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Mineral/Rock Resources of Lasbela and Khuzdar Districts, Balochistan, Pakistan

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ABSTRACT: *Revolution in the earth sciences mainly due to the formulation of plate tectonic or global tectonic hypothesis in early 70's has provided better understanding of ore genesis and major tectonic settings. The hypothesis has given an impetus to the search of valuable economic minerals and rocks particularly in the Lasbela and Khuzdar districts of Baluchistan, Pakistan.*

Igneous, sedimentary and metamorphic rocks of Mesozoic and Cenozoic ages dominate the lithostratigraphic exposures. Mineralizations are found in different tectonic settings; chromite, copper, manganese, magnesite in oceanic ophiolites and barite, lead, and zinc in the continental hot spots and rifts.

Beside minerals the area has significant potential for marble, granite, basalt, brecciated serpentinized rocks (known commercially as "Black Zebra"), quartzite, and variegated textured limestone suitable for use as building and decorative stones.

Zinc-lead deposits at Duddar, Lasbela district, are now in the proving stage. Australian company (PASMINCO). After further exploration these may turn out to be a world class ore body.

INTRODUCTION

The Lasbela-Khuzdar districts with an area of over 750 sq. km are two of the richest and most geological complex regions of Pakistan and holds vast prospects of metallic and non-metallic minerals, building and decorative stones.

The area lies within the arid type of climatic region. Rainfall is scanty, hence most of the streams remain dry for most part of the year, only a few streams such as Nar River, Kharak River, Nal River, Porali River, Winder Nai, Kharrari Nai, Gajri Nai etc. have perennial flow in some sections of their course. Vegetation is scanty.

The population of the Khuzdar and Lasbela districts is 5,00300 and 1,70,000 respectively. The main occupation of the inhabitants is sheep and goat farming. Due to limited scope of earning livelihood, unskilled and semi-skilled labour is easily available.

Diverse rocks of igneous, sedimentary and metamorphic origin of early Jurassic late Tertiary ages together with structural complexities make the area not only unique but challenging for research and investigation.

The small scale mining particularly for barite and manganese being carried out in the area since long, has increased many times since the completion of RCD highway which passes through the area (Fig. 1). Now a days besides barite and manganese, chromite, magnesite, marble, variegated and textured rocks are also being mined/quarried.

GEOLOGICAL SETTINGS

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The geological setting of the Lasbela-Khuzdar area is related to two major orogenies. The earlier relates to the break up of the super-continental Gondwanaland during late Triassic-Jurassic period (Powell, 1979; Lydon, 1990,). The key processes operating at the time were rifting and extensional tectonics. The host rocks of the mineralization of lead-zinc sulphides and barite deposits are sediments within extensional tectonics (Ahsan, 1995).

Following the break up of Gondwanaland the Indo-Pakistan plate was separated from the Turan block (Powel, 1979). The Indo-Pakistan plate collided with the Afghan and Lut microplates during late Cretaceous-Early Tertiary period. The collision led to the development of folds and thrust belt and the obduction of ophiolitic complex at the western boundary of the Indo-Pakistan plate. The folds divide an eastern calcareous facies zone of the foreland from western arenaceous zone of the hinterland (Fig.2). The Cenozoic flysch basin of the hinterland is taken as an accretionary prism above the active subduction zone (Arthorton et al., 1982, Farhoudi & Kraig 1979, Stoneley 1974 and White 1979).

