General Geology and Economic Significance of the Lahor Granite and rocks of Southern Ophiolite Belt in Allai Kohistan area

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Abstract: Geological mapping of the toposheets (43 B/13 and F/1) carried out shows the following rock units in Besham-Kohistan and Allai areas: (1) Granitic rocks: Lahor granite and associated Shang granite gneiss and Mansehra (Susalgali) granite gneiss (2) Metamorphics: Thakot group, Tanawal group, Salkhala series, Hazara type slates and dolomitic rocks and amphibolites (garnet amphibolite and normal ortho-amphibolites) (3) Jijal ultramafics: dunites/peridotites and pyroxenites.

Economic mineral deposits found so far are magnetite (in skarns, hornblendites and ultramafics), sphalerite/galena (in skarns, veins and altered granite), chromite (in dunites/peridotites and pyroxenites) and molybdenite (in silicified skarns, altered granites and pegmatites). Anomalous values of Sn, W, Bi, Cd and Mn mineralization have been found in skarns, altered and silicified Lahor granite.

The skarn type mineralization appears to be associated with the Precambrian Lahor granitic rocks which have intruded into the rocks equivalent to Salkhalas. This granite is unconformably overlain by Hazara type slates and Abbottabad Formation (dolomitic).

Two very important structural features have been noted in the area. They are, one older thrust separating Thakot group and associated Lahor granitic rocks and Tanawal group and associated Mansehra granite gneiss. The other very major thrust is the Main Mantle Thrust bringing ophiolite/amphibolite rocks onto Lahor granite, Thakot group, Tanawal group, Mansehra granite gneiss and the Salkhalas.

INTRODUCTION

Besham Kohistan area lies at a distance of about 150 km. from Abbottabad. The area lies on both sides of Karakoram Highway. Topography of the area is very rugged and it has a high relief. The highest peak of the area is at an altitude of 14070 feet at Kabakot whereas the lowest elevation is 1735 feet at Thakot.

The project area was poorly studied geologically before the present investigation due to poor accessibility. Topogeological mapping of the project area was carried out on the toposheets 43 F/1 and 43 B/13 of the survey of Pakistan on a scale 1:50,000 to know the general geology and control of mineralization. A total of about 500 samples were collected of various rocks, out of which 70 were studied by incident light microscopy and 30 by reflected light microscopy. 47 samples were chemically analysed while 60 samples were analysed by spectrochemical methods.

The area is very interesting from mineralization point of view of magnetite, sphalerite, galena, molybdenite, chromite, copper, cadmium, tungsten, bismuth and tin etc. Among them sphalerite, galena, chromite, magnetite and molybdenite are of commercial interest. Further exploration/investigation work may lead to the discovery of substantial quantity of other minerals.

Previous Work: The area was not studied in detail before the construction of Karakoram Highway and little attention was paid to geological investigations and exploration. Only the road cuts were studied and checked and no economic mineral was reported from these areas. However, following workers have carried out geological investigation in the project area and in the surroundings:

1. The western geological region of the project area was studied by Martin, Siddiqui and King (1962).
2. Jan and Tahirkheli (1969) described the geology of the lower part of Indus Kohistan.
3. Jan (1977) studied Kohistan basic complex.
4. Shah (1976) noted the metamorphism and pre-existing structures of the section between Thakot and Shatial bridge.
5. Bogio (1978) reported magnetite occurrence in Kohistan area.
6. Engineers Combine Limited (ECL, 1979) carried out geological and economic mineral investigations in Besham-Kohistan area in detail. This presentation is the outcome of the same studies.

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GEOLOGY

Igneous and metamorphics are the main rocks exposed in the Kohistan-Besham area. Igneous rocks consist of granite, granite gneiss and ultramafics whereas metamorphics are composed of pelitic, psammitic, graphitic and calcareous schists and marbles. Ultramafics are present in the northeastern part of the area and have thrusted onto Lahor granite/Thakot metamorphics, Tanawal Formation, Mansehra granite gneiss and Salkhalas. Amphibolites are exposed further northeastwards from ultramafics with which they have faulted contact.

Igneous Rocks:

Granites of the area are mainly of three types which are named as Lahor Granite (name after locality Lahor, 8 km. to the northwest of Besham), Shang Granite gneiss (name after the locality south of Besham) and Mansehra (Susalgali) granite gneiss (name after the locality near Mansehra).

