

SCIENTIFIC COMMUNICATIONS

RADON-222 EMANATIONS FROM A URANIUM DEPOSIT

SINCE the discovery of radon by Friedrich Ernst Born in 1900 (Partington, 1957) scientists have used it as a tracer in studies of atmospheric circulation, lithospheric emanations, and studies related to environmental health. The advent of nuclear energy and the subsequent demand for uranium has created a great deal of new interest in radon, the reason being that its ease of detection in extremely small quantities make it a useful tracer in prospecting for uranium. For examples of work done in this regard the reader is referred to papers by Baranov (1956), Wennervirta et al. (1960), Peacock and Williamson (1961-62), and Ghosh and Bhalla (1966). A review of radon migration in the ground including some 170 references has been prepared by Tanner (1964). This note presents the results of a preliminary survey of radon emanations in soil gas over a uranium ore deposit near Bancroft, Ontario.

The deposit of Bicroft Uranium Mines Limited is situated about 10 miles southwest of Bancroft Ontario, in a narrow belt of paragneiss and amphibolite flanked on the west by Cardiff plutonic complex and on the east by marble. The ore minerals are mainly uranothorite and uraninite (Lang et al., 1962).

Soil gas samples were collected during the later part of August from an east-west traverse 775 feet north of #1 shaft at 50-foot intervals. The radon emanating from the soil above the deposit was allowed to collect in one quart oil cans. The open end of the can was pushed firmly into the soil below the

organic matter and the sides and top were covered with leaves or organic matter. After several hours or longer the air from the can was transferred to an evacuated one liter flask through a hose inserted into a half inch hole punched into the top end of the can. A portion of this gas was then transferred to an evacuated ZnS cell and its alpha activity counted. The cells were made in a manner similar to that described by Higgins et al. (1961). The counting arrangement of gas line, photomultiplier and scaler was placed in a trailer laboratory set up in the town of Bancroft for the analysis of uranium in geochemical samples.

As shown in Figure 1 fairly good correspondence exists between the gamma ray intensity and the radon emanation rate across the deposit. The scintillometer readings can be converted to microrentgens/hour by remembering that 20 counts/sec. equal one μ R/h for the instrument used in this work. The radon concentration is expressed in picocuries/liter of air (pc/l) with one pc equal to 0.037 disintegrations/sec. The significant features of the result is the fact that 90 percent of the radon values are greater than 2 times background (60 pc/l), whereas only 40 percent of the gamma ray values are greater than 2 times background (400 c/s). Another point to note is sample site selection. The double tailed circles on Figure 1 represent measurements of samples from sites located near the first sites (circles without tails) but in a depression filled with rich humus and soil. In each case these sites yielded higher radon values. Exact duplicate measurements of several sites are indicated by single tailed points and show good reproducibility. The background was determined by testing several sites somewhat removed from known uranium deposits.

The technique employed in this test was crude, but the results demonstrate the principle of radon emanation from the surface of a uranium ore body. With some development work a portable instrument with probes permitting immediate sampling and counting of 60 to 80 sites per man day is quite feasible (Peacock and Williamson, 1961-62). Although the radon detector cannot as yet compete with the gamma ray scintillometer, it has the decided advantage that under favorable conditions it is able to detect uranium occurrences to a much greater depth, 20 to 30 feet, as compared to 2 to 3 feet for the

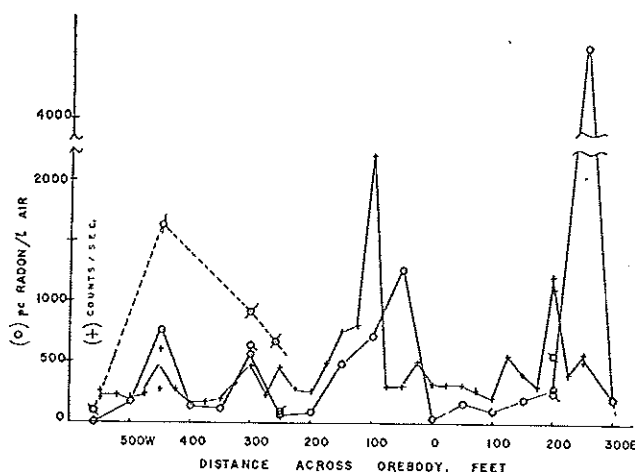


FIG. 1. Radon-222 emanations and total gamma ray activity at the surface of the uranium ore deposit.