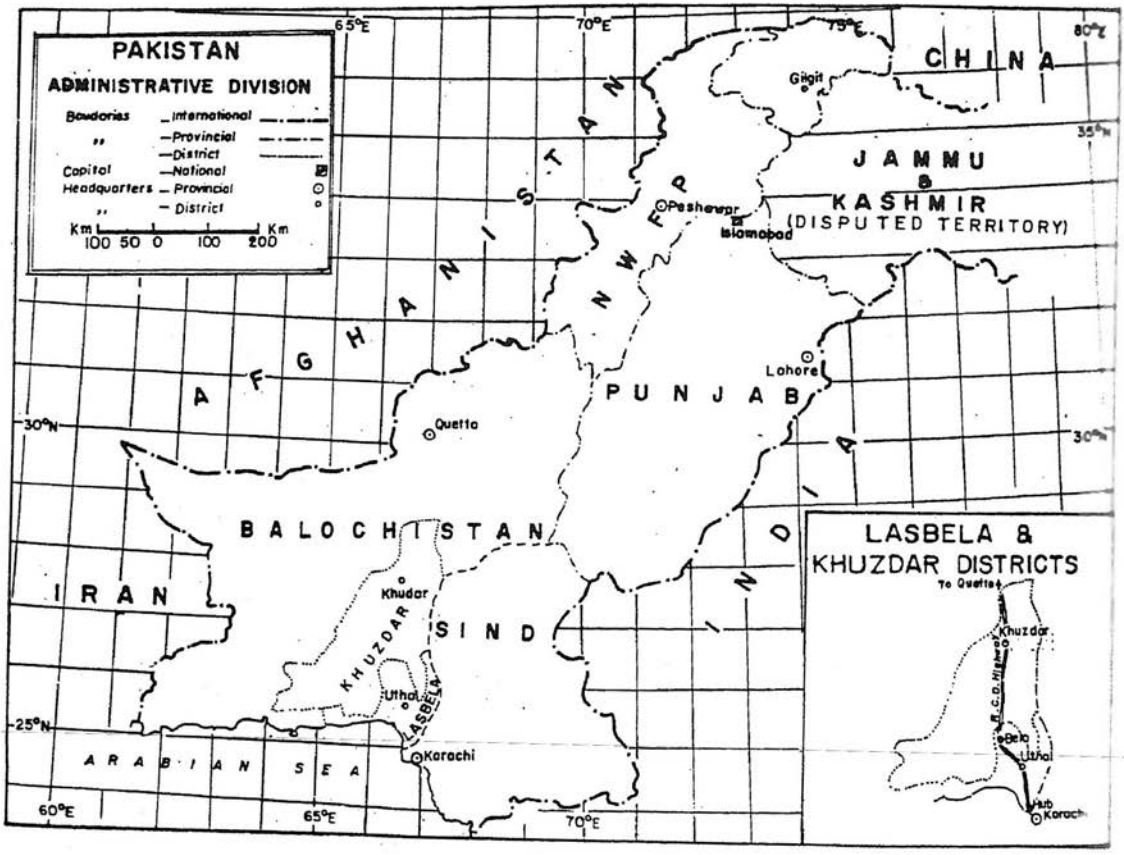

Fig. 1. Location map of the study area.