None of the granite of the project area resembles with that of Swat granite/granite gneiss.

1. *Lahor Granite:* Lahore granite covers about 800 sq. km. of the project area. In the project area this granite is bounded by the localities Karora, Chakeser, Thakot, Jambera, Sakargah, Chor Kandao and Gandori.

Granite is fine to medium grained and is usually gneissic. The granite is fine grained near its contact with country rock, (metasediments and metamorphic screens), however, it is generally medium grained. Apophyses are usually present in the bigger screens and are generally fine grained. The granite is brownish grey and grey at weathered surfaces while the fresh rocks are greyish white, light grey and grey in colour. Alignment of the black and leuco minerals produces thin discontinuous bands at some places and at places gneissic structure is weakly developed. The granite is also nonfoliated having massive structure at a few places. In massive granites the orientation of the minerals is random. Intermediate varieties between those two types are also present which show weakly developed gneissic structure. Graphic granite was also observed in the Pazang area. The northeastern contact of this granite is faulted with ultramafics. Usually migmatite zone is developed at the contact of granite and metamorphic screens. Feldspar crystals and their aggregates can be easily seen in the metasediments.

Rock constituents are quartz microcline and plagioclase as essential minerals while biotite and magnetite occur as accessories. These accessories are quite variable in quantity from place to place. Microcline crystals are upto 3 mm in longer dimension. Generally the feldspar minerals are dominant and make about 2/3 of the total constituents. At some places silicification has taken place resulting in the formation of quartz rich rocks.

All these varieties of granite are well jointed. Weathering is more pronounced along these joints and weak zones. Magnetite and biotite produce rusty colour around their grains.

Doleritic dykes, pegmatites and quartz veins have intruded the granites. Doleritic dykes are greenish black in colour and are 1.5 to 6 m in width and 6 to 75 m in length. These dykes are further cut by pegmatites and quartz veins.

Pegmatites are from a few mm to 22.5 m in width and upto a maximum of 160 m in length. Their occurrences are abundant in the screens/migmatised zones than in the granites. The pegmatites are composed of two coloured (white and grey) microcline (as dominant mineral), albite, quartz, biotite, amphibole, tourmaline and pyrite.

Quartz veins are from a few mm to 4.5 m thick and upto a maximum of 90 m in length.

