Journal of Nepal Geological Society
Vol. 2, *No.* 1., 1982. 38–45

ZINC-LEAD MINERALISATION IN GANESH HIMAL REGION OF CENTRAL NEPAL

C. K. CHAKRABARTI

Nepal Metal Co. Ltd., Thapathali, P. O. Box 468, *Kathmandu*

सारांश

गणेश हिमाल शृङ्खलाको दक्षिणी भागमा मुख्य मध्यवर्ति प्रघात नजिकै अवस्थित उच्च स्तरको शिसा जस्ता घाउ पिण्ड बाट निकट भविष्यमै नेपाल मेटल कम्पनी द्वारा खनिज उत्पादन सुरू हुँदैछ। प्रस्तुत लेखमा उक्त खानीको क्षेत्रिय भौगर्भिक वनावट तथा खनिज धनीभूतकामा नियन्त्रण (Control of mineralisation) गर्ने विभिन्न तथ्य वारे संक्षेपमा वर्णन गरिएको छ।

ABSTRACT

High grade mineralisation of zinc and lead sulphides occur near the Main Central Thrust (MCT) Zone of the Himalaya in the lower regions of Ganesh Himal Range in Nepal. The host rock is crystalline dolomitic limestone showing tremendous flow in a highly folded sequence of garnetiferous mica-schist, quartzites, calcareous schists, and bands of hornblende gneiss. The stratigraphic control and the simple nature of mineralisations suggest a syn-sedimentary genesis.

INTRODUCTION

The zinc-lead mineralisation in the Ganesh Himal region, the only significant base metal mineralisation so far found in Nepal Himalaya, has attracted wide attention. It is recorded that a U. S. Mining Engineer Robert F. Sandford visited the western part of the prospect in 1953 to investigate reported mineralisation and found rich floats. In 1967–68 the prospect was visited in chronological order by C. K. Sharma, R. N. Yadav, Y. L. Singh, Harold Knutson and D. N. Rimal of the then Nepal Bureau of Mines.

The prospect was under active exploration from 1967 till 1973. At present Nepal Metal Company Limited is developing the ore-body into a producing mine.

The centre of the prospect is in the lower regions of the Ganesh Himal range

near its eastern end and located about 58 air km N 13° W of Kathmandu. Six rich mineralisations of zinc-lead sulphides have so far been located between 4,100 and and 4,900 metres above M.S.L. in an area of 10.5 sq. kilometers. The mineralisation is best exposed at Lari, defined by 28° 14 'N latitude and 85° 11 E" longitude. Significant mineralisations also occur around Lari at Suple, Serkaping, Poktanjoo, etc.

REGIONAL GEOLOGICAL SETTING

The region has only recently attracted the attention of geologists and little work has been done to define its precise geological setup. Hagen (1969) has shown this area in his root zone of crystalline Kathmandu Nappes. His Nawakot Nappes, consisting predominantly of sedimentary rocks lies to the south but not very far from the prospect. Arita et al. (1973) find the region in the Main Central Thrust Zone, the wide schuppen zone between the Nawakot metasediments and Ganesh Himal gneisses. According to Remy (pers. comm.), the project area falls in his lower series (A) of Tibetan Series. The geological map of Nepal compiled by Tater et al. (1977) of the Department of Mines & Geology shows the project area in Himal group of probable Pre-cambrian age. However, the geologists of the HMG/UNDP Mineral Exploration Project, who have taken up a serious study of the region suggest that the M. C. T. is further north of the project area which itself is north of the Benighat Thrust.

LITHOLOGY AND SUCCESSION

The lithology of the area comprises a thick succession of alternating schists, quartzites and calcareous rocks of varying degrees of impurity, all showing apparently almandine –amphibolite facies of metamorphism of Fyfe, Turner and Verhoogen (1962). (Fig. 1)

Concordant layers of hornblende gneiss, at places garnetiferous, occur at various horizons below the main bed of crystalline dolomitic limestone in which the mineralisation has been found. These hornblende gneisses probably represent basic igneous rocks which have been intimately folded and metamorphosed with the sedimentary succession to almandine-amphibolite facies. No other evidence of igneous or volcanic activity is available.

A generalised apparent succession of rocks of the mineralised area is given in table 1.

