

## An overview of mineral resources of Pakistan\*

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### ABSTRACT

Before independence only a few mineral commodities were mined in Pakistan. But at present, the Geological Survey of Pakistan has identified favourable areas of mineralization of aluminium, chromium, copper, lead, zinc, gold, silver, iron, platinum and tungsten. Similarly, very large deposits of industrial minerals such as gypsum, anhydrite, limestone, dolomite, building stones, rock salt, silica sand, barite, fuller's earth, industrial clays and soap stone and medium sized resources of magnesite, china clay, and bentonite occur in the country. Recent discovery of over 175 billion tonnes of good quality lignite in the Thar coal field has put Pakistan into 11th position in the world among the countries with large coal deposits. After exploitation of these resources Pakistan would be an important mineral producer in near future. This paper briefly presents the overview of mineral resources of Pakistan and also describes the status of metallic and non-metallic minerals.

### INTRODUCTION

In 1947, when Pakistan came into existence only six mineral commodities were being mined on small scale and potential of finding minerals in the area that constituted Pakistan was unknown. The Geological Survey of Pakistan (GSP), through its endeavours, has proved that Pakistan is geologically a unique country. Its landmass consists of rocks formed at oceanic centers, continental and oceanic island arcs, deep oceanic to shallow marine and even continental sediments. These rocks, as elsewhere in the world, have been proved by the GSP to contain a large variety of mineral deposits.

Chromite is the only metallic mineral which is being produced on small scale since before independence. A large scale production of copper from the Saindak porphyry copper deposit will be starting very soon. Large scale mining of zinc/lead deposit of Duddar is also not very far. Favourable areas of mineralization of aluminium, chromium, copper, lead-zinc, gold, silver, iron, platinum and tungsten have been identified and it is expected that soon Pakistan will emerge as one of the important metal producing countries of the world.

It has now been proved that very large deposits of industrial minerals such as gypsum, anhydrite, limestone, dolomite, building stones, rock salt, silica sand, barite, fuller's earth, industrial clays and soap stone and medium sized resources of magnesite, china clay, and bentonite occur in the country.

Only a couple of years back Pakistan had no position on the global map showing countries having substantial coal resources but with the discovery of over 175 billion tonnes of good quality lignite in the Thar coal field, Pakistan has achieved 11th position among the countries having large coal reserves. The coal is found suitable for thermal power generation.

The prospect of making Pakistan an important mineral producing country is quite bright. Geological Survey of Pakistan is doing its best to explore the mineral potential and disseminate data, so as to make people interested in exploration and exploitation of mineral wealth of the country. A national mineral policy will be adopted to attract local and foreign investment in the mineral sector. Data in this paper are mainly taken from different reports of GSP.

\* Key note paper, 1st Nepal Geological Congress

### STATUS OF METALLIC MINERALS

At the time of creation of Pakistan chromite was the only metallic mineral which was being mined on a small scale from Muslim Bagh area in Balochistan. Through the extensive mineral exploration activities, the Geological Survey of Pakistan has established that geological environments suitable for the localization of commercially exploitable ore deposits of important metals such as antimony, aluminium, chromium, copper, lead, zinc, iron and precious metals like gold, silver and platinum exist over large areas of Pakistan (Fig. 1). The Saindak copper deposit discovered by

the GSP will soon come in trial production. It is designed to produce 15,810 tons of copper, 2.76 tons of silver and 1.47 tons of gold per annum. Duddar zinc-lead deposit is also being developed as a large metal mining venture. In this way, Pakistan has a potential sources to become an important metal producing country of the world, however, proper attention is warranted to the mineral sector.