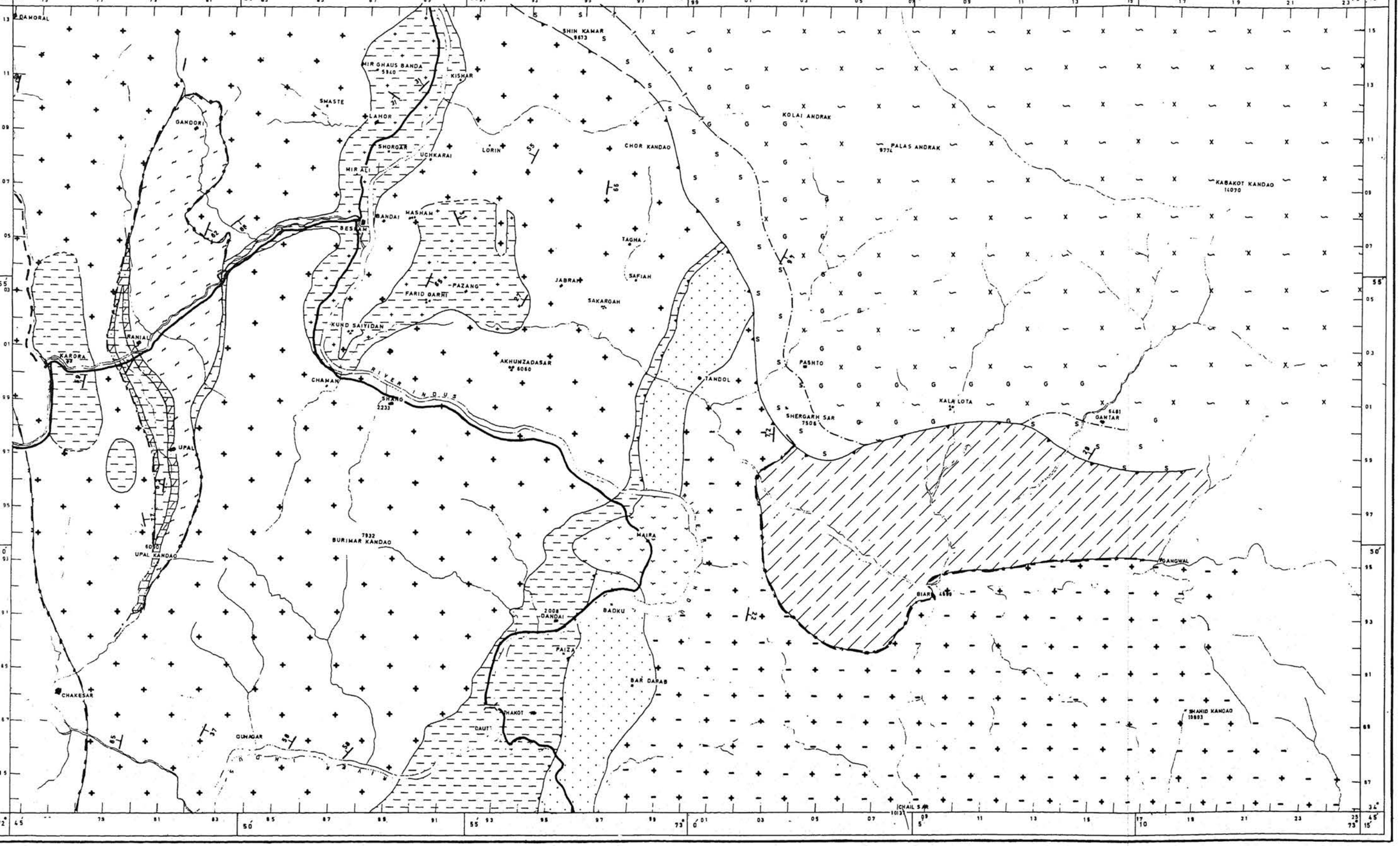
Hydrothermal alteration of these granites is a common phenomenon. This resulted in the introduction of pyrite, magnetite, chalcopyrite, galena, sphalerite and many other sulphide minerals in these rocks. Quartz and micaceous minerals were found increasing in quantity while epidote and some clay minerals were also developed.

2. *Shang Granite Gneiss:* This granite gneiss seems to be the later phase of Lahor granite exposed in the vicinity of Shang and Dubair Bazar. It is medium to coarse grained. Foliation is well developed and marked by the mineral alignment. Discontinuous layers of black and white minerals are present.

Microcline phenocrysts are about 1 cm long and 0.5 cm wide. Biotite is concentrated along these phenocrysts and is dominating black minor mineral. Quartz is in the form of fine grains between the feldspar crystals. This granite is further cut by pegmatites and quartz veins.

3. *Mansehra (Susalgali) Granite Gneiss:* These rocks cover about 300 sq. km. of the area. These are greyish white to whitish grey in colour and are well foliated. Coarse grained rocks with granitoid texture are also present within these gneissic rocks. All these rocks are characterized by porphyroblasts of K-feldspar. Detailed studies of these rocks have been carried out on the main mass occurring in Mansehra and Batgram area by Shams (1969) and Ashraf (1974).

TOPOSHEET Nos. 43B/13 , 43F/1



LEGEND

- ALLUVIUM
- JIJAL ULTRAMAFICS
- GARNET AMPHIBOLITE
- ORTHO AMPHIBOLITE
- MANSEHRA GRANITE
- TANAWAL FORMATION
- SIRBAN DOLOMITE
- DOGRA OR HAZARA FORMATION
- LAHOR GRANITE
- MINERALIZED SCRE
- THAKOT METASEDIM
- SALKHALA FORMATI
- THRUST FAULT
- NORMAL FAULT
- METALLED ROAD
- UNMETALLED ROAD
- 55 DIP & STRIKE

LONGS. 6 5 4 3 2 1 0 1 2 3 4 MILES.

1000 0 1000 2000 3000 4000 5000 6000 METRES

Fig 1 GEOLOGICAL MAP OF BESHAM - ALLAI AREA

MAPPED BY, DR. M. ASHRAF DR. M. N. CHAUDRY S. SHAHID HUSSAIN

Major rock constituents of granitic gneiss are microcline, albite, quartz, muscovite, biotite etc. Pegmatites intruding granites are composed of feldspar, quartz, muscovite, tourmaline and also beryl. Exposures of pegmatites are upto a maximum of 13.5 m in length and 2.4 m in thickness.