Facies changes are conspicuous in the region. Impure calcareous units predominate towards the lower part. Quartzites of different thicknesses are prevalent throughout the sequence but show a definite increase near the zone of transition. The mine-

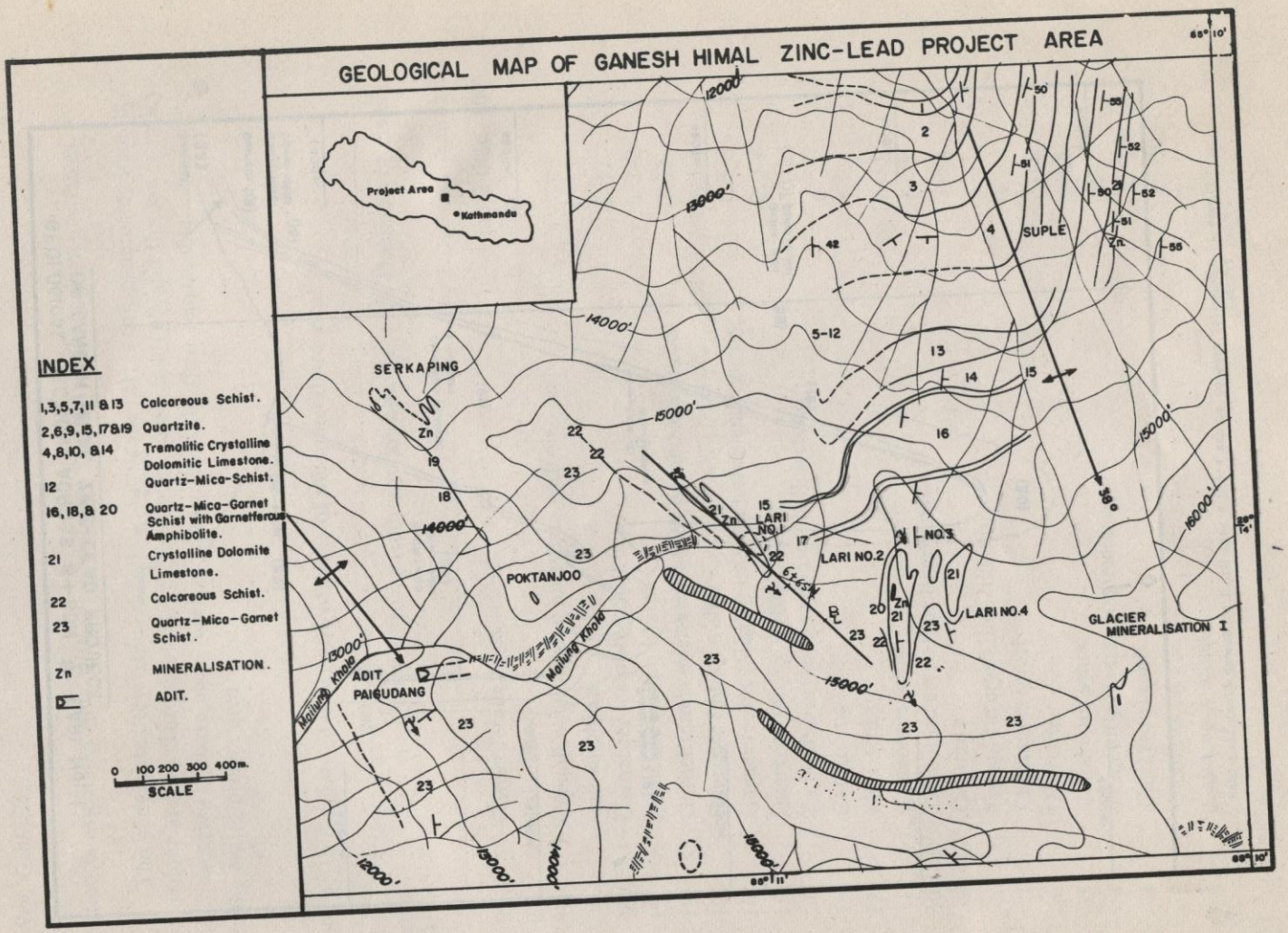

Figure 1: Geological map of Ganesh Himal Zinc-Lead Project area.

