Pak. j. sci. ind. res., vol. 34, nos. 2-3, February, March 1991

MINERALOGICAL AND ANALYTICAL STUDIES OF THE SOUTHWESTERN TANOL BARITE DISTRICT, HAZARA, PAKISTAN

VIQAR HUSAIN, HAMEEDULLAH KHAN, KHALID QURESHI, NISAR AHMAD AND IMTIAZ ALI*

PCSIR Laboratories, Peshawar, Pakistan

(Received December 17, 1989; revised February 19, 1991)

The Southwestern Tanol mineralized area north of Haripur is one of the most promising areas of barite deposits in North West Frontier Province (NWFP). Several vein type barite deposits occur in Lower Cambrian quartzite and dolomite of Abbottabad Formation. Barite veins have a direction that is parallel to the general trend of the host and associated rocks. Barite, quartz, calcite, feldspar, pyrite, illite and chlorite were identified by XRD and microscopy. Barite and quartz are predominant. Some textural features like absence of primary bedding, coarse grain size of barite and cherty quartz with cross cutting relationships suggest an epigenetic origin. To date, Kag deposit has been mined by open pit method to 300 feet below the surface and the ore veins are expected to continue further deep. The mineralization occurs in lens shaped bodies having strike length of several hundred metres. The barite content of vein deposits range from 53-97% $BaSO_4$ and impurities include quartz, calcite, dolomite, pyrite and limonite. The physical and chemical characteristics of barite from this district suggest that these barites are suitable for drilling and chemical industries. They can also be used as a filler in paint, plastic, paper and rubber industries.

Key words: Geochemistry, Barite, Hazara.

Introduction

Barite deposits occur mostly in the Khuzdar-Lasbela region of Balochistan and at several localities near Nathiagali, Haripur, Havelian and Swabi in NWFP (Fig. 1). Pakistan produced 390047 tons of barite in 1986 [1]. Most of the barite produced in the country is consumed by the petroleum drilling industry, with the rest going to the paint industries in Karachi and Lahore. The total barium chemical requirements of the country are being met through imports.

In the south western Tanol barite district, barite is being mined at Kag, Aluli, Darwaza and Chinjiala, the rest deposits have been mined at one time or the other in last two decades. All barite deposits in the district are being mined by small private companies by open pit method. These companies lack technical know-how and mining equipments. It leads to low production of barite, wastages of ore and damage to its reserves in the province. Secondly, the mined barite is neither processed nor categorised for drilling and non-drilling purpose. The dominant gangue mineral is quartz which is not easily separable from the ore.

Barite deposits of this area were first studied by Ali *et. al.* [2] for their geological characteristics. In 1967, Killinger and Richards [3] discussed these barites briefly in their report on the barite deposits of Pakistan. Later, Afridi [4] described general geological characteristics of most of the barite deposits occurring in various parts of NWFP. This paper includes a discussion of field, mineralogical and petrochemical data to conclude that these prospects may be developed into large barite producing mines, provided, modern mining methods are adopted. The physical and chemical characteristics of the ore and marketing pattern of the barite produced from the area have also been discussed.

* Geological Survey of Pakistan, Peshawer.

Materials and Methods

Geologic setting. The south western Tanol barite district lies along the Haripur Bir road and in adjacent areas (Fig.1,43 B/16). The geology and ore deposits in the area were described among others by Ali [5], Calkins *et al.* [6], and Aurangzeb *et.al.* [7]. Accordingly, the lithology of this area is briefly summarized in the Table 1.

TABLE 1.

Formation	Alluvium	Age
Abbottabad	Dolomite member with barite veins	Early
	Quartzite member with barite veins	Cambrian
	Quartz mica schist member	
	Conglomerate member	
	Unconformity	
Tanol	[Quartzite	
Hazara	[Slate	Pre-cambrian

Barite occurs as veins mostly in faintly reddish and highly jointed quartzites and grey coloured dolomite. The distribution pattern of barite is strikingly similar in Kag, Aluli, Darwaza, Soha, Bir, Kacchi and other barite deposits of this district. Generally, barite veins vary from a few inches to several feet in thickness. On the surface, a few inches thick barite veins occur in alternation with quartz veins. The quartz veins with or without barite veins are distributed throughout the district and act as a lithological guide in locating the ore. Observations at Kag open pit mine show that about 10 feet thick barite vein is continuing upto 300 feet below the surface.

