

## SPECTROSCOPIC ANALYSIS OF CERTAIN GALENAS, SPHALERITES, AND PYRITES

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To supplement a study of some sulfide minerals by Dr. W. H. Newhouse of the Department of Geology of the Massachusetts Institute of Technology, the complete qualitative analysis of sixteen samples was undertaken by means of the emission spectra. The spectroscopic method of analysis was adopted to detect in the samples important traces (0.01% to 0.001%) of elements, particularly chromium, tungsten, vanadium, and molybdenum, that were suspected but whose determination by other means would have been laborious and uncertain. The results of the analysis demonstrate the value of a spectroscope having high dispersion in the analysis of minerals.

The samples, which are described in the accompanying table, were taken from large single crystals, except samples 5, 6, 7, 8, and 9; these were taken from coarsely crystalline, massive material. The samples were prepared in three forms: fragments about  $\frac{1}{4}$  inch maximum dimension; powders of non-uniform grade, about 40 mesh; and solutions containing ten grams of the mineral in 50 cc. of a mixture of concentrated nitric and hydrochloric acids. The spectra of each sample produced by both the arc and the spark methods were recorded photographically with the aid of the 21 foot concave grating installed in a constant temperature and constant humidity room in the Spectroscopic Laboratory of the Massachusetts Institute of Technology.

### ARC METHOD

Two wedge-shaped electrodes of highest purity graphite<sup>1</sup> free from titanium and vanadium were soaked with the acid-mineral solution. The solution, containing some of the precipitate that had formed, was dropped on the hot electrodes by means of a clean medicine dropper. The arc from each pair of electrodes was exposed to the slit of the 21 foot concave grating for approximately one minute, which was sufficient to develop all lines without over-exposure. A preliminary examination of a pair of electrodes soaked in the acid reagent containing no mineral sample, performed on a Hilger E2 quartz spectrograph, revealed the presence of no lines other than those given by pure, untreated electrodes.

<sup>1</sup> Manufactured by the National Carbon Company Inc., Cleveland, Ohio.

## SPARK METHOD

The powders were packed into craters in pure graphite electrodes, 6 mm. in diameter, and subjected to a condensed spark. The aggregate exposure for each powder was ten minutes; the craters were refilled at intervals of one minute. Attempts to spark the fragments themselves were unsuccessful; after the spark had passed for about ten seconds the fragments melted. It was found that the removal of a thin layer (0.2 mm. approximately) from the inside and outside of a crater effected the removal also of all traces of the mineral with which the crater had previously been packed.

## ANALYSIS OF SPECTRA

Arc and spark spectra were obtained in the region: 2900 Å to 5800 Å, which occupied four Eastman "40" 4×10 plates. About 610 Å were included on each plate at a dispersion ranging from 2.60 Å per mm. in the ultra-violet to 2.50 in the green. Base lines, iron or air lines, or cyanogen band heads, were recognized with the aid of an Atlas.<sup>2</sup> Every unidentified line of the spark spectra was then measured with a paper centimeter scale reading to 0.1 mm. and identified in two standard wave-length tables.<sup>3</sup> The sensitive lines (de Gramont) of all the elements found in the spark spectra were sought in the arc spectra. Confusion of the line sought with neighboring iron, cyanogen, or air lines was avoided by careful measurement and by comparison with a spectrum in which the line was known to be absent. Several doubtful lines were measured with a traveling micrometer.

The results of the analysis appear in the accompanying table. Several elements, in particular, were sought, because they have been reported in similar minerals, but were not detected: aluminum, cadmium, cerium, cesium, gallium, indium, lithium, platinum, thallium, and yttrium. Although calcium and magnesium were found in the spectra of every sample, their presence may have been due entirely to atmospheric dust. Several elements that were absent in the spark were revealed in the arc spectra; the arc is usually more sensitive than the spark. Nevertheless, arsenic and

<sup>2</sup> Eder, J. M., and Valenta, E., *Atlas Typischer Spektren*: Wien, 1924.