4. *Ultramafic Rocks:* The belt of ultramafic rocks starts from Dubair/Jijal and extends to Jaba and Gantor (East of Bannan) in the project area and covers about 175 sq. km. These rocks trend in northwest direction, dip towards north and northeast and cropout near the base of the Kohistan basic complex (Tahirkheli *et al.,* 1979).

The main mass is composed of dunites, peridotites and pyroxenites as alternating layers, which are massive, compact and well jointed. These rocks form steep slopes along the Dubair Khwar and River Indus. The whole mass is light grey, dirty grey and rusty at weathered surfaces. The occurrence of these rocks has been recorded by Jan (1977) near Jijal.

Dunites and peridotites are light greenish grey to dark grey with greasy appearance. These rocks are partially serpentinized. This phenomenon is more prominent in the rocks along southern contact. Shearing of the rocks has taken place and serpentinization is intense along joints, weak and sheared zones. Serpentinites are light grey and brown to dark grey in colour. Dark grey and thin veins of serpentinite are also seen in these rocks. Chromitite has been found with these rocks on the basal side as massive lenses and layered bodies.

Magnetite dissemination is common in peridotites and dunites and is upto a maximum of 20% in the rocks so far observed. These rocks are magnetic in character.

Banding and layering in the dunites is commonly observed. The bands are of light grey, dark grey and greenish grey colour. This character of rocks is more common in dunites and peridotites.

Pyroxenites are normally green in colour with grey varieties at places. These grey rocks are rich in magnetite disseminations. Small sized bodies of lenticular chromite have been found in them.

Metamorphic Rocks:

Metamorphic rocks of the area under study are composed of pelitic, psammitic, calcareous and graphitic schists. Metamorphics can be divided into 4 groups and are described briefly in the following:

1. Thakot Metamorphic Rocks: Name is given after the locality Thakot. Lahor granite is intruded in these rocks. These are also present as big screens in the granite along Indus River, Khan Khwar, Lahor and Pazang. Numerous small sized screens are present throughout the Lahor granite. Different rock types of the group are as follows:

Pelitic-Psammitic Rocks: These are light grey, dirty grey and greenish grey in colour and are medium to fine grained. Schistosity is well developed. Rocks are composed of chlorite, muscovite, biotite, quartz, feldspar, garnet, pyrite and magnetite. In the psammitic rocks quartz is comparatively abundant. Garnet is prominent at the contact of metasediments and granite due to thermal metamorphism. Psammitic rocks are predominant among the two rock types.

Within the psammitic schists, thinly bedded quartzites are also present. In the quartzites micaceous minerals decrease and the quartz increases compared with the schists. Both type of schists are recrystallized and metasomatised. These migmatised zones contain higher quantity of feldspar.

Calcareous Rocks and Marbles: Rusty brown coloured rocks at weathered surface are present in the metamorphics of Thakot. These are from a few metres to 75 m thick and upto a maximum of 150 m long.

Calcareous impure beds contain calcite, mica, quartz and pyrite. These are jointed and fractured rocks. Most of the calcareous beds in the screens of granite show contact metamorphism and are mineralized. These are changed to skarns, having composition—calcite, siderite, amphibole, pyroxene, garnet, muscovite, biotite, quartz, pyrite and magnetite. White and greyish white marble bed (containing tremolite pods) near Dandai is exposed on the roadside. The marble is jointed.

Graphitic Schists: Graphitic Schists are interbedded with pelitic-psammitic schists. These are upto a maximum of 21 m thick and are well exposed on Besham-Karora and Besham-Lahor roads. These are metamorphosed to a low grade and contain little quantity of graphitic carbon. These schists are thinly bedded and are highly folded and faulted. Minerals recognisable in hand specimen are graphite, non-graphitic carbon, mica, quartz, feldspar, pyrite and ilmenite. Pegmatites and quartz veins have cut these rocks at many places.

2. Tanawal Group: Metamorphics of this group are composed mainly of psammitic schists with very small quantity of pelitic, calcareous and graphitic rocks. Their characters are almost the same as those of metamorphics of Thakot but are of higher grade, ranging from chlorite to kyanite (Shams, 1967).

