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ELECTRON MICROPROBE ANALYSIS OF CHALOCOPYRITE PYRROHOTITE AND CUBANITE FROM THE COPPER DEPOSITS OF KHO- DARIBA -BHAGONI, ALWAR DISTRICT, RAJASTHAN (INDIA)

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Electron Microprobe Analysis of Chalocopyrite Pyrrohotite and Cubanite from the Copper Deposits of Kho - Dariba - Bhagoni, Alwar District, Rajasthan (India)

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Abstract – The electron microprobe analysis reveals the complete chemical analysis of mineral at specific point and variation in mineralogical composition from centre to rim of the individual grain. Moreover concentration of major elements down to 0.1Wt% can be determined with an accuracy of a fraction of 1%. The ore consists of chiefly of Chalcopyrite Pyrrhotite, Cubanite, Pyrite, Mackinawite, Pentlandite in order of abundance. Chalcopyrite occurs as coarse grained anhedral aggregate and has inclusions of Pyrrhotite, Cubanite, Pyrite and pentlandite. It shows excellent intergrowth with Pyrrhotite. Pyrite occurs as anhedral grain and deformed grains are very common. Pyrrhotite occurs as massive anhedral aggregate. Elongated and deformed bodies of Pyrrhotite are also common Cubanite commonly occurs as laths in coarse grained Chalcopyrite. Cubanite lamellae are quite clear after etching. Presence of exholved bodies such as Cubanite, Pyrrhotite is a unique feature of this deposit. Previously existing mineral phases, under falling temperature conditions unmixed to form two phases, stable at lower temperature result in the formation of exholved bodies. A feature of great interest in the sulphides of this deposit lie in occurrence of a variety of intergrowth textures. Exsolution and myrmeketic texture are abundantly present in various sulphides.

Key words: analysis, coarse, grained, aggregate, deposit, textures.

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MINERAGRAPHY AND TEXTURE

Kho-Dariba-Bhagoni Copper deposits belonging to Proterozoic Supracrustal of Delhi Supergroup lying unconformably over Archaean Banded Gneissic complex situated in north- eastern part of Alwar district, Rajasthan. The rock units exposed in and around Kho-Dariba area belongs to Dogeta and Tehla formation of Raialo group. The principal rock units are quartzite, marble, dolomitic marble, phyllite, quartz-biotite-sericiteschist, quartz-biotite-clinozoisiteschist and amphibolites. Phyllitesis the host rock for mineralization. Chalcopyrite is the most abundant sulphide of the deposit with pyrrhotite next in order of abundance. Metallogenesis of the deposit is characterized by Cu- Fe- S phase with Pb – Co – Ni – Ag – As - Sb as minor trace elements. The mineralization is syngenetic and the process of remobilization helped in localizing the ore bodies. Intergrowth texture is a characteristic feature of the deposite. Most of these textures are designated as graphic, subgraphic or micrographic by earlier workers (Bastin, 1950; Edward, 1963; Brett and Kullrud 1965; craig and Kullerud, 1968) ore microscopy has revealed that myrmeketic lamellar and exsolution textures are abundantly present in various sulphides of this deposit.

MATERIAL AND METHOD

Electron Microprobe Analysis

Electron microprobe analysis has revolutionized the ore mineralogy not only by enabling the complete chemical analysis of a very small grain and identification of minerals but it also help in establishing the phase relation in the ore minerals. It is commonly employed in conjunction with ore microscopy.

A large number of samples were collected from different ore lenses for the preparation polished section and polished thin section. Five samples of different ore bodies were sent to University of Science and Instrumentation Center, Roorkee for microprobes analysis.

The electron microprobe analysis reveals the complete chemical analysis of mineral at specific point and variation in mineralogical composition from centre to rim of the individual grain (Table- 1). Moreover concentration of major elements down to 0.1Wt% can be determined with an accuracy of a fraction of 1%

A beam of electron in a potential field of 10 - 40 Kv is incident upon the specimen. This beam of electron excites the emission of X-Rays, characteristics of element present in the sample. With the help of energies and intensities of emitted X- Ray, the composition of the sample can be determined. The analytical conditions used for the analysis were as follows :-

(a) Sample current = 20 kv, 20na.