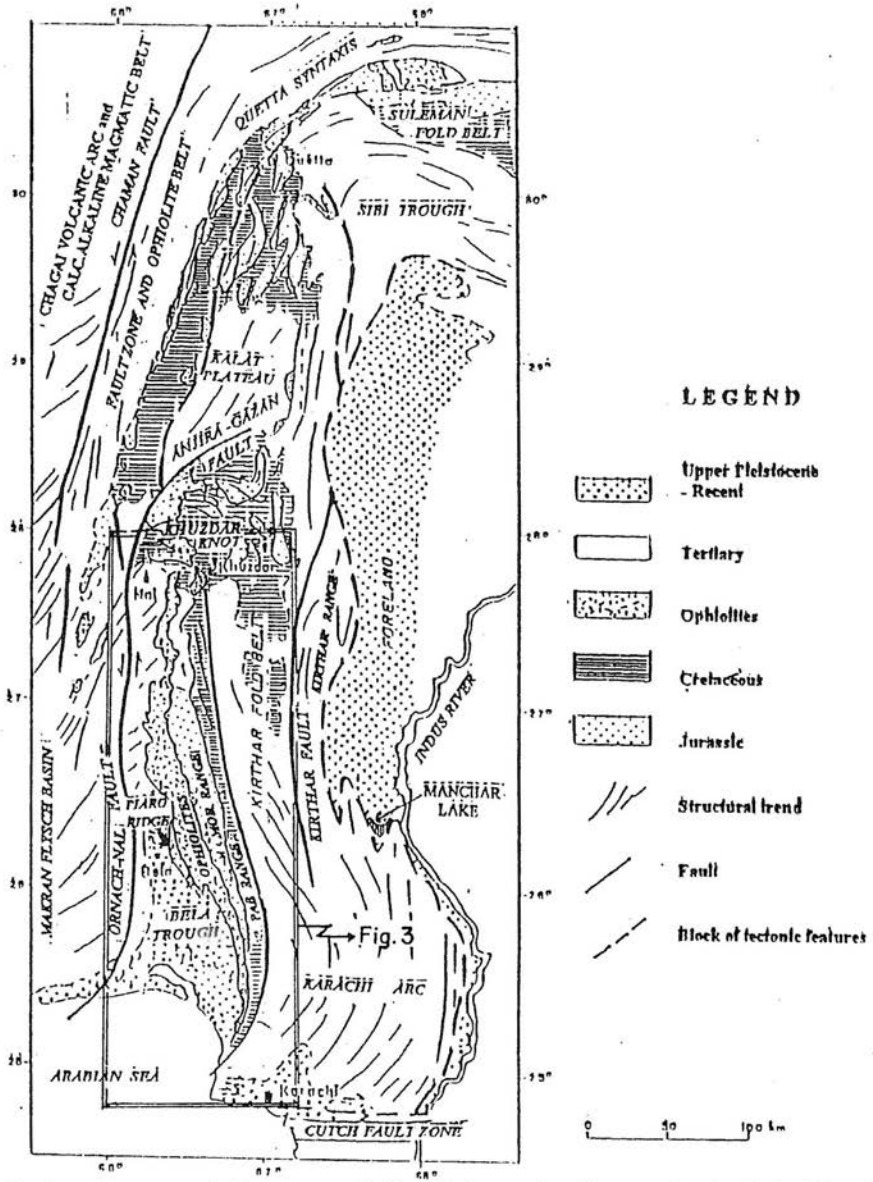

Fig. 2. Geology, structural features and distribution of sediments in Lasbela-Khuzdar area (modified after Sarwar & Dejong, 1979).

MINERAL DEPOSITS

The Lasbela-Khuzdar area hosts a variety of mineral deposits which occur in a characteristic geological settings. In Fig.3 locations of the mineral showings have been marked. However, many of the prospects have not been systematically investigated. The tectonic settings and the main deposit types in the region are as follows:

OCEANIC SETTINGS

Chromite, Magnesite and Related Minerals

Peridotites and serpentinites are common both in the melange zone and the less disturbed

ophiolite complex which often contains lenticular/podiform or disseminated bodies of chromite. However, occurrence of commercial chromite deposits is not common in the ultrabasic rocks. The principal deposits are in Sanaro, Baran Lak, Drakalo and Greshak area of Khuzdar where more than fifteen pods have been identified (Fig.3) (x). These are being mined locally by open pit methods. The deposits are fairly large and the annual production of chromite was 7698 tonnes in 1996-97.