3. Salkhalas: Salkhalas are composed of marble/calcareous, carbonaceous/graphitic and chloritic schists. Graphitic schists are most prominent.

All these rocks are metamorphosed to chlorite grade. Garnet is, however, developed near the contact with granite gneiss due to thermal metamorphism.

In the chlorite schists travertine beds are developed in Banna area. These are upto a maximum of 3 m long and 1.2 m thick. These are generally white and cream coloured. Bands with light green colour occur at a few places.

4. Dogra or Hazara Slates and Abbottabad Formation Dolomite: Near village Renial (east of Karora) a faulted block consisting of Hazara type slates, graphitic schists and Abbottabad formation (dolomitic), is present in the Lahor granite.

5. Metaconglomerates: They are exposed at a distance of 6.5 km from Besham on Besham-Karora road. The bed is 9 m thick and contains boulders and pebbles upto 22 cm in longer direction. These boulders are of slates and granites of Lahor types. This bed is developed between granite and graphitic schists/slates.

6. Amphibolites: Ortho-amphibolite belt of Dir and Swat passes from north of Jijal (Jan, 1977). Along the Indus River these rocks have southern contact with ultrabasics. Similar exposures occur in the NE of the mapped area.

Generally these rocks can be grouped into two types:

1. Garnet amphibolites.
2. Normal amphibolites.

Garnet amphibolites are massive, coarse-grained and gneissic rocks and are exposed to the south of village Pattan and north of Pashto and Gantar.

Segregation of minerals is characteristic of these rocks—resulting in the development of rocks rich in one mineral at places. Garnet amphibolites are the rocks which contain garnet as a major constituent. Mineral segregation and quantity of garnet decreases north- and eastwards.

The normal amphibolites are gneissic and medium to coarse grained. In the project area these are metamorphosed to garnet grade. Rock constituents are amphibole and feldspar as major minerals and quartz, epidote, garnet and magnetite as minor and accessory minerals.

Banding is produced at places by black and white minerals. Black bands are rich in amphibole whereas feldspar, epidote and quartz make the whiter bands. These rocks are intruded by pegmatites, quartzo-feldspathic veins and granite porphyry dykes.

ECONOMIC GEOLOGY

An area of polymetallic mineralization has been found in northern part of Pakistan. The important commercial minerals found are magnetite, galena/sphalerite and chromite. Anomalous mineralization of Mo, Sn, W, Cd, Mn, Bi etc. is also widespread. Possibility of concentration of these minerals is likely at some places. Work carried out is preliminary as far as some of these minerals are concerned. The area needs further detailed investigations as regards geological set up and the anomalous minerals found so far.

1. Magnetite: Magnetite has been found in skarns, garnet hornblendite and ultramafic rocks. The important occurrences appear to be those present in skarns and garnet hornblendites. The sizes of the bodies studied are usually small except for a few bodies in Pazang and Lahor areas.

Three types of magnetite deposits have been found in the area :

Igneous-Metamorphic Deposits: These are associated with Lahor granite and associated metamorphics and in mixed rocks of these types. The skarns developed so contian variable quantity of magnetite. Within this type, three varieties of magnetite bearing skarns can be distinguished.

a) Magnetite-Carbonate skarns: Seventeen samples of this type were studied petrographically. The rocks are medium to coarse grained and hypidioblastic generally. Magnetite varies from 12 to 79% in these rocks. Other minerals are carbonates, olivine, pyroxene and minor amphibole, clay, pyrite, antigorite, barite, biotite, apatite and sphene.

Minor element study of nine samples shows Pb = traces to 0.05%, Zn = 0 to 2.0%, Cu = 0.002 to 0.03%, Bi = upto 0.01%, As = 0.005%, Mo = 5 to 500 ppm, Sn = 0 to 600 ppm and W = 50 to 400 ppm.

b) Siliceous-Magnetite Skarns: Six samples of this type were studied microscopically. In this type quartz is the dominant phase instead of calcite. The rocks are medium to coarse grained hypidioblastic to xenoblastic. Magnetite in these rocks varies from 18 to 60%. Other minerals are quartz, carbonates, haematite/limonite, amphibole, garnet, barite, pyrite, fluorite and epidote.

