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Uranium in Soil around Phosphate Processing Plants in Pocatello, Idaho

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The phosphate field in southeastern Idaho accounts for 35% of the U.S. phosphate reserves. This phosphate deposit has been surface mined and processed near Pocatello and Soda Springs for over 30 years. The phosphatic shale deposits mined in Idaho contain high concentrations of uranium and other trace elements. The rocks of this phosphoria formation contain Idaho's largest uranium resource. According to a U.S. Geological Survey (1978) report, these rocks contain on the average about 90 ppm U, with a maximum of 400 ppm. Compared to an overall average in the Earth's continental crust of only 2.7 ppm U, this is quite significant.

Currently about 5 million tons of phosphate ore are being processed annually in Idaho. Based on an average content of 90 ppm U, this quantity of ore contains a total of 450 tons of uranium. The phosphate ore is processed locally, either by a sulfuric acid process to make phosphoric acid, or by an electric furnace reduction process to produce elemental phosphorus. At present, only vanadium is recovered as a by-product of the electric furnace process in Idaho. Other trace elements are discharged into the surrounding environment through aerial emissions and with waste byproducts to waste ponds or solid waste stockpiles.

There are two phosphate processing plants in operation near Pocatello, which is a major population center in southeastern Idaho. The two processing plants (an elemental phosphorus plant and a phosphate fertilizer plant) are located about 6 km west of Pocatello and are separated from each other by less than 1 km. A U.S. Geological Survey (1978) report showed that the concentration of uranium in soil increases as the phosphate processing plants in Pocatello are approached. However, detailed distribution of uranium in soil around the processing plants as a function of distance, depth, and prevalent wind direction of the area is unknown. Such information is essential for understanding the dispersion of uranium and its daughter products into the environment by the phosphate processing operations.

In the summer of 1978, we carried out a survey of uranium in soil around two phosphate processing plants in Pocatello. Soil samples were collected at different depths along three lines radiating from the center of the two plants. According to records

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at the Pocatello airport which is about 5 km west of the plants, well over 50% of the wind movement is from the southwest quadrant. Therefore, the southwest (SW) radius was chosen to represent the downwind direction, and the northeast (NE) radius to represent the upwind direction from the plants. A third radius in the east to northeast (E-NE) direction, which passes part of the city of Pocatello was also sampled. Soil samples were dried in an oven, ground with a mortar and pestle, and then sifted through a U.S. No. 80 standard testing sieve. U concentrations in soil (less than 80 mesh size fraction) were determined by neutron activation analysis (NAA). The details of our NAA procedures are described elsewhere (JOHNSON 1979).

According to Figure 1, the surface soil (0-5 cm) in the NE direction shows a trend of increasing uranium content as the processing plants are approached. The content in surface soil at 0.8 km (0.5 mile) from the plants reaches 6.9 ppm U which is about 2 to 3 times higher than the values found at 10 km or farther away. However, this trend is not evident at soil depths of 5-10 cm or 10-15 cm. In the SW direction, no significant difference in soil uranium content was found either as a function of distance or depth. These results indicate that elevated levels in soil are limited

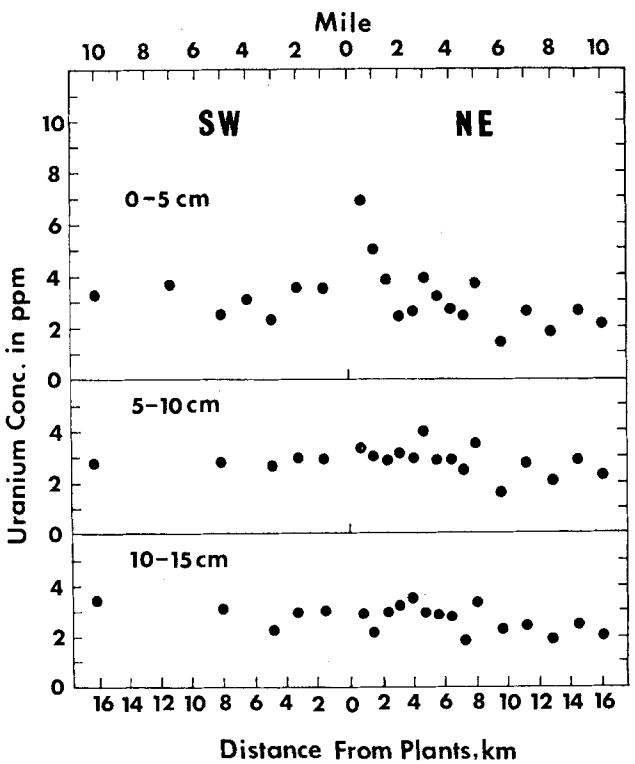

Figure 1. Distribution of uranium in soil along southwest and northeast radii from the processing plants.

primarily to the surface soil in the vicinity of the processing plants and correlate with the prevalent wind direction in the area.