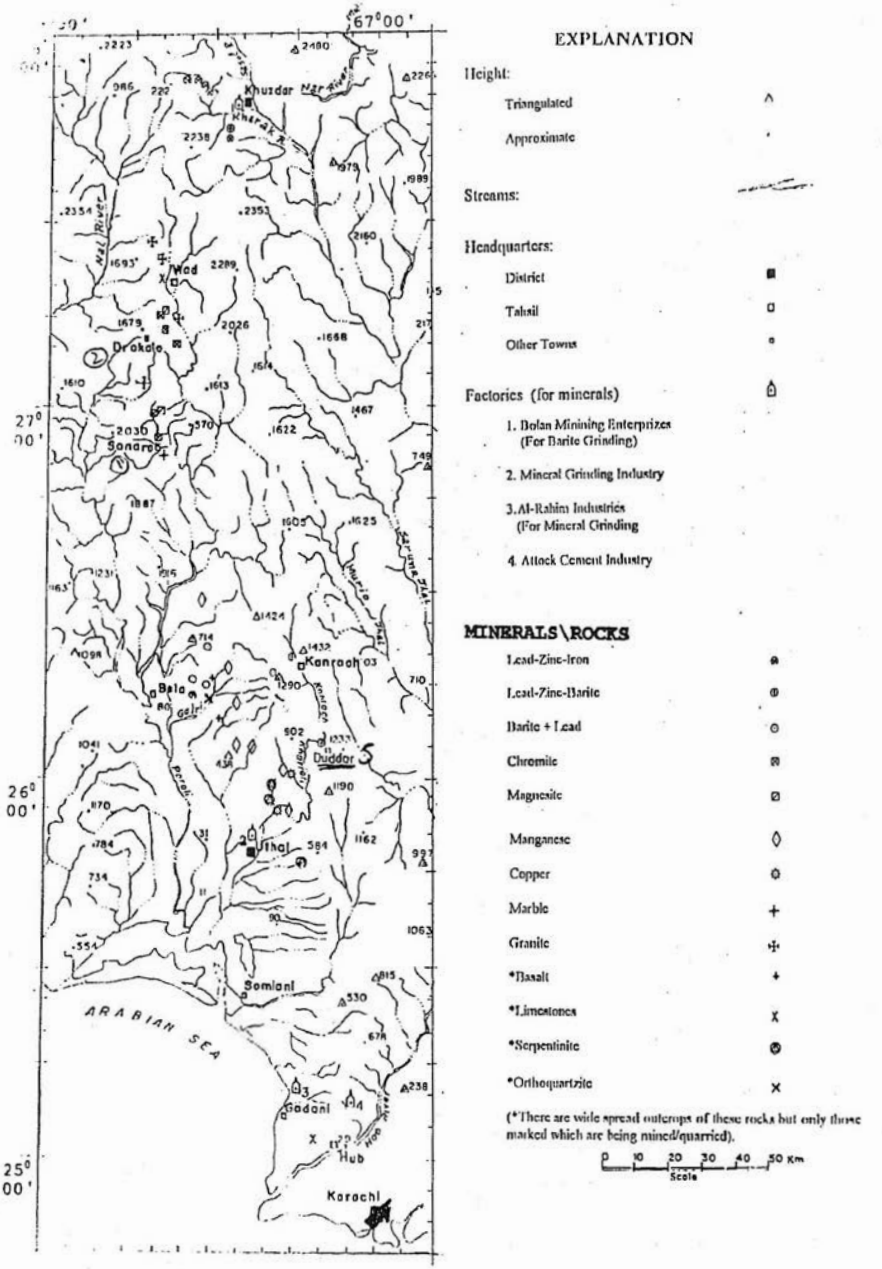

Fig. 3. Minerals/Rocks occurrence location map of Lasbela and Khuzdar districts.

Showings of magnesite and to a lesser extent asbestos occur widely. However, only a few are commercially exploitable. The promising deposits are in Baran Lak, Ornach cross and Drakalo which are being mined locally.

The nickel-iron laterite is a localized development at the unconformable contact of the ophiolites and the Late Tertiary limestone beds. Its detailed study to prove its potential for economic exploitation.

Massive Copper Sulphide Deposits

Massive copper sulphide prospects associated with pillow lavas in the ophiolite complex have been identified in the Saap and Ann Dhoros localities of Lasbela district but these are of no economic value. Pillow basalt is wide spread in the areas under discussion with bright possibility of some promising deposits of if systematically prospected using modern concepts and exploration techniques.

Manganese Deposits

Lenticular bodies of manganese oxides occur in iron and silica rich layered (Jasperoids and siliceous red shales) horizons underlain by top layers of basaltic pillow lavas. Many manganese occurrences associated with the volcanic rocks, mostly of pillow lavas of basaltic/spilitic composition are recognized in Lasbela-Khuzdar area. However, the most promising localities are Kharrari Nai, Bhamani Dhoro, Siro Dhore, Sanjro Dhoro, Kohan Jhal and Khabri Dhoro. These are being mined by locals on small scale by open pit mining. The annual production of chromite was 424 tonnes only in 1996-97.

A brief description of these deposits is as follows:

Name of deposits	District, coordinate and toposheet	Size of mineralized zone	Grade	Reserves
Kharrari Nai	Lasbela, 25°54'N 66° 45'E, 35 k/9.	Two separate pods having an exposed surface of 70 and 7 square meters respectively.	Mn 42% (Nasim,1996)	34,000 long tons (Abbas,1980)
Siro Dhoro	Lasbela, 26°17'N 66° 33' E, 35'J/11.	Manganese in irregular veins/lenses range from one to six inches in thickness.	Mn 36% (Nasim,1996)	950,000 long tons (Master,1960)
Sanjro Dhoro	Lasbela, 26° 28' N 60° 26' E, 35 J/7.	Mineralization in discontinous lenticular bodies having 0.5 km strike length and 1 to 5 meters thickness.	Mn 15% (Nasim,1996)	65,000 long tons (Ahmed, 1969)
Bhampani Dhoro	Lasbela, 26° 11' N 66° 33'E, 35 J/12.	The ore is exposed in a vertical cut, made by open cut mining. It is almost square in shape, with each side measuring about 6 meters.	Mn 41% (Nasim,1996)	5,800 (H.S.C., 1960; Abbas,1980)
Gadani Ridge	Lasbela, 26° 05'N 66° 34' E	Undetermined	Mn 48% (Nasim,1996)	Undetermined
Dadi Dhoro	Lasbela, 26° 05'N 66° 37'E	Undetermined	Mn 35% (Nasim,1996)	Undetermined

