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SPHALERITE ORES FROM KOHISTAN-HAZARA THEIR PETROGRAPHY AND CHEMISTRY
Part I

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Geology, petrography, chemistry as well as liberation studies of the sphalerite ore of Kohistan-Hazara are presented. The ore is also evaluated for different trace elements using atomic absorption spectrophotometric methods.

Key words: Geology, Chemistry. Sphalerite,

INTRODUCTION

Lead-zinc mineralization of galenosphalerite type associated with Lahor pegmatoid granite was first reported by Ashraf *et al* (1980) from Besham area of Kohistan [1]. Later a British economic geologist submitted an encouraging report on the sulphide mineralization in the surroundings of Lahor and Pazang areas. Sarhad Development Authority is also working on the lines suggested by the British expert. Preliminary studies indicate that it is the stratabound volcanogenic sulphide mineralization rather than of Skarn type as noted in the earlier studies. Precious metals are generally associated with such mineralization and hence are of considerable economic significance. A few samples were evaluated for gold and silver by atomic absorption spectrophotometric techniques.

Geology of the area. Besham Kohistan area is situated on both sides of the Karakuram Highway at a distance of about 150 Km from Abbottabad. It has high relief and rugged topography (Fig. 1). The area is geologically complex, having mainly igneous and metamorphic rocks. The igneous rocks consist of granite gneiss and ultramafics. The granites present in the area are the Lahor granite/pegmatoid complex most probably of Precambrian age such as Shang and Mansehra granite gneiss, while the metamorphics include schists and marbles.These rocks lie just to the south of the Main Mantle Thrust of Kohistan (Thahirkheli *et al* 1969). Lahor granite is brownish grey and gives light grey colour on the fresh surface. It is medium grained and gneissic. In Pazang area graphitic granite was also observed. Lead zinc sulphide mineralization lies on the right and left bank of Indus River at Lahorserai and Pazang area respectively around Besham (Fig. 2). The mineralization can be traced along approximately linear belt of about 5 Km. The mineralization is associated with the granite and metamorphics exposed in the Lahor and Pazang areas. The hanging wall of the mineralized zone consists of banded quartzite of greyish colour with

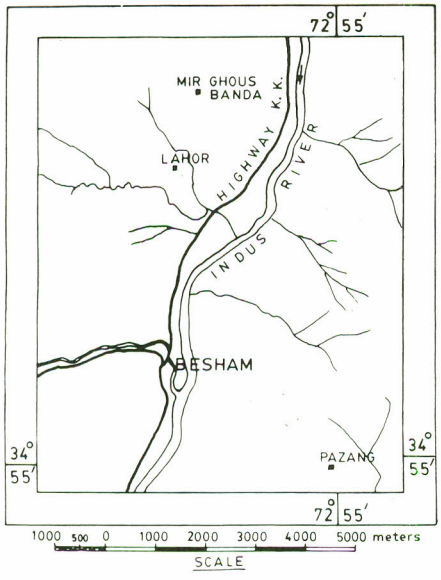

Fig. 1 Location Map.

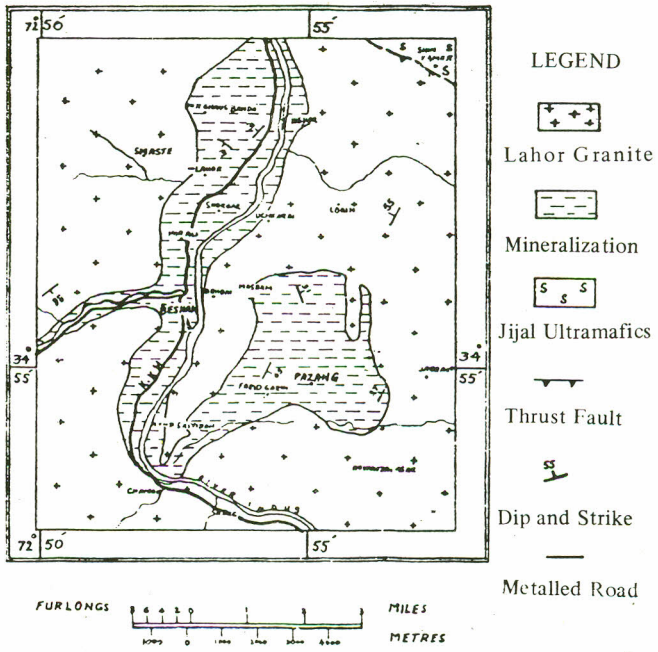

Fig. 2 Geological map of Besham area

chinopyroxene, iron sulphide, rarely seen galena and sphalerite grains. This is followed by gneiss at Pazang and greyish quartzite at Lahor area. While the footwall consists of magnetite carbonate unit.