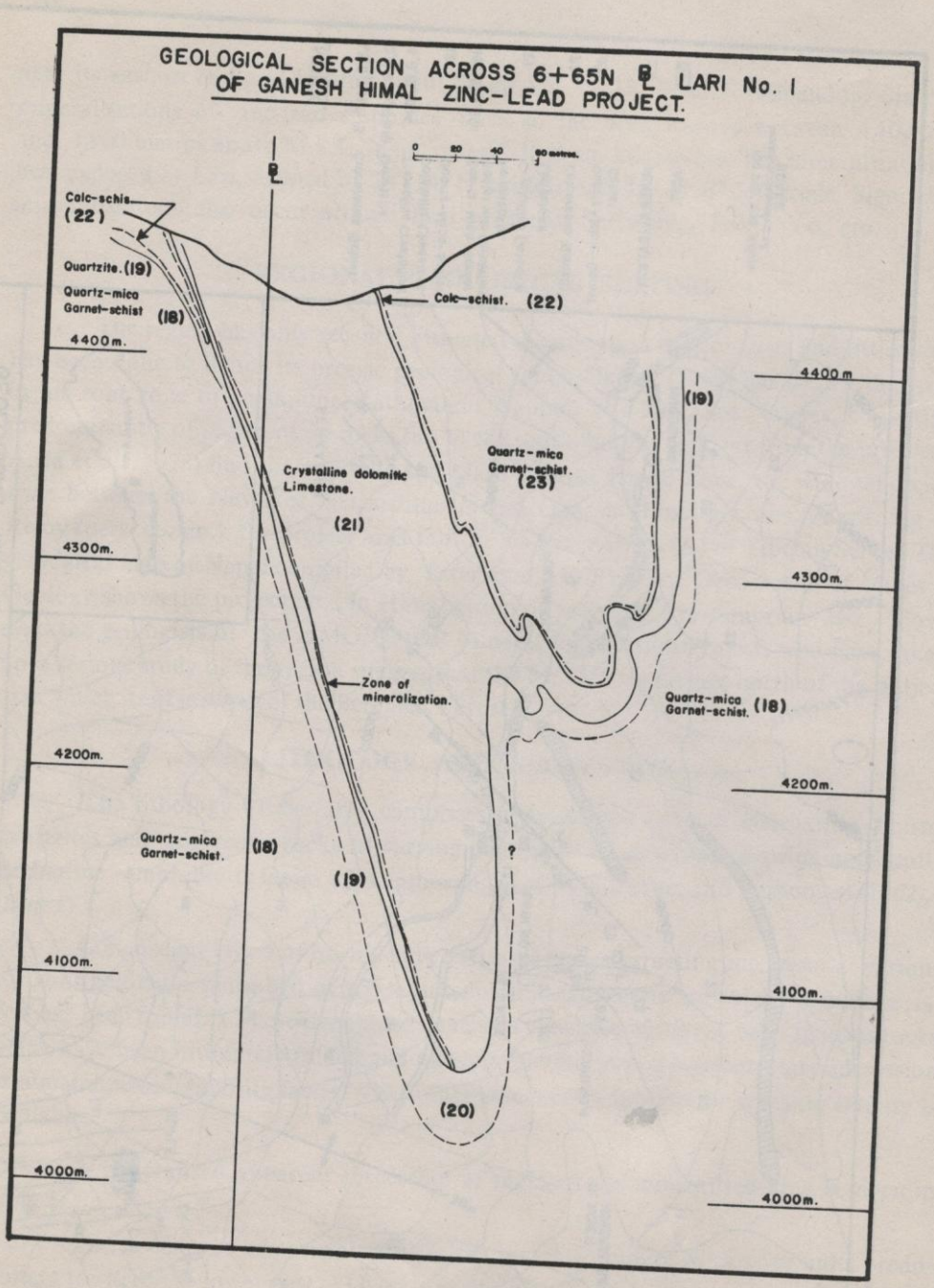

Figure 2: Geological section across 6+65N B Lari No. 1 of Ganesh Himal Zinc-Lead Project.

ralisation is associated only with the uppermost portion of the calcareous facies.

The mineralised crystalline dolomitic limestone (21) is conspicuous by its milky white colour and saccharoidal texture. The upper calc-schist (22) and the lower milky white quartzite (19) have been used as marker beds for their remarkable consistency over the entire project area.

Table 1 A generalised succession of rocks of the mineralised area.

Succession No.	Succession of rocks from top downwards	Thickness in meters
23	Garnetiferous mica schist	more than 300
22	Calc-schist	0–7
21	Crystalline dolomitic limestone with zinc and lead sulphides	0–15
20	Garnetiferous mica-schist	1–17
19	Quartzite (milky white)	0.3–2
18	Garnetiferous mica schist with hornblende gneiss	2–33
17	Quartzite (milky white)	0.3–2
16	Garnetiferous mica schist with hornblende gneiss	0.5–33
15	Quartzite (milky white)	0.5–8
14	Tremolitic crystalline dolomitic limestone	30–86
13	Calcareous schist	6
12	Mica-schist	1
11	Calcareous schist	6–33
10	Tremolitic crystalline limestone	6–25
9	Quartzite	3–33
8	Tremolitic crystalline limestone	5–7
7	Calcareous schist	5
6	Quartzite	3–15
5	Calcareous schist	3–25
4	Tremolitic crystalline limestone	25–67
3	Calcareous schist	33–100
2	Quartzite	15–50
1	Calcareous schist	?