DEPOSITS RELATED TO CONTINENTAL HOT SPOTS AND RIFTS

Zinc-Lead-Barite Deposits

Zinc, lead and barite occur widely as veins and replacement deposits in carbonate rocks. The most promising, however, is the stratiform massive deposit found in association with black shales, mudstones/argillaceous limestones and pyroclastic/brecciated rocks. It is interpreted as an exhalative sedimentary or Mississippi valley type deposit (Ahsan et al., 1996). Duddar in Lasbela and Gunga & Surmai in the Khuzdar districts are the three most important deposits. There are 20 other prospects/occurrences such as Sekran, Malkhor & Ranj Laki in Khuzdar district and Mithi Nai, Kanrach and Dham Jal in Lasbela district already identified in the region which require further exploration.

The exploitation of zinc-lead well depend upon the reserves found by PASMINC. It is stated that over 14 m tone with a combined Zn-Pb grade of 14-16% has already been proved. However, barite is being mined. The annual production of barite was 2,827 tonnes in 1996-97.

The characteristics of the important zinc-lead mineral deposits/prospects are summarized below:

Gunga

The Gunga deposit (Fig. 3) is located at about 3.5 km south-southeast of the village Gunga at lat.27°44'N and long.66°33'E. It is accessible from Khuzdar by traveling 11 km to the southeast on an unmettaled road. The distance from Khuzdar to Karachi and Khuzdar to Quetta is approximately 350 km and 270 km respectively. RCD Highway connects both the cities with Khuzdar.

Topographically, the Gunga zinc-lead deposit area is rugged with slopes ranging from 30° to 60° and at places steeper on escarpment sides. The local elevation difference is up to 200 meters.

The Gunga deposit is hosted by the lower part of the Early to middle Jurassic Anjira formation of the Ferozabad Group. The host rocks are predominantly black carbonaceous shale, siltstone and mudstone, subordinate limestone and local synsedimentary breccia and conglomerate.

The mineralization is stratiform, strata-bound and open space filling.

Outcrop of the ore mineralization associated with rugged hogback rides, is over 1,200 meters long and is distinguished as a silic goassan. This gossan is composed of leached and silicified calcareous siltstone and yellowish brown-red oxides of iron. The metal content in the silicic gossan varies from 3-4% Pb and Zn.

Based on the surface geology and information obtained from 14 drill holes, two main mineralized zones were delineated and established in the Gunga area:

1. The upper mineralized zone is dominantly barite. Sphalerite and galena are concentrated in the lower part of the barite bed. The barite bed lies between the hydrothermally altered shale in the hanging wall and the highly silicified rocks in the foot wall. The thickness of barite bearing horizon varies from a few meter to over 70 meters (Jancovic, 1986). The lead-zinc mineralization in the barite s evenly distributed and confined to a narrow zone.

2. The lower lead-zinc mineralized zone has lenses and irregular veins formed along a brecciated zone. The mineralization is dominantly stratiform relative to the enclosing rocks but in places epigenetic as fracture/open space fillings. The mineralized bodies mostly contain over 6% Zn and 1.5% Pb and at places exceed 10% (Jancovic, 1986).

The mineralized bed in it lower horizon is composed of dissemination and thin layers of the sulphide minerals.

The estimated reserves (Pb-Zn combined) are as under:

- Proven 6.5 million tons
- Probable 3.0 m tons
- Possible 3.3 m tons (Jankovic 1983)

Surmai

The Surmai prospects are located at about 1 km south of Ganga deposits (lat.27°43'17"N and long.66°31'27"). However, the mineralization at Surmai occupies a lower stratigraphic position. It is accessible from Gunga by a fair weather jeepable track.