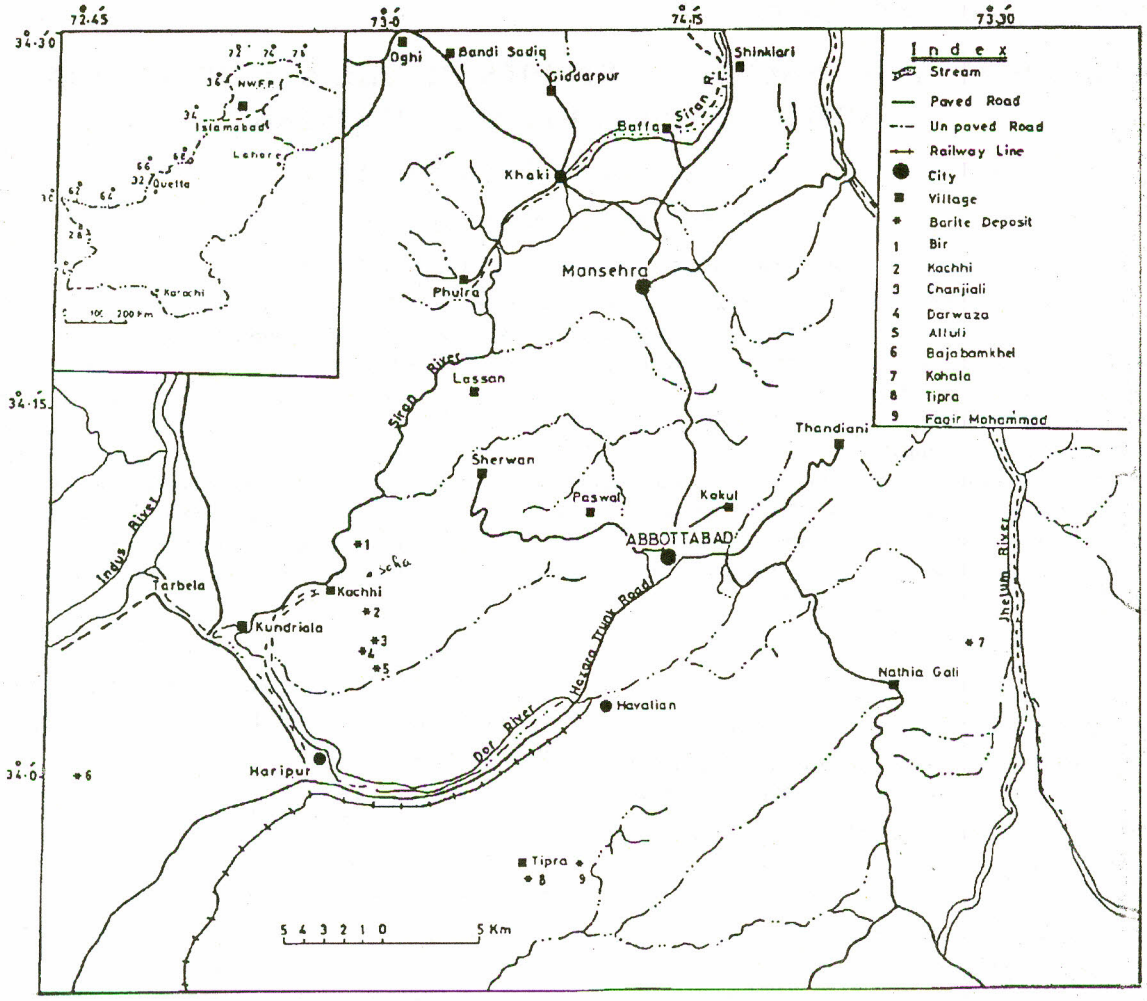

Fig. 1. Map showing the location of barite deposit of Hazara, N.W.F.P.

The vein is expected to continue further deep in the dip direction of the strata. Generally, barite veins occurring in quartzites of Abbottabad Formation consist of three sections. (i) an assemblage of very coarse, platy and acicular white to creamy barite crystals with quartz; (ii) dark grey bands of pyrite and galena with greyish white and irregular pockets of barite (iii) brownish barite with stringes of limonite. While, barite occurring in dolomite member of the Abbottabad Formation is snow-white, massive in texture with brownish shades of iron oxide. Barite veins are sharply delimited against the quartzite but appear merged with dolomite. The principal vein minerals barite and quartz are associated with minor to trace amounts of calcite, dolomite, pyrite, limonite, galena and chalcopyrite.

