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Electrochemical Trace Analysis of Sphalerite in Ore for its Metal Content

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Abstract

Sphalerite (zinc blende), is a most common zinc ore ((Zn,Fe)S) it is a mineral that is the chief ore of zinc The composition of sphalerite are 67% Zn, 33% S with varying amounts of iron and manganese, and other elements. a sphalerite ore sample obtained from Rajpur Dariba, Udaipur district, Rajasthan India. Element the method of standard addition was used for quantitative analysis. The DC and DP Polarograms of the sample saluting (Fig 3 a, b)showed well defined waves / peaks with E½ / Ep values = -0.08/-0.09, -0.24/-0.28, -0.40/-0.42,-0.49/-0.50,-1.14/1.16,-1.2/1.3, -1.32/1.28,-1.56/-1.57,-2.36/2.38, V vs. SCE in DCP/DPP mode Indicating the presence of Au, Cu, Pb, Cd, Zn, Mn, Fe, Ga, Mg, Finally the obtained polarography analysis results on sphalerite ore sample and their comparison with atomic absorption spectroscopy Method.

Keywords*:* **Ammonium Tartrate, Potassium Chloride, distilled water, Polarography, AAS**

INTRODUCTION

Sphalerite (zinc blende), is a most common zinc ore ((Zn,Fe)S) it is a mineral that is the chief ore of zinc(1) The compositon of sphalerite are 6 7% Zn, 33% S with varying amounts of iron and manganese, and other elements(2). It consists largely of zinc sulphide in crystalline form but almost always contains variable iron sphalerite is also extracted for use in dietary supplements and rust-proofing materials Normally, it is used for making copper, lead and silver Sphalerite also can be used to make batteries, brass, pigments and medicine It alters to hemimorphite, smithsonite, and willemite Sphalerite can make a rather attractive specimen as well On rare occasion it is cut into a collector only type gemstone it a very sparkly crystal Gemologists usually add sphalerite to their collections as it can be polished to create a beautiful presentation It can also be cut for use in jewellery.

EXPERIMENTAL

The ore Sample sphalerite was procured from the Geology department of autonomous science college Jabalpur (MP). According to their information they had collected it from Rajpur Dariba, Udaipur district, Rajasthan

APPARATUS

Polarographic measurement were done on elico modelCL32banglore India Three electrode system consisting of a dropping mercury electrode (DME) as the working electrode, AgAgcl reference electrode a coiled platinum wire as auxiliary electrode and a saturated calomel electrode (SCE) as reference electrode(3,4)

CHEMICAL AND REAGENTS

All the chemicals used were of Anala R/BDH grade, stock solutions of, ammonium tartrate, (each 1M) and potassium Chloride Au, Pd , Cu, Co ,Cd, Fe, Mg, and Mn, Ga, In (each 0.01M) were prepared by dissolving requisite amounts of their soluble salts in double distilled water Gelatin (0.01%) solution was prepared in hot distilled water solutions were standardized by known methods and diluted as required.