An anomalously high content (41 ppm U) was found in surface soil collected at 0.8 km (0.5 mile) from the processing plants in the E-NE direction (Figure 2). This site also has high uranium concentrations at depths of 5-10 cm and 10-15 cm. With the exception of this site, the rest of the data observed along the E-NE radius follow approximately the same trend as along the NE radius. This sampling site at 0.8 km along the E-NE radius happened to be on the bank of a highway (Business 30). It should be pointed out that materials similar to phosphate slag were found abundant around that location. It is known that phosphate slag produced by the electric furnace process has been widely used as an aggregate material for road construction in southeast Idaho. According to the literature, uranium is concentrated in the slag produced by the electric furnace process of making elemental phosphorus

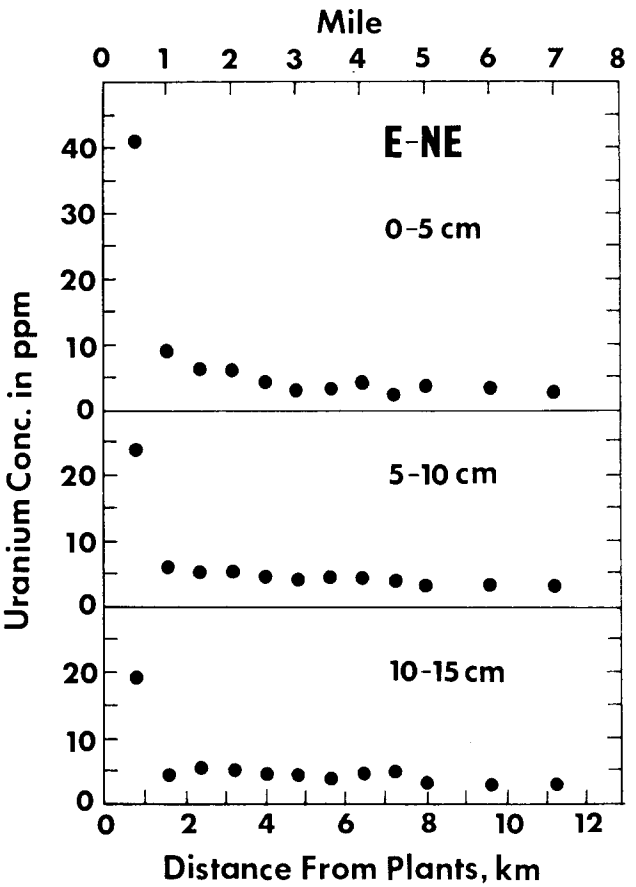

Figure 2. Uranium concentrations in soil along the east to northeast radius from the processing plants.

(U.S. ENVIRONMENTAL PROTECTION AGENCY 1977). A phosphate slag sample analyzed by this group showed a content of 110±5 ppm U. The anomalous uranium content found in soil at the site 0.8 km along the E-NE direction is probably caused by a combination of two factors: proximity to the phosphate processing plants and the use of phosphate slag for roadbed construction.

To test the U levels in soil along highways in the Pocatello area, some roadside soil samples were collected randomly at 1.5 m (5 ft) and at 7.5 m (25 ft) away from the pavement of a local highway I-15W. Average U content of six surface soil samples at 1.5 m from the pavement was found to be 9.6 ppm with a range of 2.7 to 19.1 ppm. Average soil content (6 samples) at 7.5 m away from the pavement was found to be 4.0 ppm with a range of 2.7 to 5.5 ppm. Because of the small number of samples, this result can only be considered as preliminary. Nevertheless, it does indicate a potential widespread presence of uranium in this phosphate producing area due to commercial use of phosphate slag for road construction. Further studies on the dispersion of uranium from highways and roads built on phosphate slag and its effect on the environment of this area are highly desirable. It seems that extraction of uranium from phosphate slag may prove to be profitable as fuel costs continue to rise. This would simultaneously reduce the potential for undesirable environmental impacts resulting from the use of slag in road construction or other applications.

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