The major structural feature in the area is the Sherwan syncline [6]. The study area is moderate to highly deformed giving rise to features such as regional folds, faults and local folds. The regional folds are subparallel and have east-west axes. Most of the faults are normal while others are thrust faults [5,7].

Experimental. Thirty samples of barite were collected from the prospects and working mines of about a dozen barite deposits in the district. The specimens mostly collected from the veins of barite varied in weight from 1/2 to 1kg. These samples were crushed to 100-150 mesh for chemical analysis and 200-250 mesh for doing the whole rock mineralogy of each sample by X-ray powder diffraction (XRD). Thin section of each sample was made for doing microscopic study. Chemical analysis of these samples was carried out by conventional and some instrumental methods to determine BaO, SO_3, SiO_2, CaO, MgO, Al_2O_3 etc. (Table 2).

Results and Discussion

Barite mineralization. Total barite in the district is mined from the vein type deposits hosted by quartzites. The barite is generally massive and snow-white in colour. Most often it is mixed with quartz, calcite, pyrite, limonite and chalcopyrite.

Barite mineralization is characterised by open space filling of vugs and fractures [2]. Although the barite minerali-

zation is in the Abbottabad Formation, the principal stratigraphic control seems to be the availability of open space. Barite mineralization also appears to be controlled by structural elements like faults, present throughout the district.

The age of barite mineralization in the study area can be determined indirectly. Its mineralization is younger than Lower Palaeozoic, the age of barite hosting sediments. The mineralized structures cut formations as young as Eocene at Faqir Mohammad barite deposits which are 40 km southeast of the Aluli-Darwaza barite deposits. Although, the Kohala barite deposits near Nathiagali, like many of the showings in Hazara, occur in Lower Palaeozoic rocks, the mineralized faults are the part of the Murree fault system, which is the western extention around the northwest Himalayan syntaxis of the Main Boundary Fault. It places Palaeozoic rocks in contact with the post-Middle Miocene Formation [6]. Hence, mineralization in this region is post-Middle Miocene in age [8].

Mineralogy. The barite district of the southwestern Tanol is characterized by a simple mineral assemblage. Barite and quartz are the most abundant minerals. Calcite, pyrite, limonite, feldspar, cherty quartz and chalcopyrite are rare to minor phases. X-ray powder diffraction results reveal the presence of barite as a major constituent. Quartz is the second most abundant mineral. Very weak reflections of calcite, illite and feldspar indicate their presence in minor quantities.

Petrography. In thin section, barite is white to light brown varying in size from medium to very coarse bladed aggregates. The coarse grains of barite show two to three sets of perfect cleavage (Fig. 2). Within each aggregate, regardless of grain size, the crystals have parallel and elongated nature which may be due to diagenetic microtectonic movement [9]. The pockets of finely recrystallized chert may also be due to such movement (Fig. 3). Clear, transparent and subhedral crystals of barite are common throughout the district. Sometimes, it contains the inclusion of pyrite and limonite (Figs. 4, 5).

Fine to coarse crystals of pyrite of varying shapes are ubiquitous(Figs. 2, 3). Subhedral, clear and coarse grains of

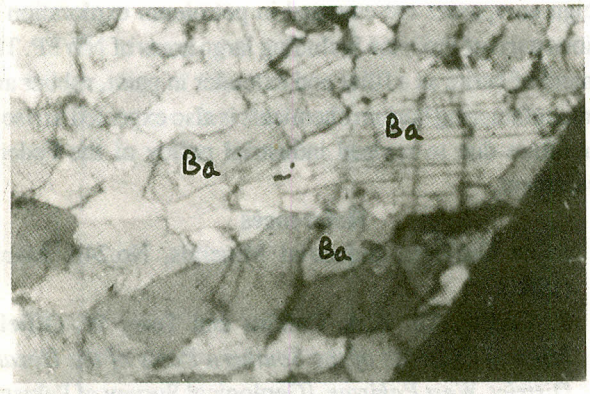

Fig. 2. Coarse bladed grains of barite (Ba) occurring in aggregates and showing perfect sets of cleavage (cross polarized light x 25).