### Aluminium

Bauxite, which is generally used as an ore of aluminium, is found in the districts of Abbotabad,

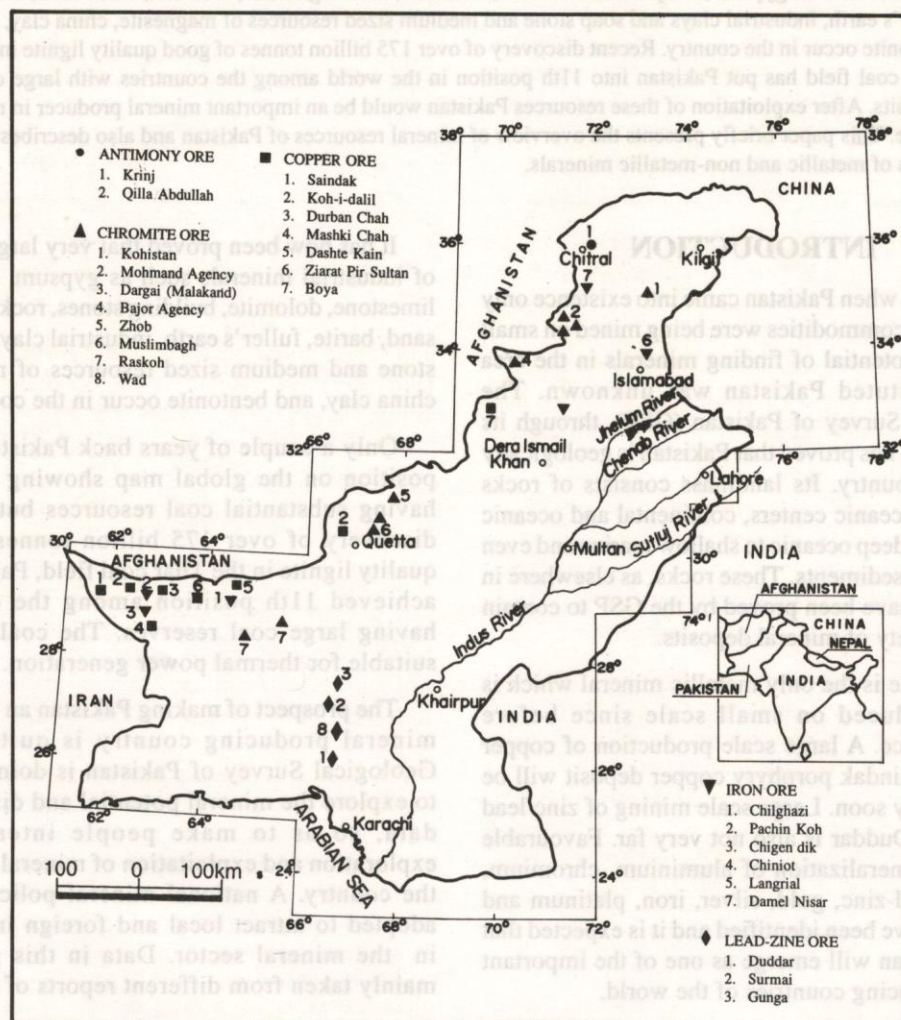


Fig. 1: Locations of major metallic mineral deposits of Pakistan.

Kohat, Attock, Chitral, Ziarat, Kalat, Khushab and in Azad Jammu and Kashmir (AJK). Deposits of the Kalat district and AJK are considered to be the large ones.

**Chromium**

Host rocks favourable for the localization of chromite are exposed in the Lasbela, Khuzdar, Kharan, Muslim Bagh and Zhob districts of Balochistan, Malakand and Kohistan districts of North West Frontier Provinces (NWFP) and Waziristan and Mohmand Agencies of Federal Administrative Tribal Areas (FATA). Fairly large deposits of high to medium grade chromium ore are aspected in these areas. For confirmation, proper exploration activities are warranted.

production have been identified in the Lasbela-Khuzdar region. Duddar lead-zinc deposit has been proved to contain over 10 million tons of high grade ore with over 12% Pb+Zn content. It will be a producing mine in near future. It is expected that the country will soon be an important producer of zinc-lead ore.