There are three distinct mineral showings along an uplifted zone. These are called Surmai I, II and III extending discontinuously from north to south for approximately 1 km. These showings are hosted in limestone of Loralai formation. These are considered to be Mississippi Valley (MV) type which is a combination of replacement along the bedding plane of the host rocks and fissure filling. The bedding replacement type is seen in Surmai I and III while the fissure filling type is seen in Surmai II.

On the basis of drill hole data, total ore reserves are estimated at 30.51 million tones of which 22.7 million tons are sulphide and the balance 7.81 million tons are oxide ores. The lead-zinc ore has a grade value of 0.66% Pb, 3% Zn and 7.4 g/t Ag (JICA, 1989).

Duddar

The Duddar deposit is located on the eastern flank of the Mor Range at lat.26°05'N and 66°50'E. Road distance from Karachi 200 km is (about 92 km upto Khurkhera on Karachi-Bela section of the RCD Highway and 108 km on the unmetalled Khurkhera-Kanrach road which detours north from the main highway).

The Duddar mineralization occurs in two separate exposures known as Duddar North and Duddar South. These exposures are 258 and 274 meters long with an average thickness of 10 meters. Its extension further north of approximately 700 meters in strike length under alluvial cover has been delineated by drill holes.

The mineralization is stratiform, hosted by interbedded siltstone, mudstone and shale sequence of Anjira formation. The hanging wall of the sulphide ore contains about 30 meters thick barite with traces of marcasite.

The sulphide mineralization below the exposed barite ore body is consists of laminated sphalerite, marcasite and galena.

The detailed drilling program (completing a total of 63 holes, almost 18km of core) has outlined an indicated mineral resources of 6.86 Mt grading 11.43% Zn and 2.10% Pb (Allen et al., 1994).

Other Promising Occurrences

The characteristics of the other promising occurrence in the area are summarized below:

Name of Prospects	Dist., site, coordinates and toposheet	Type of mineralization	Grade	Size of Mineralized zone	Reserves	References
West Sekran	Khuzdar, Sekran hill, E27° 52' N66° 52, 35-I/5	Stratabound and vein types.	Zn-3.15% Pb-0.02%	Surface showing 1.5 km x 0.5 km. The mineralized zone ranges in thickness from 1 to 5m.	not estimated	JICA (1987)
East Sekran	Khuzdar, Sekran Hill, E27°15' N66° 33' 35-I/5.	-do-	ND	Surface showing 400m x 200m, Bedded ore bodies, range in thickness from 3m to 5m	-do-	-do-
Ranj Laki	Khuzdar, malkhor, E66° 26' 45" N27°52' 30', 35-I/9.	-do-	ND	Surface showing 300m x 90m. The mineralized zone shows change in meineralization from thick to massive bedded & open space filing	Possible Zinc-lead= 3.3 mill. t.	Jankovic (1983) JICA (1987)
Kundni-Dham Jhal area	Lasbela, E66°31' to E66°31' and N26°17' to N26° 25' 35-J/11.	-do-	Ba 40% Zn<.50 % Pb 2%	The mineralization as discontinuous exposures/bodies is traceable for about 5km in between Kundni and Dham jhal	Fairly large barite deposit.	Ahsan, 1994
Kanrachzi bro Dhoros	Lasbela, E66° 50' N26° 04', 35-J/11.	-do-	Ba 45% Zn max 0.7% Pb max 5%	The mineralization is discontinuous and restricted to a 700m long and an average 2.5m wide zone	Barie more than 33,350tonnes	Ahasn, 1991 & 1994
Mithi-Arrara Dhoros	Lasbela, Mithi Nai, E66°26' N26° 08', 35-J/8.	-do-	Zn-2.7% Pb-1.6% Ba-38%.	The development of gossan is widespread as discontinuous exposures traceable for about 7km in strike lenght and range in thickness from 1m to 6m.	Fairly large deposits of barite	Ahsan (1989)

MISCELLANEOUS DEPOSITS

Industrial rocks

Igneous rocks

Granite

Commercial use of the term granite is considerably broader than geologic use. In industry, the term refers to true granite, granite gneiss, and the intermediate members of the granite-gabbro series. Notwithstanding the broad use of the term most of the granite of commerce has composition in the range that includes true granite and granodiorite (Bates 1969). The important deposits known from the area under discussion are:

1. Plagiogranite, also called trodjomite is exposed as a solitary outcrop on the RCD Highway about 2km north of the Khabbar Jhal (35 I/8). It is pale white to white, hard and resistant to weathering. Pistachio green epidote grains, are sporadically distributed in the rock giving an appealing look. This granite can be used in facing of building and other decorative purposes.