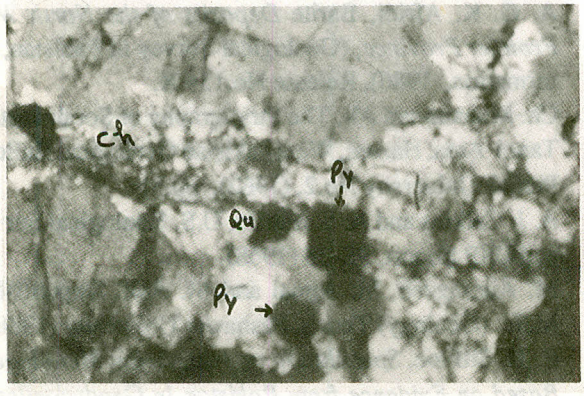

Fig. 3. Coarse to fine crystals of Pyrite (Py) with subhedral grains of Quartz (Qu) and finely crystallized chert (Ch) are common (cross polarized light x 25).

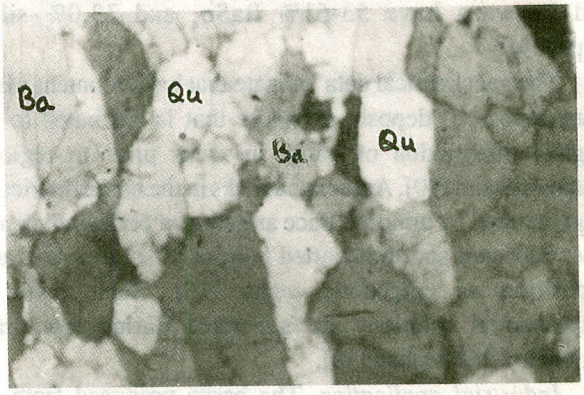

Fig. 4. Barite (Ba) and Quartz (Qu) crystals showing elongated and parallel behaviour (cross polarized light x 25).

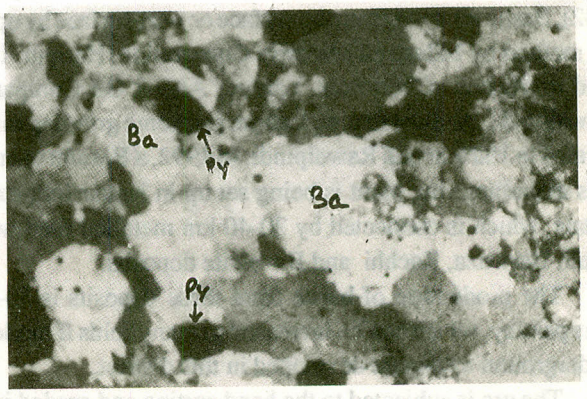

Fig. 5. Transparent and euhedral crystals of Barite (Ba) with inclusions of Pyrite (Py) crystals (cross polarized light x 25).

TABLE 2. CHEMICAL ANALYSIS OF BARITES FROM SOUTH WESTERN TONAL AREA, HAZARA.

Chemical composition %	Aluli-3	Aluli-4	Aluli- 5	Darwaza-1	Bir-1	Bir-3	Bir-4	Bir-5	Soha-1	Kachhi - 1	Kachhi - 2
$BaSO_4$	53.18	89.19	91.47	60.53	8.52	92.80	89.91	95.00	95.27	89.10	93.16
SiO_2	39.12	2.30	2.44	33.24	71.60	0.68	4.12	–	1.06	2.26	0.45
Fe_2O_3	0.40	0.19	–	0.11	0.47	0.18	Nil	–	0.28	0.37	–
Al_2O_3	2.65	5.11	0.61	1.93	10.37	2.10	4.55	0.37	0.61	2.20	0.68
CaO	1.40	0.84	3.65	1.26	1.12	1.68	0.70	2.49	0.84	1.68	3.56
MgO	0.81	1.41	–	0.10	0.81	0.06	0.50	–	0.04	1.61	Nil
Co_2	0.55	Nil	–	Nil	0.02	0.98	Nil	–	0.01	1.23	–
Organic matter	0.19	0.14	–	0.30	0.22	0.12	0.07	–	0.29	0.52	–
Total	98.30	99.18	98.17	97.37	93.13	98.60	99.85	97.86	98.40	98.97	97.85

quartz occur parallel to the barite crystals (Fig. 4). The massive aggregates of barite with interlocking texture typically reflect the open space vein type of mineralization.