(b) Samples were carbon coated.

(c) Natural mineral standards and pure elementary standards were used.

Nowadays electron microprobe analysis has become increasingly useful in analyzing traces /minor elements in crystals, in solid solutions and in analyzing variation in constituent elements in zoned / rimmed crystals and thus helps in genetic interpretations. Moreover with the help of this technique the analysis can be done quickly and without destroying the material.

Chemical Analysis

The chemical analysis of various sulphides are as follows :-

Table -1. Electron Microprobe Analysis of Chalcopyrite

(Showing variation in constituent elements)

UNK	D- -6		M- -5		D- -10		KB- -24		D- -9		Mean
No.	1	2	1	2	1	2	1	2	1	2	
Cu	32.603	31.117	32.153	32.627	33.395	34.097	33.150	32.254	32.640	32.761	32.680
Fe	33.343	31.977	33.16	33.223	32.881	34.107	33.866	33.600	33.582	33.698	33.344
Zn	--	--	--	--	--	--	--	--	---	--	--
S	33.951	33.567	35.424	34.193	33.497	33.848	33.343	33.245	34.500	34.559	34.213
Pb	0.067	0.05	0.075	0.157	0.036	0.086	0.078	0.204	--	0.038	0.080
Total	99.964	97.714	100.812	100.199	99.809	102.14	100.35	100.3	100.72	101.06	100.32

Point 1 is in the core and point 2 is at the periphery of the same grain.

Atom

UNK	D- -6		M- -5		D- -10		KB- -24		D- -9		Mean
No.	1	2	1	2	1	2	1	2	1	2	
Cu	23.648	22.873	22.945	23.558	24.336	24.350	24.058	23.300	23.441	23.464	23.601
Fe	27.520	26.746	26.926	27.342	27.200	27.715	27.964	27.618	27.443	27.628	27.400
Zn	--	--	--	--	--	--	--	--	--	--	--
S	48.815	50.367	50.11	49.023	48.388	47.915	47.926	49.359	49.115	49.064	48.980
Pb	0.014	0.012	0.016	0.348	0.008	0.018	0.017	0.045	--	0.008	0.017
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Point 1 is in the core and point 2 is at the periphery of the same grain

Table -2 Microprobe Chemical Data of Chalcopyrite

(Sample No. M5)

	Peak Pos	Peak C/S	Bkg C/S	K-Ratio	Weight%	Atomic%
S	61392	3264.3	16.1	0.5606	32.94	51.08
Fe	48079	3123.3	34.3	0.6472	27.64	24.61
Co	44424	29.7	26.8	0.0002	0.00	0.00
Ni	41161	27.6	29.7	0.0000	0.02	0.02
Zn	35632	37.5	39.6	0.0000	0.00	0.00
Cu	38253	2936.8	55.9	0.2753	30.98	24.24
Sb	39297	24.8	28.8	0.0000	0.00	0.00
Au	66776	5.5	5.1	0.0002	0.03	0.01
Ag	47478	10.9	8.4	0.0007	0.09	0.04
As	37666	12.0	11.9	0.0000	0.00	0.00
Pb	60385	8.6	8.4	0.0001	0.01	0.00
Total					91.72	100.00

Table -3 Microprobe Chemical Data of Chalcopyrite

(Sample No. D10)

	Peak Pos	Peak C/S	Bkg C/S	K-Ratio	Weight%	Atomic%
S	61392	3225.8	13.9	0.5549	32.63	50.91
Fe	48079	3117.3	34.8	0.6466	27.61	24.73
Co	44424	28.3	28.8	0.0000	0.00	0.00
Ni	41161	24.9	29.7	0.0000	0.01	0.01
Zn	35632	37.5	40.7	0.0000	0.00	0.00
Cu	38253	2910.8	44.4	0.2742	30.86	24.30
Sb	39297	26.9	26.0	0.0002	0.01	0.00
Au	66776	3.7	5.7	0.0000	0.00	0.00
Ag	47478	8.7	6.6	0.0005	0.08	0.04
As	37666	11.6	15.4	0.0000	0.00	0.00
Pb	60385	8.5	8.8	0.0000	0.00	0.00
Total					91.19	100.00