The predominant lithologic unit of the area is garnetiferous mica schist. Biotite is predominant in lower schists (18 downwards) of dark colour. The upper schist (23) occurs extensively (more than a few hundred metres) and contains a few thin bands of quartzite. Around glacier mineralisation, the schist is dirty grey colour. Euhedral, dodecahedron garnet (almandine) of various dimensions is present in all the schists which contain quartz segregations of various dimensions. Within these quartz segregations occur kyanite blades in cluster mainly in the uppermost schist bed. Under the microscope, felspars, epidote, actinolite and hornblende are observed in a highly schistose texture.

The hornblende gneiss is a very hard, dark coloured, medium grained with protruding red garnet crystals, thus having a pock-marked appearance. When garnet is absent it is a dark, black shining rock. It generally occurs as concordant bands of 0.1–2m thick, but bands of 5–6 m thickness are also seen at places.

Pinching and swelling quartzite forms the most spectacular rock-unit of the area because of the surprising continuity of its exposures in such a tightly folded region. In the upper part of the succession it is milky white, yellow stained on surface, medium to fine grained, bedded to massive quartzite composed almost wholly of quartz, and little muscovite and chlorite.

Calc-schist is a dirty white to dirty green, medium to coarse grained rock containing tremolite, actinolite, phlogopite and carbonate.

Milky white to creamy white, medium to fine grained saccharoidal crystalline dolomitic limestone containing sulphide mineralisations of zinc and lead occur as a thick bed at Suple, apparently detached four oval shaped bodies at Lari and thin beds at Serkaping and Poktanjoo. The whole mass of crystalline limestone, especially at Lari, contains traces of zinc-lead sulphides. Veins of magnetite, actinolite and tremolite mostly associated with yellowish green or light coloured sphalerite, occur frequently. Light yellow mica, probably phlogopite is abundant but mostly concentrated in zones. The cross joints appear very closely spaced on the weathered surface. Under the microscope it shows a fine grained granular carbonate and talc with a granoblastic texture.

At Suple and Lari, where the crystalline dolomitic limestone bed is considerably thick, the mineralised zones occur near its bottom, just above grey impure crystalline dolomitic limestone of variable thickness increasing downwards in schistosity followed by a dark grey puckered shining schist, quartz sericite schist and finally garnetiferous mica schist. At Serkaping and Poktanjoo, the limestone bed is very thin, generally less than a half metre.

STRUCTURE

In and around the project area the formations trend NE–SW to almost E–W and dip steeply northwest to almost north. Identical stratigraphic sequence has been recorded from all the occurrences of zinc-lead mineralisation. The uppermost quartzite bed (19) shows surprising continuity in spite of intricate and tight folding and has helped in deciphering the structure of the project area.

At Suple the formations are not disturbed by small folding. Near the mineralisation pucker lineations plunge at 51° due N 30° E.

At Lari, the sequence is highly folded and the crystalline dolomitic limestone (21) is squeezed out from the limbs into the cores to form four lens shaped bodies on plan which appear to have an extensive plunge length. All folds plunge moderately to steeply towards NE to ENE. One of the bodies at Lari has been followed along plunge for a considerable distance by diamond drilling. All the four lens shaped beds of crystalline dolomitic limestone occur in synclines at their northwestern or western ends while the other ends are in anticlines. The present configuration appears due to the extreme flowage. At Serkaping, the sequence is also highly folded, more acutely than at Lari.

But a thick crystalline dolomitic limestone bed (21) is yet to be encountered under the thick talus. Between Serkaping and Poktanjoo the limestone bed (21) and the cale-schist bed occur in traces only but at Poktanjoo they are repeated many times. From Suple to Poktanjoo through Lari and Serkaping, the formations make asymmetrical anticlinorium and synclinorium with Lari at the crest of the anticlinorium and Serkaping at the core of the synclinorium.

The glacier mineralisations show thin mineralised crystalline dolomitic limestone in acutely flow-folded sequence, similar to Lari, but with a marked predominance of hornblende gneiss and actinolite rock and at places tourmaline quartz-carbonate veins. The exact structural relations of glacier mineralisation with Lari mineralisation is not yet clear, however, the glacier mineralisation represents a change in facies.

The quartzites vary from upright folds to fantastic fold forms like an asymmetric overturned fold, at places twisted. Small folds in schists are abundant. Calc-schist (22) shows numerous small flow folds near the anticlinal crests. All the small folds show moderate to steep northeastern plunge. The southernmost syncline at Lari plunges at 43° due N 37° E.