Minor elements in four samples are Mo =

0 to 0.01%, Zn = 0 to 0.1%, Pb = 0 to 0.005%, Mn = 0.01 to 2%, Sn = 0 to 0.01% and W = 0.05%.

c) Magnetite-Silicate Skarns: Eight samples of this type were studied petrographically. These are almost completely reconstituted skarns. They are generally rich in magnetite i.e. 51 to 96%. Other minerals are pyroxene, antigorite, carbonates, quartz, haematite/limonite, amphibole, barite etc.
Important minor elements are Zn = 0.08%, Pb = 0.005%, Sn= 0.2% and W = 100 ppm.

These types occur near village Ghaus Banda, Serai, Shorgar, opposite Kishar, Lahor, Mir Ali, Tor Shah Kandao, Bankhad, Uchkarai, Derai, Pazang, Maidan, Besham-Derai slopes, Masham, Farid Garhi, Darra, Akhunzada Sar (Tapher, Kandora, Darya Sar) Bela and Derai (Thakot) and Paiza.

The magnetite bodies are from a few metres to about 250 metres long and a few cm to 45 metres wide.
Inferred reserves of this type of magnetite ore are of the order of 6.79 million metric tonnes.

Magnetite in Hornblendites: Lenses of magnetite (3 to 45 metres long and 1 to 14 metres wide) occur in hornblendites of garnet amphibolite in the area of Sherakot (Baznai and Gumagali) and Kolai.

Concentration of magnetite in these rocks is about 70 to 75%, while other minerals are amphibole, epidote, garnet, talc, chlorite, haematite/limonite, pyrite etc.

Inferred reserves of this type of magnetite ore are 174,200 metric tonnes.

Magnetite in Ultrabasics: Magnetite occurs in ultrabasics as disseminations and as lenses. The lenses are 1 to 2.4 metres wide and 2 to 6 metres in length in Lomoto. The disseminations of about 12x45 m area have been found in Kot and Lomoto and at many other places.

Magnetite contents in the rich rocks vary from 78 to 90%. Other minerals are antigorite, olivine, pyroxene, talc and spinel. Magnetite in disseminated samples is 15%. It is associated with spinel, antigorite, olivine, granet etc.

The inferred reserves of this type are 51,323 metric tonnes.

The magnetite deposits are generally well exposed. Their underground extension can be proved only by drilling and aditing. Geophysical survey also may prove helpful. However, the reserves given are calculated on the basis of field observations and structural behaviour of the host rocks.

2. Chromite: Chromite has been discovered in Kohistan district for the first time. It is associated with the ultramafics (dunites, peridotites and pyroxenites) of Jijal and Dubair. Chromite is found mainly in dunites as lenses, layered veins and pockets. It appears to be podiform in nature. Their size varies from 0.15 to 4 m in width and 3 to 60 m in length. Important deposits occur near Jijal, Shungial, Kokial, Taghtai, Gabar, Mani Darra, Khairabad, Jag, Tangai, Chinarai, Kolai, Serai, Lomoto and Kot.

Generally the chromite is medium to coarse-grained and is present from 45 to 95% in the rocks. The associated minerals being olivine, antigorite, chrysotile, diopsidic augite, chlorite, talc, magnetite, hematite/limonite, spinel, anthophyllite and carbonates. Chemically Cr_2O_3 = 22.3 to 54.7%, Fe_2O_3 = 14.74 to 23.4%. Cr/Fe ratio is 1 to 3.62 in these samples. Mining may be carried out by quarrying initially which may be followed by underground working at later stages.

Inferred reserves of chromite are 157,260 metric tonnes.

3. Lead and Zinc Mineralization: This mineralization is associated with Lahor granite and the metamorphic screens exposed in Ghaus Banda, Serai, Shorgar, opposite Kishar, Kund and Pazang areas of Kohistan and Besham. Lead/zinc mineralization is mainly in normal skarns, silicified skarns/veins and altered granites. The size of the mineralized bodies varies from 8 cm to 15 m in width and 1.2 to 84 m in length.

Minerals are mainly galena, sphalerite, quartz, pyroxene, amphibole, goethite, albite, pyrite, garnet, calcite, epidote, biotite, pyrolusite, quenselite, hematite/limonite, muscovite, talc, chalcopyrite, colusite etc.