**Gold**

Porphyry copper deposits generally contain gold. The Saindak deposit has been estimated to contain 0.75 million ounces of gold. Prospects similar to the Saindak deposit in the Chagai district, when developed, will be the large producer of this precious metal. Large areas with anomalous concentration of gold have also been identified in the northern

**Table 1: Status of metallic minerals.**

Mineral/Commodity	Ore Reserves (in Million Tonnes)	Location	Quality
Alluminium (Laterite/Bauxite)	74	Muzaffarabad-AJK; Ziarat, Kalat - Balochistan, Khushab - Punjab.	Low to medium grade
Chromite	Fairly Large Deposit	Muslim Bagh, Wadh, Kharan-(B) Dargai.	Medium to high grade
Copper	500	Saindak, Chagai - Waziristan areas.	Low to medium grade
Lead/zinc Ore	46	Lasbela, Khuzdar - Basham - NWFP.	Medium to high grade
Gold	0.75 million ounce	Saindak, Chagai - Northern Areas.	Low to medium grade (0.5 ppm)
Silver	82.94	Saindak, Chagai.	Low to medium grade
Iron Ore	400+	Chagai District-Kalabagh/Mianwali.	Low to medium grade
Platinum	Not Estimated	Dargai, Kohistan - NWFP, Muslim Bagh - Balochistan.	Not Estimated
Tungsten	Not Estimated	Chitral - Northern Areas.	Not Estimated
Lithium	Not Estimated	Northern Areas	Not Estimated

**Copper**

Twenty two porphyry copper prospects normally containing large tonnage of low grade ore, have been identified by the GSP in the Chagai district of Balochistan. One of these, located at Saindak, has been proved to contain 412 million tons of ore averaging about 0.4% cu. Massive copper sulphide deposits, with high grade but small tonnage, are expected to be found in Lasbela, Khuzdar and Chagai districts of the Balochistan and Waziristan Agency of FATA.

mountain belt of the country and quite a few commercially exploitable gold deposits are expected in the area.

**Iron ore**

The deposits located so far are either small in tonnage or low in grade. However, it is expected that large deposits of high grade iron ore will be found in the Chagai district of Balochistan and Chiniot area of Punjab. High grade iron ore has also been identified in Dammer Nesar, Chitral.

**Lead-Zinc**

Thirty four carbonate hosted zinc-lead occurrences with potential of commercial

Like-wise, the northern mountain belt has been found to contain good potential for high value metals such as platinum, tungsten and lithium.

## STATUS OF NON-METALLIC MINERALS

A wide variety and vast reserves of non-metallic minerals and rocks occur in almost all the provinces of Pakistan. Although these are being used in local industries and for other domestic purposes but the consumption is not commensurate with the available resources. As a matter of fact potential exists for export of certain industrial minerals (Fig. 2). The brief description of industrial minerals in Pakistan is presented in Table 2.

## Abrasive Minerals

Many minerals and rocks are used in different industries as natural abrasives for grinding, cutting, boring, sharpening, buffing and polishing purposes. The minerals are used either in natural form or after shaping. The abrasive materials include garnet, quartzite, natural sand, etc.

Garnets are found in the Dir, Swat and Kohistan districts of NWFP. Quartzites occur in Cherat, Tarbela and quite a few other places in NWFP and other provinces. Pumice and basalt are found in the