Table -4 Microprobe Chemical Data of Cubanite

(Sample No. KD-24)

	Peak Pos	Peak C/S	Bkg C/S	K-Ratio	Weight%	Atomic%
S	61392	3339.5	16.3	0.5743	33.34	50.96
Fe	48079	4053.6	35.6	0.8429	36.80	32.39
Co	44424	28.2	27.5	0.0001	0.01	0.00
Ni	41161	27.8	29.0	0.0000	0.00	0.00
Zn	35632	37.4	37.8	0.0000	0.00	0.00
Cu	38253	2018.0	46.0	0.1887	21.49	16.63
Sb	39297	23.2	28.6	0.0000	0.00	0.00
Au	66776	4.7	5.1	0.0000	0.00	0.00
Ag	47478	9.7	10.6	0.000	0.00	0.00
As	37666	12.1	11.4	0.0002	0.01	0.01
Pb	60385	9.1	7.9	0.0007	0.07	0.02
Total					91.62	100.00

Table -5 Microprobe Chemical Data of Pyrrhotite

(Sample No. D9)

	Peak Pos	Peak C/S	Bkg C/S	K-Ratio	Weight%	Atomic%
S	61429	3330.9	18.4	0.2963	35.01	51.95
Fe	48081	6040.4	40.5	0.5194	56.35	48.00
Co	44421	30.3	27.9	0.0002	0.02	0.03
Ni	41166	33.5	30.1	0.0003	0.03	0.02
Cu	38252	32.6	32.8	0.0000	0.00	0.00
Sb	39300	25.4	27.2	0.0000	0.00	0.00
Au	66782	5.3	4.8	0.0002	0.03	0.01
Ag	47478	9.1	9.4	0.0000	0.00	0.00
As	37677	15.5	14.9	0.0000	0.00	0.01
Total					91.44	100.02

Table -6 Microprobe Analysis of Chalcopyrite

(At.Wt.% Average of three points in each grain)

Elements	Grain I	Grain II	Grain III	Grain IV	Grain V
S	32.94	32.63	34.64	34.94	33.80
Fe	27.64	30.61	30.04	29.62	30.26
Co	0.02	0.00	0.05	0.00	0.00
Ni	0.00	0.00	0.01	0.01	0.04
Cu	30.98	33.86	34.29	34.54	34.56
Sb	0.00	0.01	0.05	0.01	0.00
Au	0.03	0.01	0.00	0.14	0.00
Ag	0.09	0.08	0.01	0.01	0.00
As	0.00	0.01	0.00	0.00	0.03
Pb	0.01	0.00	0.01	0.00	0.02
Total	91.71	97.21	99.10	99.27	98.71

Table -7 Microprobe Analysis of Pyrrhoitite

(At.Wt.% Average of two points in each grain)

Elements	Grain I	Grain II	Grain III
S	32.69	35.01	34.90
Fe	56.56	56.35	56.20
Co	0.06	0.02	0.02
Ni	0.01	0.03	0.03
Cu	0.00	0.00	0.00
Sb	0.00	0.00	0.00
Au	0.00	0.03	0.01
Ag	0.01	0.00	0.02
As	0.00	0.00	0.00
Total	89.33	91.44	91.18

CONCLUSION

1. The study of microprobe chemical data of various sulphides(Table -2,3,4,5) and microprobe analysis(At. Wt %, Table 6,7) and variation in constituent elements (Table-1) indicate that the massive ore chiefly consist of chalcopyrite, pyrrhotite and cubanite in order of abundance constituting more than 90%of the ore minerals.

2. The comparative study of various sulphides assemblage indicate a quantitative and qualitative variation in mineralogy. The variation in mineral composition in percentage from core to rim is shown in Table-1

3. The metallogenesis of the deposit is chiefly characterized by Cu-Fe-S phase. The presence of Pb – Co- Ni- Ag- As- Sb- have also been recorded in the form of trace/ minor elements.

4. The average combined concentration of trace / minor elements in chalcopyrite is 0.13%, similarly the average combined concentration of minor/ trace element in pyrrhotite is 0.8%.

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