Chemically, lead ranges from 0.6 to 10.0% and zinc from 1.0 to 8.0% in most of the mineralized zones. The ore may be produced as a by-product of magnetite mining.

Inferred reserves of the ore are of the order of 108,603 metric tonnes.

4. Molybdenum Mineralization: Molybdenum occurs as molybdenite in areas where lead/zinc mineralization is prominent. Mineralization of molybdenite is in three types of rocks. (1) Silicified skarns: It is present in Serai area as disseminated flakes in an area of about 0.9x7.5 m. The quantity of flakes is less than 1% in this zone. (2) Altered granite: This in

general has abnormal background values of molybdenum. A part of skarn body of Derai/Pazang area is composed of altered granite containing molybdenite. Mineral constituents of altered granite are quartz, amphibole, epidote, garnet and altered feldspars. Associated metallic minerals are pyrohotite, pyrite, galena and sphalerite. Molybdenite occurs as flakes, 0.10 mm to 3 mm across. The distribution has no regular pattern. It is 1% in rocks at some places. (3) Pegmatites of Pazang, Derai and Maidan contain a small quantity of molybdenite. The maximum size of flakes is 7x2.5 cm.

A pegmatite-skarn zone (300x12 m) contains randomly distributed flakes of molybdenite. Mo in some of the pegmatites, altered granite and calc-skarn varies from 0.005 to 0.05%, there-by showing an anomaly in these rocks.

5. Sn, W, Bi, Cd and Mn Mineralization: Anomalous values of these metals have been recorded from the skarns, altered and silicified granites of Ghaus Banda, Pazang areas and Chain Sar. They have maximum Bi (0.8%), Cd (0.2%), Sn (0.12%), W (400 ppm) and Mn upto 8.0%.

CONCLUSIONS

1. Geologically oldest rocks of the area appear to be Salkhalas. Thakot metasediments are possibly equivalent to Salkhalas or lateral facies variations of the same or they are younger than Salkhalas. Lahor granite has intruded Thakot metasediments. On Besham-Karora road these rocks have been overlain by slates, possibly of Dogra or Hazara type, having a brecciated boulder bed at the base. The slates are overlain by dolomite bed of Abbottabad type (Cambrian, Latif 1974). From the relationships it appears that the age of Lahor granite might be Precambrian. However, this can be confirmed by radiometric dating methods. The younger rocks appear to be of Kohistan sequence and associated ultramafics near the Main Mantle Thrust.

2. Structural history of the area is very complicated and it will be dealt with in separate publication. There are a number of small faults at many places. However, only major faults are discussed in the following:

i) Thakot-Sakargah Thrust: The younger Tanawal Group and Mansehra granite gneiss are riding over the Thakot metasediments which has resulted into truncation of the latter northwards.

Across the thrust the metasediments contain distinctly different type of granites and associated pegmatites.

ii) Gantar-Talus Fault: The Tanawal group and Mansehra granite gneiss have a faulted contact with Salkhala rocks. The former are riding over the latter truncating their western extensions.

iii) Main Mantle Thrust: The most prominent and significant is the Main Mantle Thrust (Tahirkheli *et al.*, 1979) where the Kohistan sequence is overthrusted southwards onto Lahor granite/Thakot metasediments, Mansehra granite gneiss/Tanawal metasediments and Salkhalas truncating their north-south striking outcrops.

3. Magnetite Mineralization is of the following type:

i) Magnetite occurrence in skarn and similar rock type is igneous-metamorphic type i.e., addition of solutions rich in iron and silica to carbonate rocks.

ii) Magnetite deposits in garnet hornblendite and ultramafics are of magmatic segregation type and also as disseminations in latter type.

4. Lead/zinc mineralization appears to be mainly skarn type and at places of hydrothermal origin.

5. Sn, W, Mo, Pb, Zn, Bi, Cd mineralization appear to fit into vertical zoning pattern (Park and MacDiarmid, 1970). Preliminary studies show that Sn, W etc., occur at lower elevation; Mo, Pb, Zn, Bi etc., at moderate elevation while Ag, Hg are found at higher elevations.

6. Chromite associated with dunite/peridotite is possibly magmatic whereas chromite associated with pyroxenite is perhaps hydrothermal/magmatic as the chromite bodies are small irregular lenses and swarms.

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