scintillometer. Thus the method will come into greater use in detecting deposits buried beyond the reach of present gamma ray detection methods. In addition, the method may be of use not only in prospecting for uranium but also for polymetallic deposits (Tsigelman, 1959).

WILLY DYCK

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SYNTHESIS OF TWO NEW SILVER SULFOSALTS

DURING an experimental investigation of low temperature phase relations of the Ag-As-S and Ag-Sb-S systems, two new sulfosalts were synthesized. The new compounds have previously (Hall, 1964) been named "pseudopearceite" Ag_7AsS_6 and "pseudopolybasite" Ag_7SbS_6 because of their general similarity to pearceite $(\text{Ag}, \text{Cu})_{10}\text{As}_2\text{S}_{11}$ and polybasite $(\text{Ag}, \text{Cu})_{10}\text{Sb}_2\text{S}_{11}$, respectively. New mineral names are not proposed because of the lack of conclusive evidence that these compounds occur in nature. It is hoped that the present description will assist geologists working on silver deposits in recognizing these phases.

The compounds Ag_7AsS_6 and Ag_7SbS_6 probably have been prepared by several previous workers (Berzelius, 1826; Sommerlad, 1898; Gaudin and McGlashan, 1938; Béland, 1946; Weil et al., 1954), but have been misidentified. Berzelius (1826) and Sommerlad (1898) report having synthesized the ill-defined mineral polyargyrite $(\text{Ag}_{24}\text{Sb}_2\text{S}_{15})$ and its arsenic analog. Present experimental work has shown that there is no indication of phases having the compositions reported. All of the other above authors suggested that they had prepared either pearceite or polybasite. Hall (1967) has demonstrated that copper is an essential component of pearceite and polybasite. More recently, Rolland (1966), Keighin and Honea (1966) and Frondel (1967, personal communication) have reported the synthesis of Ag_7AsS_6 and Ag_7SbS_6 .

Methods

All syntheses in the present study were carried out in sealed, evacuated, silica-glass tubes. Arsenic,

antimony, and copper used in these experiments were obtained from the American Smelting and Refining Co. The arsenic (lot no. P-6923), antimony (lot. no. 168), and copper have a reported purity of 99.999%, exclusive of dissolved gases. The sulfur supplied by the Freeport Sulfur Co., Port Sulfur, Louisiana, contains 0.007 percent impurities, substantially all of which is carbonaceous material (see Skinner et al., 1959). The silver used has a reported purity of 99.999% and was obtained from the United Mineral and Chemical Co.

Standard X-ray and optical techniques were used to identify the phases. When an accurate measurement of a particular reflection was desired, eight oscillations were made with a Norelco diffractometer using Lake Toxaway quartz ($d_{1101} = 3.3432 \text{ \AA}$) as an internal standard.

Results

The appearance of other phases (sulfur, Ag_2S , Ag_3AsS_3 or Ag_3SbS_3) in the products of experiments with bulk compositions only 1% from Ag_7AsS_6 and Ag_7SbS_6 indicate that these phases are essentially stoichiometric compounds. X-ray diffraction data for pure Ag_7AsS_6 and Ag_7SbS_6 quenched after having been near 350°C for several days are summarized in Table 1. After similar heat treatment, charges of intermediate composition give X-ray diffraction patterns intermediate between those of the end members. Because the character of the pattern changes continuously as a function of composition, it is concluded that a continuous solid solution series exists at 350°C between Ag_7AsS_6 and Ag_7SbS_6 . Microscopic examination confirms the homogeneity