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RARE ELEMENTS IN OKLAHOMA SPHALERITE

Earl L. Hassler and H. C. Roys
University of Oklahoma

This investigation consisted of a qualitative analysis of Oklahoma sphalerite by X-ray spectroscopic methods. Sphalerite, often called zinc blende, is composed chiefly of zinc sulphide, although here the small amounts of other elements are of greatest concern.

Because of the way the long ore runs of sphalerite occur between great beds of dolomitic limestone and chert, it was natural that geologists should attempt to explain their origin. The genesis of many sphalerite deposits may be definitely attributed to cooling masses of molten igneous rock called magma, because they are still partially in contact with the granite. The origin of the Oklahoma zinc deposits around Miami and Picher has been disputed because of the scarcity of known granitic intrusives. Some geologists claim that these deposits were formed by downward flowing ground water.

The deposition of sphalerite from a cooling magma takes place under such high pressure and temperature conditions that it is often characterized by the presence of uncommon elements in very small quantities. Professor S. Weidman of the University of Oklahoma and Professor W. A. Tarr of the University of Missouri suggest that the presence of certain rare elements in any sphalerite would substantiate a claim for its magmatic origin. Sensitive analyses of sphalerites for all elements have been infrequent, but from widely scattered information it was found that gallium, germanium and indium are the most significant of the rare elements to be expected. These, along with iron and cadmium occur with greatest frequency in ores actually having contact with granite.

Some of the elements of search: gallium, germanium, indium, cadmium, silver, tin, lead, etc., were not expected to be present in greater concentration than a few parts in 100,000 parts of ore. There was presented then, an opportunity to develop a technique of sensitive qualitative analysis by X-ray spectral lines and at the same time furnish evidence of value to geologists

in connection with the origin of Oklahoma sphalerites. There was no great need for quantitative determinations.

The powdered sphalerite was placed on the target of a Siegbahn type tube and the X-ray beam resulting from its bombardment with electrons was diffracted into lines characteristic of the elements on the target. The diffraction was accomplished by an oscillating crystal spectrograph which gave a dispersion of about 9.3 X-units per millimeter of film with wave-lengths around 1400 X-units. There was developed a type of adjustable focussing shield which is not described in literature. This, with the aid of a helical filament, would produce on the anode a rectangular focal area of any practicable size desired.

A total of 57 spectrograms was taken to prove the presence or absence of the elements in question. Length of exposure of the films ranged from one to four hours each. At the 1933 fall meeting of the Academy a slide was exhibited, which had been made directly from one of the series, showing quite clearly the K alpha lines of both gallium and germanium, the rarest of those elements found. They were probably not present in greater amount than one part in 100,000 parts of ore. The germanium lines were weakest because they are only 30 X-units on the short wave-length side of the zinc absorption edge, whereas the gallium lines were on the long wave-length side.

Supplementary work with prepared mixtures showed that with the apparatus used, one part nickel in 100,000 parts of mixture could easily be detected. Tubes which are more efficient in utilizing the X-rays produced, can detect the presence of as little as one part in a million. A very small amount of sample is all that is required to make a test.

Iron, zinc, gallium, germanium, cadmium, lead, and tin were found. Manganese, cobalt, arsenic, silver, and indium were shown not to be present. In addition to developments along the line of X-ray spectroscopy it is believed that there has also been furnished evidence of value to geologists in substantiating their claim for magmatic origin of Oklahoma sphalerite.