No primary sedimentary structure is discernable in the project area. Many samples of schist and fold forms show two sets of deformations. However, this aspect

of structure has not yet been studied.

The regional metamorphism probably took place at great depth under high confining pressure which limited the acutely folded quartzite beds within their elastico-viscous field. The dolomitic limestone, on the other hand, flowed readily into the axial portions of the folds and probably also contribute to the distortion of folds.

MINERALISATION

The zinc mineralisation as mainly sphalerite, is dispersed in the carbonate phase (dolomitic) of host rock containing minor calcite, biotite and talc. Galena is closely associated with and dispersed in the sphalerite. The grain size (galena) varies from coarse, 2 mm or more to as fine as 50 m. Pyrite is present with grains 100 m–15 cm in diameter. Electronprobe analysis shows some iron within crystal lattice of sphalerite. Chalcopyrite is rare but when present fills up open spaces and interstices. Magnetite occurs generally as porphyroblast within the sulphides. The triple point junctions are found in both polyphase and monophase assemblages. Sphalerite generally shows excellent twining. As the ores are metamorphosed, no paragenitic sequence of mineral formation could be suggested.

Light coloured sphalerite is disseminated throughout the bodies of crystalline dolomitic limestone at Lari. Prospecting of the southernmost body has been done thoroughly and drill cores up to 175 m in depth recorded an average content of 0.1% to 0.3% zinc.

Mineralogical examination of a smaple of zinc tailings identified zincite, smithsonite, cerussite, rutile and ilmenite.

From megascopic observations, the following types of mineralisations have been distinguished :

1 Dark brown sphalerite, with little or considerable galena and at places pyrite and pyrrhotite, forming massive lenses. It is very common and together with the light brown sphalerite forms the main ore.

2 Light to medium brown sphalerite, occuring as disseminations and sometimes as veins. It is most predominant.

3 Greenish yellow to light sulphur yellow sphalerite in veins or as tiny isolated lenses. Magnetite and actinolite are commonly associated with the variety. It is not very frequent.

Three modes of mineralisation have been observed:

1 Disseminated mineralisation with varying dimensions and grade near the lower contact of crystalline dolomitic limestone.

2 Massive sulphide lenses of varying dimensions arranged enechelon, occurring alone or associated with disseminate zone.

3 Veins semicontinuous or enechelon, occurring mostly in planer structural zones.

The main mineralised zone explored so far at Lari is a sheet like body near the bottom of the crystalline dolomitic limestone and parallel to the contact. (Fig. 2) It has been followed for 688 m along plunge. The ore consists of dissemination and massive lenses of various dimensions and concentrations. In one body a rectangular small ore zone consisting of disseminated mineralisation makes an acute angle with the contact. At Serkaping the massive sulphides occur almost in schist where zinc and spinel is seen to occur abundantly. At Poktanjoo also the ore is massive, but apparently like a thin continuous vein. At Suple, the ore occurs as massive lenses but at Glacier it is disseminated while at both places pyrite occur in considerable quantity. The ore is rather low in silver and cadmium.

Confinement of the ore to a single stratum of crystalline dolomitic limestone throughout the project area is a unique feature. This unique stratigraphic control and and the simple nature of the ore suggest its syn-sedimentary origin.

CONCLUSIONS

1 The composition of the ore is very simple and mineralisation is confined to a single stratum. Therefore, sedimentary origin of the ore is suggested.

2 The project area is highly folded without any visible dislocation suggesting deep seated metamorphism and contiguity of M. C. T.

ACKNOWLEDGEMENTS

My grateful thanks are due to Mr. J. M. Tater, Deputy Director General, Department of Mines & Geology, H.M.G., Dr. C. K. Sharma, Water & Energy Commission, H.M.G., Nepal, and Mr. David G. Netherway of Golder Moffitt and Associates Limited, Berkshire, U.K. for helpful criticims and suggestions. Grateful thanks are also due to authorities of Nepal Metal Company Limited for allowing to publish this paper.

REFERENCES

Hagen, T., 1969. Report on the geological survey of Nepal, vol. 1 (preliminary reconnaissance). Denkschr. Schweiz. Naturf. Ges. Bd. 6, Ad.

Hashimoto, S. et al. 1973. Geology of the Nepal Himalayas.

Sanford, R. S. Unpublished report, Dept. Mines & Geology, Kathmandu.

Sharma, C. K. & Yadav, R. N. 1967. Unpublished Report. Dept. of Minese & Geology, Kathmandu.

Geological Survey Professional Paper 558, U. S. A., 1967.

Turner, F. J. & Verhoogen, J.. 1962. Igneous and Metamorphic Petrology.