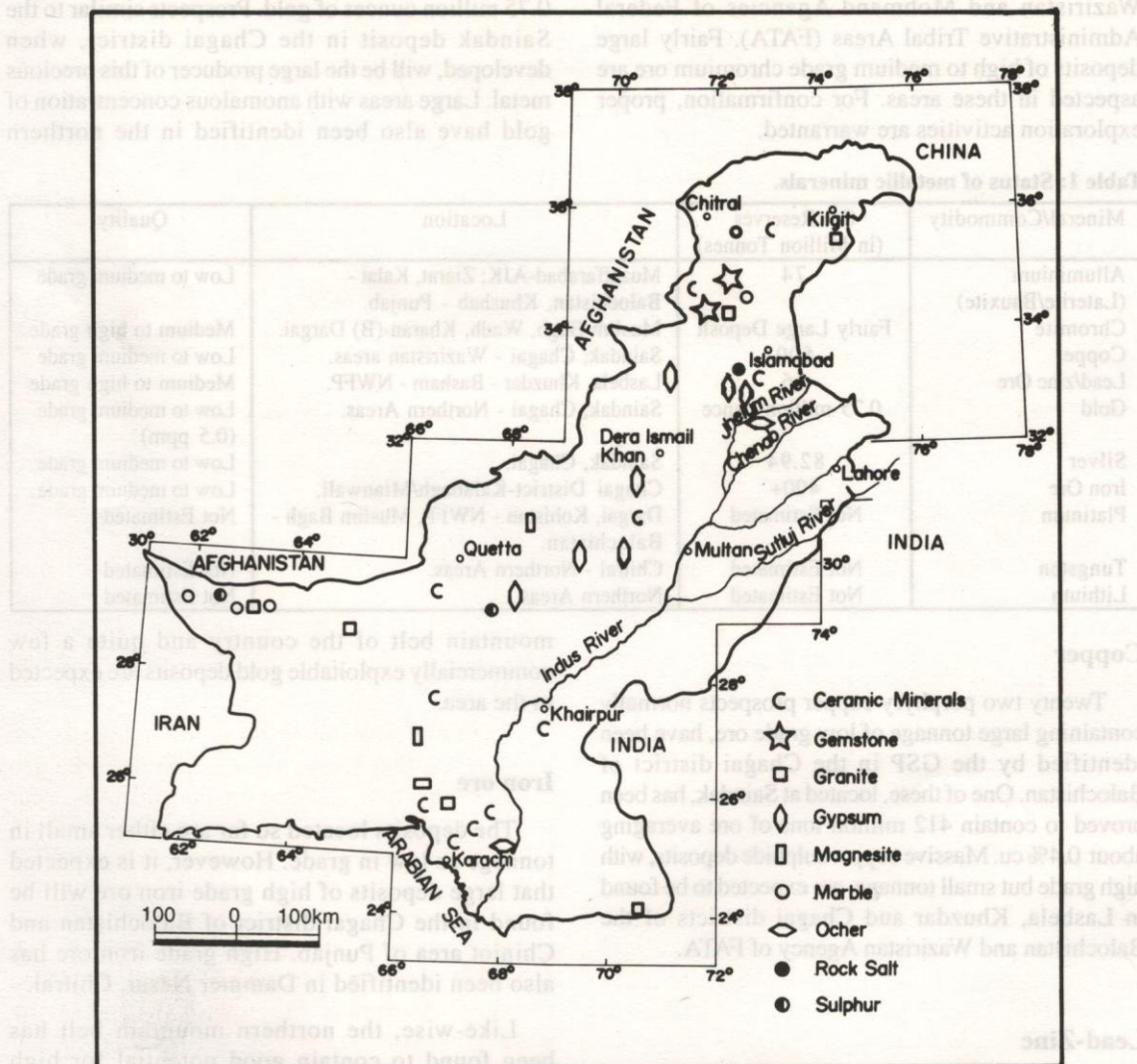


Fig. 2: Locations of major nonmetallic mineral deposits of Pakistan.

Table 2. Status of non-metallic minerals.

Mineral/Commodity	Reserves (in Million Tonnes)	Location	Quality
Barite	30	Lasbela, Khuzdar - Balochistan, Hazara - NWFP.	Mostly drilling mud type
Building Stones	Very Large Deposit	Many districts of Balochistan, NWFP, Sindh.	Good
Cement Raw Material	Very Large Deposit	All provinces of Pakistan.	Very Good
Clays (including China Clay)	34	NWFP - Punjab - Sindh.	Good
Coal	184,000	Sindh, Balochistan, Sindh, NWFP.	Lignite A to Bituminous A
Dolomite	Very Large Deposit	Mianwali, Attock - Punjab Jhimpir - Sindh.	Medium
Fire Clay	100	Kala Chitta and Salt Range - Punjab, Meting Jhimpir - Sindh.	Good
Fluorite	0.1	Kalat.	Good
Fuller's Earth	Fairly Large Deposit	Khairpur, Dadu - Sindh.	Good
Gemstone	Not Estimated	Northern Areas.	Good
Gypsum and Anhydrite	350	Salt Range, D.G. Khan - Punjab Spintangi - Balochistan, Dadu - Sindh	Good
Limestone	Very Large Deposit	All provinces and AJK	Good
Magnesite	12	Abbottabad - NWFP, Muslim Bagh, Wad - Balochistan.	Medium
Marble/Aragonite	Very Large Deposit	Chagai - Balochistan, Noushehra - NWFP.	Very Good
Phosphate	22	Kakul - NWFP.	Medium to low
Rock Salt	Very Large Deposit	Salt Range - Punjab.	Very Good
Silica Sand	Very Large Deposit	Surghar Range - Punjab.	Medium
Soap Stone	0.6	Thano Bulla Khan - Sindh.	Good
Sulphur	0.8	Parachinar, NWFP, Koh-i-Sultan-Balochistan	Medium to low