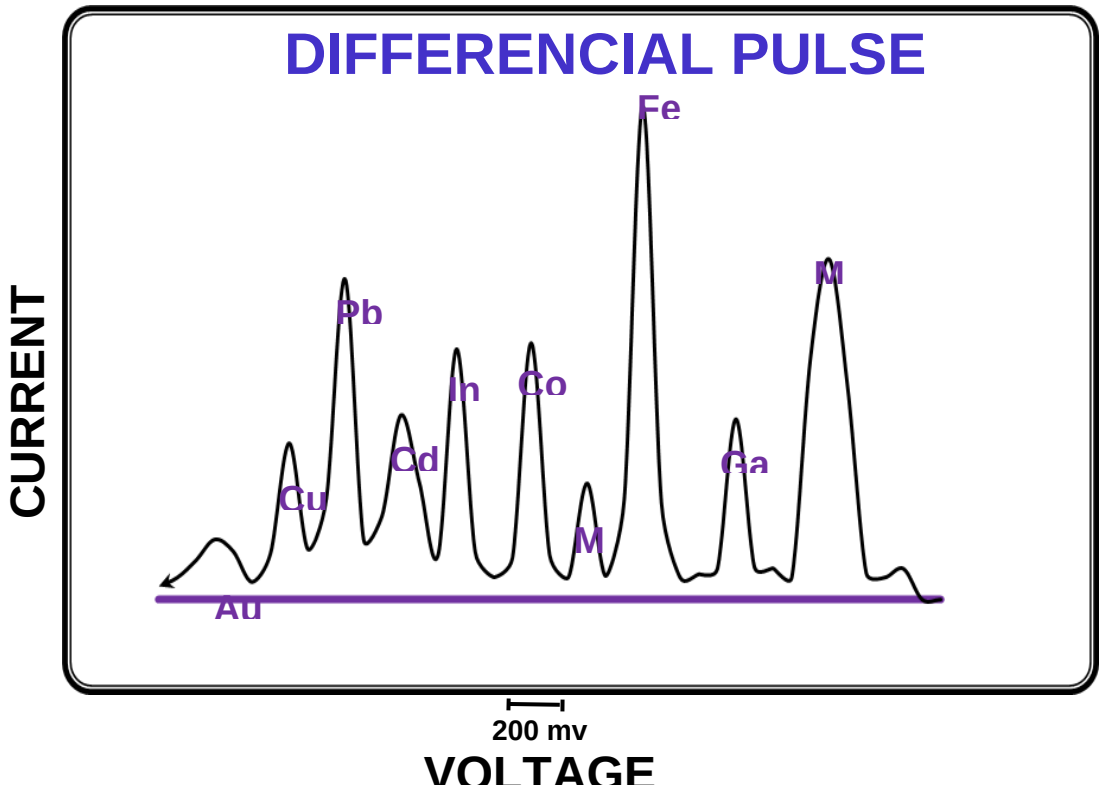
SAMPLE PREPARATION FOR POLAROGRAPHY

Ammonium Tartrate :-The sample solution (10 ml) was mixed with 10 ml of 1 M ammonium tartrate as supporting electrolyte and 0.01% gelatin as maximum suppresser was taken in a polarographic cell and, the final volume was made up to 100 ml with distilled water The pH of the test solution was adjusted to 9.0 ± 0.02, with ammonia solution Pure nitrogen gas was bubbled through the test solution for 15 min and the pH of the test solution was checked before recording the polarogram The results confirmed the presence of Au,Pb,Cd,Zn,Ga,Mg, in the sample.

Potassium Chloride: - To 10 ml of the sample solution 20 ml of KCI (1M) as supporting electrolyte, were added and the final volume was made up to 100 ml with distilled water. The pH of the test solution was adjusted to 4.0 ± 0.02. The analyte was taken in a polarographic cell and pure nitrogen gas was passed through the solution for 15 min at the onset of the experiment. The voltammogram were then recorded. The results confirmed the presence of Cu,Fe and Mn,, in the sample.

RESULT AND DISCUSSION ORE SAMPLE

The DC and DP Polarograms of the sample saluting (Fig 3 a, b)showed well defined waves / peaks with E½ / Ep values = -0.08/-0.09, -0.24/-0.28, -0.40/-0.42,-0.49/-0.50,-1.14/1.16,-1.2/1.3, -1.32/1.28,-1.56/-1.57,-2.36/2.38, V vs. SCE in DCP/DPP mode Indicating the presence of Au, Cu , Pb, Cd,In ,Zn ,Mn, Fe,Ga, Mg,



To confirm which increased the observed wave / peak height of each metal ion signal without any change in E½ / Ep values. The linear relationship between the concentration of each metal ion and the corresponding wave / peak height was also unchanged confirming the possibility of an accurate simultaneous qualitative and quantitative determination of the metal ions in the sample. They produced well defined waves/ peaks with same E½ / Ep values. Quantitative analysis of the sample using DCP and DPP of Ag, Cu, Pb,Cd,Sn,Ni,Zn,Fe and Cr in the sample were carried out by using DCP and DPP methods. Spiked samples were prepared in order to evaluate the concentrations of each metal ion, the results

TABLE 1.1: POLAROGRAPHIC ANALYSIS RESUTS ON THE SPHELERITE SAMPLE (mg/100 mg)*FOR IT'S METAL CONTENT

Metal Ion	Parameter	By DCP			By DPP		
		Added		Found	Added		Found
Au(I)	Amount % Rec SD **	- 0.011	 95.5 0.002	0.013 0024	- 0.012	 98 0.001	0.015 0.027
Cu(II)	Amount % Rec SD **	- 1.26	 99.2 0.011	1.28 2.54	- 1.270	 99.2 0.001	1.270 2.540
Pb (II)	Amount % Rec SD **	- 2.16	 99.5 0.020	2.26 4.42	- 2.16	 99.4 0.020	2.19 4.35
Zn(II)	Amount % Rec SD **	- 54.09	 100 0.003	55.06 109.15	- 54.09	 99.5 0.003	56.09 110.18
Mn(II)	Amount % Rec SD **	- 0.125	 96.2 0.006	0.125 0.250	- 0.125	 99.1 0.007	0.141 0.266
Mg(II)	Amount % Rec SD **	- 9.03	 99.8 0.004	9.025 18.05	- 9.04	 99.6 0.003	9.04 18.08
Ga(II)	Amount % Rec	- 2.065	 97	2.015 4.080	- 1.065	 97.2	1.014 2.079

	SD **		0.004			0.002	
Fe(III)	Amount % Rec SD **	- 11.15	 100 0.005	11.12 22.27	- 11.15	 100 0.006	 11.17 22.32

The results indicated that the percentage recovery is over 97% for all the metal ions, with high accuracy and precision of the determination.

Table – 1.2 Final analysis results on SPHELERITE ore sample and their comparison with AAS
TABLE 1.2

Metal ion	**Polarographic (DCP)**	**AAS**
	(mg g^{-1} of the sample)	
Au (I)	0.13	0.15
Cu (II)	12.8	12.7
Pb (II)	22.6	23.00
Cd (II)	5.4	5.5
Zn(II)	550.6	550.9
Mn (II)	1.25	1.25
Mg(II)	90.25	90.25
Fe (III)	111.2	110.2
Ge (II)	20.15	20.17

CONCLUSIONS

The Polarographic method a simple, economical and eco-friendly methodology for pre concentration and separation of trace element in various ores samples prior to their analysis by DCP. The present method has added advantages over the reported methods:

A. Synthesis of metal at ordinary laboratories was simple and economical.
B. Synthesized organic reagent is distinct in terms of sensitivity, selectivity towards metal ions.
C. The comparative data are shown in the table Although the Polarographic and AAS data, are in good agreement for the Cu, Pb, Cd, Fe,Zn,Mn and Mg,content of the sample but AAS failed to determine Au under existing situations .

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