At Pazang the mineralization is associated with a very distinctive-rock type which weathers to give a nobby and pitted appearence, is usually stained red with limonitic material. The thickness of the mineralized zone varies from 1 m to 1.5 m.

The mineralization at Lahor area is associated with the carbonate rocks, barite and layered silica rich rocks at the same horizon as exposed at Pazang. The mineralized zone can be traced for about 800 meters at a somewhat sinuous strike length. Here the geology is more complex and the area is intruded by a number of quartz feldspar Pegmatities.

The stratigraphical sequence together with the variation in the nature of mineralized material along the strike indicates that mineralization is of volcanogenic exhalative type subsequently metamorphosed along with surrounding rocks. The sulphide mineralization seems to be paralled to the regional strike but discordant locally and post dates the other rock type, favour the idea that it is most probably the stratabound volcanogenic sulphide mineralization, as suggested by Dr. R.C. Leake from U.K. In view of presently available data roughly 5 million tonnes of mineable grade ore is available at Lahor and Pazang areas [2].

Petrography. The petrographic studies of the representative samples collected from Ghaus Banda and Pazang area exhibited the following results.

The samples from Lahor area reveal that the rock is medium to coarse grained having hypidioblastic texture. The subhedral to anhedral grains of ore are distributed along specific zones. Ore is disseminated. Commonly the mineralization is associated with silicification. The rock samples are composed mainly of fine to medium, anhedral grains of quartz which form aggregates of welded grains with subordinate amount of medium grained subhedral and green amphibole. Clinopyroxene and possibly olivine is also observed. Pyroxene is associated with amphibole. The fine orange yellow garnet associated with the ore is most probably the spessartite because of its colour due to the higher manganese contents. Anhedral grains of magnetite and barite are seen in few samples. Subhedral to anhedral epidote occurs as aggregates. Goethite forms grains, and zoisite and calcite are also present.

Sphalerite and galena are in the form of subhedral to anhedral grains and aggregates which occur as disseminations as well as streaks and bands. The sphalerite varies from 5 – 7%, but in few samples it goes up to 10% of the rock.

Other associated metallic minerals are pyrite, chalcopyrite, and pyrrhotite.

The samples from Pazang are fine to medium grained. The rock is hypidioblastic and porphyroblastic. It is composed of subhedral to anhedral grains of amphibole, garnet, quartz, pyroxene with zoisite, limonite, biotite and muscovite.

Sphalerite and galena are fine to medium grained. They are subhedral to anhedral. The associated metallic minerals include pyrite, chalcopyrite, pyrrhotite and magnetite.

Microscopic studies of some are samples show that the minerals present are in the form of network of veins. Sphalerite is fine grained and exhibit brownish grey colour. It occurs as independent grains. Sphalerite of Lahore area seems to be coarser in grain size and less intimately intergrown with other sulphides as compared with Pazang ore.

The size of the sphalerite grains varies from few to 250 microns but major portion lies between 100 to 150 microns.

Modal analysis. Representative samples of the sphalrite ore from Lahor and Pazang areas were crushed and ground to separate valuable minerals from the gangue. Sieve analysis of the ground samples were undertaken and the fractions collected were of 60,80,100, 150 and 200 mesh sizes (B.S.S.). Microscopic study was carried out to estimate the extent of grainding required for separations and was obtained by comparison between the grain size in ore samples and the average particle size after comminution.

Modal analysis of each fraction was carried out using the swift point counter. The particles were classified as free sphalerite, gangue and locked or compound grains as shown in the Table.

