.8 ppm Au and 2.4% As. These data indicate that it is a small sized sub-economic copper-tungsten deposit.

Devrali, Makawanpur District

The prospect is situated in the upper Nawakot Group within the highly compressed Mahabharat zone about 1 km south of the Mahabharat Thrust.

Mineralization is in the form of chalcopyrite and its alteration products chalcocite and malachite. The mineralization is often associated with ferruginous gossany rocks and conspicuous silicification gave well defined surface geochemical and geophysical anomalies which were investigated by trenching and final drilling. Channel samples yielded 0.1 to 0.6% Cu. Two drill holes in conjunction with trench results indicated ore reserve of 0.38 million tons of 0.25% Cu. (UNDP Report, Phase II).

Baisekhani/Okharbot, Myagdi District

As the name "Baisekhani" implies twenty two mines, the area was once an active district for copper mining in the last century. The Baisekhani encompasses widely distributed old workings and mineralizations that exist in Baglung, Myagdi and partly Gulmi districts of Central-West Nepal.

The host rocks are chlorite-sericite phyllite, quartzitic phyllite, and dark slaty phyllite, probably equivalent of Dandagaon Phyllites of Lower Nawakot Group. Copper mineralization is associated with quartz veins and lenses of variable sizes (generally a few cm to one metre in width and less than a metre to a few tens of metre long). At some places, quartz lenses are associated with carbonate rocks containing chalcopyrite and pyrite.

Among numerous old workings and mineralized bodies existing in the area, follow-up investigation was

carried out in Bhairbunga, Khumkhani, Bungakhani, Malkabang and Machhimkhani. In all cases except at Okharbot, the surface grade of mineralization has been found too low to be significant for commercial exploitation. Okharbot is the only occurrence that was being mined selectively a few years ago on a very small scale producing a few thousand kilograms of metal per year. The narrow adits have reached up to 150 m inside along dip plane, mostly towards dip direction of the mineralized quartz vein. The mining was apparently concentrated on the high grade ore shoots associated with most intense silicification. Drilling was only partly successful in intersecting the ore bodies. The grade of mineralization obtained was too low to justify further exploration at Okharbot.

Ganesh Himal Zinc-Lead Deposit, Rasuwa District

The Ganesh Himal zinc-lead deposit lies at an elevation of 4450 m on the southerly slope of a ridge of Ganesh Himal Range, about 58 km NNW of Kathmandu.

The rocks in the region consists of thick succession of alternating schists, quartzites and carbonates of the Central Crystallines of Precambrian age. The mineralization occurs in the topmost calcareous unit (white crystalline saccharoidal dolomite) of a repetitive sequence of quartzite, calc-schist, amphibolite and garnet-quartz-mica schist.

The Ganesh Himal Zn-Pb deposit is confined to the limb of an overturned isoclinal syncline plunging about 40° north easterly. The host rock consists of sugary textured dolomite.

Out of the several ore occurrences in an area of about 4 sq. km the Lari area was explored in detail. At least three zones of mineralizations have been identified. The one at the southern contact has been consistently followed down from 4520 m to 4130 m altitude.

The reserve now stands at 698,000 tons at a grade of 13.57% zinc and 2.31% lead in the measured and indicated categories (proven and probable). An additional tonnage of 154,000 tons at a grade of 12.08% Zn and 1.41% Pb was also identified as inferred (possible) (UNDP Review panel Report, 1992). Silver content associated with the Zn-Pb ore is around 30 g/t.

The strong stratigraphic control indicates a strata bound syn-sedimentary origin of the deposit. But later mobilization along pressure release areas such as along minor fold axes and faults suggest definite structural control. The deposit is not Mississippi Valley type but probably is a synsedimentary volcanic exhalative deposit which has been remobilized (structure controlled).

Labang-Khairang Lead-Zinc, Dhading District

The prospect is situated on both sides of a high marble ridge; Labang on the northern slope and Khairang to the south-east of Labang, about 50 km west of Kathmandu.

The Labang-Khairang lead-zinc mineralization was discovered as a result of systematic geochemical stream sediment sampling. The prospect is hosted by massive, coarse crystalline marble belonging to the Markhu Formation of Kathmandu Complex. The rocks strike approximately WNW-ESE, dipping 60-40° north. They appear to have been strongly affected by schuppen-like thrust sheets.

Primary mineralization observed in outcrops, trenches and drill holes is in the form of disseminated galena and sphalerite but massive lenses and stringers of galena up to 2 to 3 cm thick were observed in trenches at Khairang. All observed mineralizations are banded along foliation, generally in dolomitic marble. At Labang the highest assay grades did not exceed 1% lead-zinc over 0.5 m true thickness for over a few hundred metres. Trench and drill hole data at Khairang

confirmed the continuity of the mineralization along strike and down dip. Drilling at Khairang has demonstrated an existence of 0.2 million tons of average 6% lead plus zinc and 2 million tons of 4% lead and zinc combined.

Pangum Zinc-Lead, Solukhumbu District

Pangum Zinc-Lead prospect is located approximately 100 km east from Kathmandu. The mineralization is confined to the carbonate unit, mostly within tremolitic marble underlying black carbonaceous schist and overlying garnet-mica schist. Mineralization consists of sphalerite, galena and minor chalcopyrite and pyrite in thin stringers parallel to the lithological layering. Limited channel sampling indicated a maximum value of 3.8% Pb and Zn over 0.9 m thick zone. Five drill holes totalling around 220 m with the maximum grade intersected a zone of over 1 m of 2.0% Zn. Results indicate that the mineralization is weak. Probable ore reserve estimated is 0.16 million tons with 0.79% Zn and Pb. Exploration was discontinued due to extremely poor grade of mineralization.

Discussion and Conclusion

The mineral exploration carried out in a part of the Lesser Himalaya of Nepal has demonstrated that geochemical drainage reconnaissance method in combination with geologic knowledge has been quite effective and efficient for locating discrete mineralized areas. The mineralized bodies have produced fairly long geochemical dispersion trains (in particular of copper 2-3 km, Jnawali, 1981) in the sediments downstream. Almost all anomalies of category 1 and 2 upon follow-up investigation disclosed the bedrock sources. In the Higher Himalaya, drainage sampling has been found to be of rather limited use. This is probably due to the fact that there is apparently little secondary dispersion of the metal being inhibited by high gradient of the drainages, lack of fine sediments to adsorb the mobile ions and perhaps too much dilution caused by

melting snow. Geochemical soil sampling in conjunction with outcrop mapping has enabled mineralized bedrock sources to be defined rapidly with reasonable accuracy despite some difficulty faced due to downslope distortion of the anomalies. Trenching and channel sampling over strong soil anomalies has been useful in determining the approximate thickness of mineralized zones, although it has not been possible to make precise estimate of subsurface grade (Tooms & Shrestha, 1981). Out of 20 prospects that reached the drilling stage through successive stages of exploration, only Ganesh Himal Zn-Pb is an economic deposit, 2 prospects namely Kalitar and Wapsa are considered to be of marginal economic grade while the rest are inventoried as deposits of subeconomic to non-economic grade. In an infrastructurally favourable situation marginal economic deposits could possibly be considered for exploitation to mine selectively on small scale.

Although no economic deposits were located within the project area, the methodology has been proved to be quite successful in delineating the mineralized areas and hence assessing the mineral potential of the country.

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