Chagai district of Balochistan and Northern Areas. Natural sand occurs in all the provinces.

Balochistan. Small reserves of celestite deposits occur in the Dadu district of Sindh.

### Ceramic Minerals

Ceramic minerals include naturally occurring substances used in pottery, sanitary ware and various industries like oil, steel, paper and glass. Major ceramic minerals include china clay, fuller's earth, fire clay, barite, feldspar, fluorite and celestite.

China clay is found in Swat, NWFP and Nagar Parker, Sindh. Fuller's earth occurs in Dadu and Khairpur districts, Sindh. Substantial reserves of fire clay occur in the Salt Range and in D.G. Khan, Punjab. Abundant fire clay deposits are present in the Mianwali, Sargodha and Attock districts of Punjab, Thatta and Dadu districts of Sindh and D.I. Khan district of NWFP. Barite occurs in the Lasbela and Khuzdar districts of Balochistan and Abbottabad district of NWFP. Feldspar deposits are found in the Swat and Chitral districts of NWFP, Gilgit and Skardu districts of Northern Areas and Nagar Parker in Sindh. Fluorite is found in the Kalat district of

### Fertilizer and Industrial Minerals

Fertilizer raw material includes rock phosphate and apatite whereas industrial minerals are gypsum/anhydrite, rock salt, limestone/dolomite, silica sand/glass sand, magnesite, soapstone/talc, ochre and sulphur.

Huge deposits of gypsum and anhydrite are found in the Salt Range and D.G. Khan in Punjab and Kohat district of NWFP. Medium deposits occur at various places in Balochistan and Sindh. Rock salt occurs in the Salt Range in Punjab and NWFP. Limestone and dolomite occur in huge quantities in all the provinces of Pakistan. Silica sand deposits are found in the Mianwali district of Punjab, D.I. Khan and Abbottabad districts of NWFP and Dadu district of Sindh. Magnesite occurs in the Abbottabad district of NWFP, Muslim Bagh area of Balochistan and in the Malakand district of NWFP. Soapstone is found in Kurram and Khyber agencies

and Swat and Abbottabad districts of NWFP. Ochres are found in the Sargodha district in Punjab, Dadu and Thatta districts of Sindh and Ziarat district of Balochistan. Sulphur occurs only in Balochistan in Koh-i-Sultan and Sanni areas of the Chagai district.

**Building Materials**

Building materials and decorative stones are found in abundance in Pakistan. These include marble, building stone, lightweight aggregate and sand, gravel and crushstone.

Marbles of excellent quality and in substantial quantities occur in the Chagai district of Balochistan and Nowshehra district of NWFP. Building stones

of both igneous and sedimentary nature occur in large quantities in almost all the provinces of Pakistan. Lightweight aggregate material is likely to be found in the Chagai district of Balochistan and the Northern Areas. Vermiculite occurs in the Dalbandin area of Balochistan. Sand, gravel and crushstone occur in inexhaustible quantities in all the provinces of Pakistan.