Mesh size (BSS)	Sphalerite	Compound (grains)	Gangue
– 60 + 80	4.14%	21.89%	73.96%
– 80 + 100	9.04%	14.29%	76.66%
– 100 + 150	13.36%	6.46%	80.17%
– 150 + 200	13.57%	2.14%	84.28%

The liberation studies show that the material of 100-150 mesh size (BSS) may be suitable for the upgradation of the sphalerite of Kohistan. However, detailed pilot plant studies are required for the further confirmation of these results to enable the economic utilization of these deposits.

RESULTS AND DISCUSSION

Chemical composition: Samples from various localities of Besham Kohistan area were analysed by conven-

Table 1 (a). Chemical analyses of the sphalerite ore (major elements)

Sample No.	Loss on ignition	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Na_2O	K_2O	PbO	ZnO	MnO_2	Total
1.	9.20	38.54	8.09	12.11	8.48	2.82	0.12	0.08	16.53	2.15	1.57	99.68
2.	2.04	37.69	8.68	20.84	2.09	1.42	0.50	0.12	18.93	3.84	3.54	99.69
3.	10.27	41.91	11.40	15.54	4.19	0.58	0.31	0.11	13.26	0.68	0.79	99.04
4.	4.37	22.44	14.40	27.28	6.64	1.92	0.08	0.02	13.57	6.58	1.79	98.75
5.	6.19	39.21	5.62	17.47	8.74	2.53	0.05	0.01	18.42	0.18	1.21	99.63
6.	11.95	30.01	7.09	10.79	13.39	0.64	0.15	0.10	24.47	0.08	1.01	98.96
7.	2.19	56.26	11.36	13.97	1.94	0.38	0.63	0.25	10.58	1.47	0.13	99.56
8.	4.79	60.22	9.90	91.07	1.95	0.51	0.53	0.18	9.86	0.93	0.13	99.97
9.	8.19	60.23	9.90	16.07	1.95	0.91	0.73	0.35	0.63	Nil	0.09	99.05
10.	7.86	33.47	15.49	26.91	2.76	1.82	0.42	0.13	6.64	3.02	1.40	99.92
11.	5.39	80.71	2.85	6.14	1.95	0.84	0.21	0.03	0.95	0.78	0.09	100.21
12.	5.73	60.33	9.95	18.40	0.83	0.71	0.48	0.21	1.41	1.42	0.19	99.66
13.	5.43	47.67	5.61	34.17	0.16	1.42	0.32	0.10	1.92	1.59	1.19	99.58
14.	13.55	55.84	11.36	13.26	0.83	0.91	0.72	0.28	0.98	1.72	0.19	99.64
15.	14.50	60.25	7.12	4.35	2.79	0.58	0.63	0.31	8.80	0.38	0.11	99.82

*Percent composition.

Table 1 (b). Analyses of the sphalerite (trace elements) (percent).

Sample No.	Co	Cu	Ni	Cr	Au	Ag
1.	Nil	0.48	Nil	Nil	Nil	0.05
2.	"	0.09	"	"	"	0.01
3.	"	0.03	"	"	"	Nil
4.	"	0.23	"	"	"	0.07
5.	"	0.23	"	"	"	0.03
6.	"	0.12	"	"	"	Nil
7.	"	0.23	"	"	"	0.01
8.	"	0.06	"	"	"	Nil
9.	"	0.14	"	"	"	"
10.	"	Nil	"	"	"	"
11.	"	"	"	"	"	"
12.	"	0.35	"	"	"	"
13.	"	0.21	"	"	"	"
14.	"	0.35	"	"	"	"
15.	"	0.11	"	"	"	"

tional as well as instrumental methods. Lead and zinc were determined by volumetric and gravimetric methods of analysis [3]. The associated trace elements i.e. Mn, Co, Cu, Ni, Cr, Au, Ag, Na and K were determined using A.A.Spectrophotric techniques [4-5]. Results of the analyses are given in Table 1 (a & b).

CONCLUSION

The ore is geologically complex having mainly igneous and metamorphic rocks. Petrographic studies show that Zn-pb and Cu minerals are mainly present in the form of sulphides with subordinate amounts of quartz, amphibole, garnet, epidote and pyrite.

The average content of Zn as its oxide is 2.7% and Pb is 9.8% whereas Cu, Mn and Ag is 0.2, 0.9 and 0.04% respectively.

The separation studies indicate that material of 100-150 mesh may be suitable for the upgradation of the sphalerite of Kohistan.

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