2. Pink Granite is present as an exotic block within the melange zone. The main outcrops of one square km is located at about 5 km south of Wad. There are few other small exposures in Wad tehsil. They are resistant to chemical and physical weathering. The deposit is minable, however, the main problem is the removal of outer weathered part of the rock. After cutting and polishing it results a pleasing look.

3. Cumulate Gabbro: Exposures of cumulate gabbro are present along the RCD highway in the vicinity of Baran Lak and Ornach Cross. In cumulate gabbro, orientation of feldspar, olivine and pyroxene is clearly seen. If cut across and polished the rock displays a beautiful look. This can be very suitably used as building and decorative stone. However, at present there is no mining activity.

4. Basalt/diabase: Exposures of basalt are widely distributed in the ophiolite compelx of the region. The fresh and easily accessible exposures (e.g. in Gajri Nai) are being mined locally. Basalt is used for building aggregates, riprap etc. A modern application is for high-density aggregate in the concrete shields of nuclear reactors.

   Small amount of basalt is mined cut and polished as dimension/decorative store. This rock is commercially termed as "black granite".

5. Ultramafic rocks: Sheared variety of serpentine later cemented by calcareous mateial is present as allochthons within the melange zone. It is locally quarried for use as polished slabs/tiles. This rock is commercially termed as "Black Zebra" or "Red Zebra".

Metamorphic rocks

Marble/recrystallized limestone: Blocks of Recrystallized limestone of unidentified age are being mined for a long time. The blocks are usually of smaller dimensions and exposed in the melange zone. The main problem of these blocks is their shattered nature and difficult accessibility. However, private sector has been working on these small deposits according to the demand in the market. This limestone is usually pale white to light dirty white and normally used in mosaic tile industry.

Besides the above mentioned variety, the relatively much less disturbed beds of grey and dirty off white marbles ranging in thickness from few centimeters to more than one meter are exposed in the vicinity of Sonaro Village (35 J/5) of Khuzdar district. It is also being quarried in big blocks and transported to Karachi for cutting and polishing.

Orthoquartzite: The orthoquartzite exposures found along Gajri Nai (35 J/8) in Bela tehsil is being quarried for quit some time for use as flux in the steel mills.

Sedimentary Rocks

Limestone: A limestone is a valuable geological resource in the region. Depending upon its colour, texture, composition and hardness it is being mined for different uses.

The Limestone of Jhakker Group (Paleocene-Eocene) which is argillaceous in nature and low in magnesium has the ideal composition as raw material for cement. It is available in large quantities with no overburden and within 50km from Karachi. One cement factory namely the "Attock cement" is already in production and the other namely "Galadari Cement" is being established in Hub tehsil of Lasbela district.

Limestones of Parh and Jhakker Groups exposed near Karachi (toposheet no. 35 K/12 & 16) are the main target of the mine owners for use as decorative stones. The limestone is typically porcellanous and sublithographic. It is variegated and in the referred area light pink, light green and pale white varieties dominate which exhibit lake polish. The beds are characteristically regular, smooth faced and 0.5 to 1.5 meter thick which help in easy mining. Rocks are excavated as blocks which are transported by trucks to factories in Karachi for cutting, polishing and marketing.

CONCLUSIONS AND DISCUSSIONS

1. Politically the area is peaceful, the people are poor, hospitable and looking forward for jobs and other facilities of life.

2. The occurrence of metallic sulphides of zinc and lead and sulphate of barium in Early-Middle Jurassic carbonate and clastic rocks of the area appear to offer high potential for the country.

3. The huge deposits of overall varieties of limestones in the area appear to have a good reserves of high quality raw material for the establishment of huge cement industrial complex in the area for a good economic return.

4. The reserves of good quality decorative stones are huge and transport charges would not be very high due to easy approach to the sites, cheap labour and proximity to the industrial and port city of Karachi.

5. So far as accessibility is concerned, the sites are not very far off from the RCD Highway which passes through the area under investigation and which connects the biggest industrial area of Karachi of Pakistan.

6. The exploitation of the rocks can be economical and a good source of foreign exchange earning.

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