**STATUS OF COAL RESOURCES**

GSP, from its own resources and aided by USAID and USGS, has continued its efforts to explore and establish coal resources of the country (Fig. 3). The efforts of the department have resulted in the recent

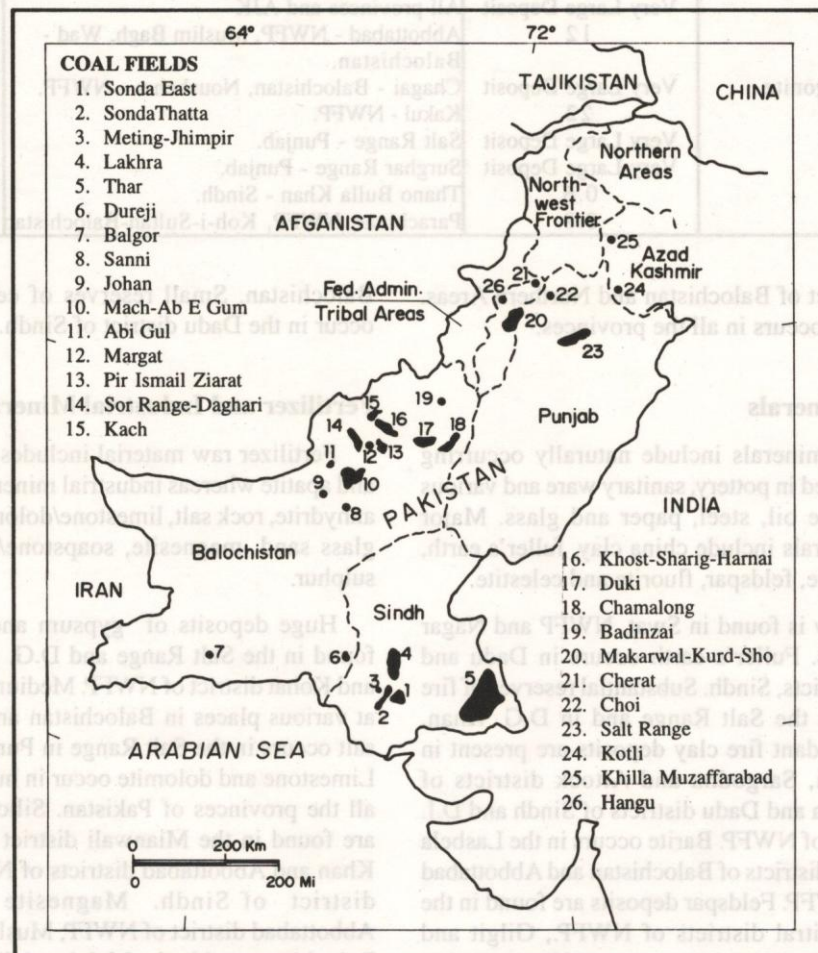


Fig. 3: Locations of Pakistan coal fields and occurrences.

discovery of a large coal field in Thar, Sindh with coal quality suitable for power generation. The coal resources of the country are now projected at more than 184 billion tonnes, out of which 1,686 million tonnes are measured, 5,588 million tonnes indicated 68,350 million tonnes inferred and 109,029 million tonnes hypothetical. Over 97% of these resources occur in the Sindh province, not very far from Karachi, the biggest industrial centre of the country.

The Pakistani coals are lignite A to Hv sub B and generally high in sulphur. However, the latest discovered coal of the Thar desert contains low sulphur. With the erection of three power plants of 50 MW each, based on Lakhra coal, a beginning to utilize indigenous coal for large scale power generation has been made. It is expected that the discovery of low sulphur coal in Thar will encourage investment for the development of huge coal resources of the country for power generation. As a matter of fact a project of 1,320 MW is on line which will use coal from the Thar coal field. Present status of coal resources in Pakistan is given in Table 3.

**Table 3. Status of coal resources.**

Coal Field	Reserves in Million Tonnes					Coal Bank	Sulphur content	Heating value BTU/Lb
	Measured	Indicated	Inferred	Hypothetical	Total			
Sindh	1585.73	5,550.71	68134.88	108851.37	184,123	Lig. A - Sub Bit. A	0.4-6.5	4600-11029
Balochistan	52.50	12.50	130.00	-	195	Sub Bit. C - High volatile Bit. A	04-7.7	7950-12590
Punjab	47.50	21.00	9.50	178.00	256	High volatile Bit. C-B	2.6-10.7	9352-12194
NWFP	0.50	4.50	76.00	-	81	High volatile Bit. C	3.0-5.2	10500-12500
Total	1686.23	5,588.71	68350.38	109029.37	184,655	Lig. A - High volatile Bit. A	0.4-10.7	4600-12590