<sup>3</sup> Twyman, F., and Smith, D. M., *Wave-length Tables for Spectrum Analysis*: Adam Hilger Ltd., 1931.

Kayser, H. G. J., *Tabelle der Hauptlinien der Linienspektren aller Elemente*: Springer, 1926.

TABLE OF MINERALS, THEIR LOCATIONS, AND ANALYSES

Mineral	Location	Ag	As	Au	Bi	Ca	Co	Cr	Cu	Fe	Ir	Mg	Mn	Mo	Ni	Pb	Pd	Sb	Sn	Sr	Ti	V	W	Zn	Zr
1. Pyrite	Near Phillipsburg, Mont.			x		x			x	x		x		x		x	x		x		x	x			
2. Pyrite	Elba.			x	x	x	x		x	x		x				x			x		x		x		
3. Pyrite	French Creek, Pa.				x	x	x		x	x		x		x	x	x			x				x		x
4. Pyrite	Commercial Mine, Bingham Canyon, Utah.			x	x	x	x		x	x		x		x		x	x		x			x	x		
5. Pyrite	Central City, Colo.			x	x	x	x		x	x		x		x		x			x		x		x		x
6. Sphalerite	Wheatley Mine, Phoenixville, Pa.	x				x			x	x		x				x	x				x				x
7. Sphalerite	Kisbanya, Ungarn.				x	x			x	x		x				x		x					x		x
8. Sphalerite	Oradna, Siebenburgen.					x	x		x	x		x				x		x					x		x
9. Sphalerite	Lautenthal, Harz.	x			x	x	x		x	x		x				x			x						x
10. Sphalerite	Warren, N. H.	x	x			x	x		x	x		x				x			x						x
11. Sphalerite	Joplin, Mo.	x	x			x	x		x	x		x				x	x		x						x
12. Galena	Leadville, Colo.	x				x		x	x	x		x				x	x		x			x	x		x
13. Galena	Utah Apex Mine, Bingham Canyon, Utah	x				x		x	x	x		x				x	x		x			x			x
14. Galena	Przibram, Bohemia.	x				x		x	x	x		x				x	x		x			x			x
15. Galena	Bleiberg, Karnten.	x				x		x	x	x		x				x	x		x			x			x
16. Galena	Joplin, Mo.	x				x		x	x	x		x				x	x		x						x

antimony, elements not easily excited, were found only in spark spectra.

The author, in concluding, wishes to acknowledge the helpful suggestions of Dr. G. R. Harrison and Dr. W. H. Newhouse.

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## NOTES AND NEWS

### A ROCK SAW

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Many laboratories are equipped with either a diamond saw or a thin carborundum wheel for cutting small specimens of minerals or rocks but very few are equipped to cut specimens 3 inches or more across. Believing that this subject may be of interest to mineralogists and petrologists I shall describe an inexpensive and mechanically simple rock saw adapted from the "gang saw" used extensively in the marble industry. In the field office, of the Section of Metalliferous Deposits of the U. S. Geological Survey, at Golden, Colorado, this saw has proved itself very useful for cutting both large and small specimens.

The following does not imply that the power bandsaw used in larger laboratories is not an effective tool for sawing rock. The fundamental principle, that is the use of loose abrasive and a moving smooth blade of metal, is similar to that of the "gang saw" and even the hardest kind of rock can be cut. Undesirable features of a power band saw are that its cost is too high for many small laboratories, readjustment of specimen against saw blade is necessary every half hour or so, and that it scatters abrasives about the room. None of these objections can be made against the saw described.

Cutting with a "gang saw" is effected by loose abrasive dragged back and forth across a rock under the edges of a series of soft metal blades with the motion of a hack saw or hand wood-saw. In a single operation a "gang saw" cuts blocks of marble several feet across into a series of slabs. For our purposes only a single cut is necessary and therefore only a single metal blade is used, otherwise the operation is essentially the same. The principle employed is quite simple and can be applied in a number of mechan-

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