Geochemical observations. Barite samples from the Aluli, Soha and Kachhi localities have high contents of $BaSo_4$ (89-95%)The massive, often white coloured barite also have low contents of silica and iron. Some samples from the Aluli and Darwaza have 53-61% $BaSo_4$ and 33.0% silica respectively.

The geochemical data indicate that barite content varies from deposit to deposit, a feature that is attributed to the original distribution of barite in rocks prior to regional metamorphsim [10]. Associated rocks in the barite district are characterized by minor to trace amounts of barite which may have collected and transported barium in solution to barite deposition as epigenetic veins [10]. Such types of hydrothermal solutions are generated during low grade regional metamorphsim [8].

Industrial application. The barite produced from the south western Tanol barite district consists of the three grades of barite i) white to creamy white barite (Sp.Gr. 4.29) ii) darkgrey barite(Sp.-Gr.4.63) iii) brownish white barite (Sp.Gr. 4.42). Barite is mined from the surface or near surface by open pit method by Industrial Minerals Corporation, Haripur. It is sold to Shaheen Chemicals, Lahore; Attock Oil Company, Rawalpindi, Andrews Paint, Lahore and some grinding mills located in Haripur and Rawalpindi. In 1992, a Barium chemicals manufacturing plant is being set up in Hattar Industrial Estate, which is connected by 20-40 km metalled road with Aluli, Darwaza, Kachhi and Bir barite deposits.

The production of barite from these deposits is 10-15 tons per day, which can be increased to many folds if modern underground mines are developed in this district.

The ore is subjected to the hand sorting and graded into three categories mainly on the colour basis. About 60% barite produced from these deposits belongs to the first category (Sp. Gr. 4.29 $BaSo_4$ 89-95%). Major impurities of the barite vein in the district are quartz, calcite, dolomite, pyrite and limonite. Preliminary flotation studies carried out on Aluli barites show that silica and other impurities can be reduced considerably from the low grade barites.

In Pakistan, unlike other parts of the world, the demand of barite for drilling purpose may increase in next couple of years. Besides several local oil companies, about a dozen foreign companies are engaged in petroleum exploration in various parts of Pakistan including large areas of NWFP. The demand of barite as a filler and extender in paint, rubber and for manufacturing barium chemicals is also expected to rise in near future due to revised industrial policy of the Federal government.

References

1. Joyce Griffiths, Industrial Minerals, No.246, March (1988).
2. S. Tayyab Ali, J. A. Calkins and Terry W. Offield, *Mineral Deposits of the Southern Parts of the Hazara District, West Pakistan* (Geological Survey of Pakistan Record, 1964), vol. 13, Part 1, pp.38.
3. F. L. Killinger and R. J. Richards, U.S. Geological Survey and GSP Report, PK-31 (1967).
4. A. G. K. Afridi, Barite *Deposits of the North West Frontier Province*, (Geological Survey of Pakistan, Information, 1986), Release No.134 X.
5. Ch. Muhammad Ali, The Stratigraphy of Southwestern Tanol Area, Hazara, West Pakistan Geological Bulletin Punjab University No.2, (1962), pp.31
6. A. J. Calkins and A. S. Martin, U.S. Geological Survey and GSP Report, PE-38 (1968).
7. M. Aurangzeb, M. Ajmal and M. Asif, Unpublished M.Sc. (Geology) Thesis, Peshawar University (1988).
8. R. H. Sillitoe, *Speculation on Himalayan Metallogeny Based on Evidence from Pakistan in Geodynamics of Pakistan*, Abdul Farah and A. Dejong, eds, (Geological Survey of Pakistan, Quetta, 1979).
9. R. A. Zimmermann and G. C. Amstutz, *Developments in*

Sedimentology, G.C.Amstutz, ed., (Elsevier Publishing Company, 1964), vol. 2.
10. K. R. Dawson, Economic Geology Report 34, Geological Survey Commission, Canada (1985).
11. Personal Communications with Kag-Aluli Mine Workers and Rizvi Mine Owner, Balder, Haripur.