Lig. Lignite Bit. Bituminous

### CONCLUSIONS

Pakistan has a very good potential for copper mining, particularly in the Chagai arc in Balochistan and Kohistan arc in the northern part of the country where environment for both porphyry and massive type copper mineralization exists. Exploration for Cyprus type massive sulphide copper is being done in Waziristan Agency and there is a strong possibility of finding commercially exploitable deposits in the area. Indications of massive sulphide copper mineralization exist in Lasbela-Khuzdar belt in

Balochistan. About 22 copper prospects have been identified by the GSP in the Chagai district alone.

Carbonate hosted lead-zinc mineralization is another target for exploration in the Lasbela-Khuzdar belt. About 34 prospects have been located by the GSP out of which three have been investigated in some detail and are likely to prove economic deposits. Similar environments exist in NWFP where possibility of finding commercial deposits is quite strong.

Geological environment favourable for localization of gold/silver exists in the Chagai district of Balochistan and northern mountain belt and there are reasonable chances of finding such deposits in these areas. A number of anomalous zones of gold mineralization have recently been identified in the northern areas of Pakistan.

Exploration activities are also likely to lead to proving of economic viability of a number of occurrences of bauxite, chromite, lithium ore and

platinum group elements, particularly in Balochistan and the northern part of the country.

Inexhaustible reserves of limestone, sandstone and dolomite are found in almost all the provinces of Pakistan. Limestone, suitable both for chemical and industrial use is being mined from various parts of the country. Considerable scope exists for enhancing production, and export to other countries where limestone resources are scarce.

Rock salt, gypsum and anhydrite are also available in very large quantities for domestic use as well as for export. Varieties of excellent quality

marbles and other building stones are being mined and marketed both for domestic consumption and for export. Industrial clays and barite resources are also available in large quantities. Their optimum utilization has not been made so far. Reasonable resources of fertilizer minerals, magnesite, talc, silica sand and fluorite are present in the country and there is a lot of scope for their development and utilization in various industries.

Reserves and thickness of coal seams in the coal fields of Balochistan, Punjab and NWFP do not warrant large scale mining because of, (i) thin coal seams (normally less than a meter), (ii) steep dip of

the seams (more than 40°), (iii) present depth of most of the mines (1500 to 2500 feet), and (iv) limited reserves. However, the coal fields of the Sindh province have a good promise for large scale mining due to shallow over burden, low dips and sizable coal seam thickness.

Recently discovered Thar coal field has a very large resource potential (about 175 billion tonnes) and almost horizontal and quite thick coal seams (up to 27 meters). These deposits will be able to support very large open cast mines needed for large thermal power generating units in the country.

Table 3. Status of coal resources.

Coal Field	Reserves in Million tonnes				Coal Rank	Sulphur content	Heating value B.T.U./lb.
	Measured	Indicated	Intended	Hypothetical			
Total	168.33	2,288.71	68130.38	100029.77	L.g. A - High volatile bit. A	0.4-10.7	4600-12390
NWFP	0.20	4.20	76.00	-	High volatile bit. C	3.0-5.5	10500-12200
Punjab	47.20	21.00	9.20	178.00	High volatile bit. A	3.0-10.7	9322-12194
Balochistan	32.20	12.20	130.00	-	Sub bit. C - High volatile bit. A	0.4-7.7	7950-12390
Sindh	128.73	2,250.71	68134.88	108821.77	L.g. A - Sub bit. A	0.4-0.2	4600-11029

Fig. 1. Granite bit. Bismuthous

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Indicative reserves of limestone, sandstone and dolomite are found in almost all the provinces of Pakistan. Limestones, suitable both for chemical and industrial use is being mined from various parts of the country. Considerable scope exists for enhancing production, and export to other countries where limestone resources are scarce.

Rock salt, gypsum and anhydrite are also available in very large quantities for domestic use as well as for export. Varieties of excellent quality