United States Department of the Interior
Geological Survey

Helium soil-gas survey of a portion of the McDermitt Caldera complex, Malheur County, Oregon

By

G. M. Reimer

Open-File Report 81-565

1981

Helium soil-gas survey of a portion of the

McDermitt Caldera complex, Malheur County, Oregon

ABSTRACT

A helium soil-gas survey was performed in the vicinity of the Bretz mine within a portion of the McDermitt Caldera complex, Malheur County, Oregon. The area surveyed included the Aurora uranium mineralized area. The overall helium concentrations were high, averaging 52 parts per billion above ambient air. The highest helium values were found in two areas inside the caldera. Those areas were located immediately to the west and to the southeast of the known uranium mineralization. The ground-water environment, which can control the location of the helium anomaly from uranium deposits, has not been resolved. If these helium anomalies are directly related to the uranium, though somewhat displaced from the source deposits, then helium may have unique potential for locating other, similar uranium deposits within the Caledra compelx.

Introduction

The McDermitt Caldera complex consists of several calderas formed by the collapse of Miocene ash flows. Located along the Oregon-Nevada border, the complex covers an area of approximately 1200 km^2 and includes the Double-H, Montana, and Trout Creek Mountains. A thorough description of the geology is provided by Rytuba and Glanzman (1978). Deposits of uranium, lithium, and mercury occur within the complex, all probably derived from the rhyolitic rocks produced from the volcanism preceding formation of the calderas.

An area of shallow uranium mineralization, known as the Aurora deposit, occurs in Malheur County, Oregon and is located about 1 km southeast of the Bretz mercury mine. The prospect, controlled by Placer Amex, Inc. and Locke Jacobs, has been described by Roper and Wallace (1980). The mineralized area is about 1500 m by 450 m and about 100 m thick and at a depth of 70 to 100 m. It is estimated to contain 17 million tons of 0.05% U_3O_8. Emplacement of the mineralization has been postulated as being controlled by hydrothermal activity and possibly supergene remobilization (Roper and Wallace, 1980).

A preliminary survey seeking geochemical variations in plant material as well as soil gas indicated the possibility of some anomalies near the Aurora prospect (Erdman and McCarthy, 1981). The caldera complex provided a geologic setting in which a helium soil-gas survey had not previously been performed and the study by Erdman and McCarthy indicated that the complex caldera structure might play a large role in controlling the location of various geochemical anomalies.

Helium is a product of natural radioactive decay of uranium, being produced from the alpha particles emitted from uranium and its daughter isotopes. If a helium anomaly was found, it was hoped that previous principles learned from helium surveys in other areas might be applied in this area to aid in the interpretation of the data. Also, the survey might reveal whether helium could be useful as an exploration tool for uranium in this type of environment.

This brief report presents the results of a helium survey that was conducted in the vicinity of the Aurora uranium deposit. Helium anomalies are associated with the uranium deposit but a detailed explanation for that association must await further studies.

Analytical Procedure and Data

A total of 112 soil gas samples were collected October 9 and 10, 1980. A hollow steel probe was pounded into the ground to a depth of 0.75 m and a gas sample was extracted by means of a hypodermic syringe. The syringe was then capped and stored for analysis later in the day. Analyses were performed using the U.S. Geological Survey's mobile helium analyzer (Reimer and others, 1979) which has a sensitivity of about 10 parts per billion for helium.

The overall average helium concentration seemed quite high at about 52 parts per billion above the helium concentration found in ambient air. By way of comparison, 838 samples collected in a reconnaissance survey of the Powder River Basin in Wyoming and Montana averaged 0 parts per billion (air value) (Reimer, and other, 1980).

Figure 2 shows a contour map of the helium values in relation to the Aurora uranium deposit. The highest helium values, greater than 80 ppb, occur to the west and to the southeast of the deposit. The distribution of helium in the northern sections of the map should be viewed with some reservation because the sampling pattern became wider in that region, following more of a traverse pattern than a grid pattern.

Discussion

The high average helium values could be a reflection of the high uranium concentration found in the rhyolitic material comprising the caldera fill or from a uranium bearing horizon containing 100-300 ppm present throughout the area of the helium survey (J. Rytuba, written commun., 1981). Commonly, wet ground could act to increase helium concentrations relative to dry ground but soil moisture content in this study was not an influencing factor; there had been no recent precipitation.

The location of the helium anomaly to the southeast of the uranium mineralization would be explained by displacement caused by ground-water movement in that direction assuming that normal ground-water flow is generally from the north to the south following the topography. The location of a helium anomaly of greater extent to the west of the Aurora deposit is difficult to explain. It could indicate a complex ground-water situation, as mentioned by M.W. Roper (oral commun., 1981) might well exist. Perched aquifers could have accumulated high concentrations of helium and the soil gas could be a reflection of the unique equilibrium condition posed by these aquifers with overlying soil. Alternatively, movement of warm waters

containing higher helium concentrations and mixing with other aquifers could lead to the particular location of the western anomaly. These questions might be resolved if the waters themselves could be analyzed for helium.

Conclusions

Because the range of soil-gas helium concentration is great for this area, reflected in the high average of values, the resolution in this survey is good. Helium anomalies were found in close proximity to a known uranium deposit, although the reasons for their location with respect to the deposit are not resolved at this time. A complex ground-water situation may be contributing to the difficulty of interpretation. If further studies can show a direct relationship of the high helium concentrations to the uranium deposit, helium surveys may offer unique potential for locating other similar uranium deposits within the caldera complex.

References

Erdman, J. A., and McCarthy, H., 1981, Uranium in sagebrush can be a guide to buried deposits (abs.): Geol. Soc. Am., Abstracts with Programs v. 13, no. 2, p. 55.

Reimer, G. M., Denton, E. H., Friedman, Irving, and Otton, J. K., 1979, Recent developments in uranium exploration using the U.S. Geological Survey's mobile helium detector: J. Geochem. Explor., v. 11, p 1-12.

Reimer, G. M., Murrey, D. G., and Been, J. M., 1980, Helium soil-gas concentrations in the Torrington, Newcastle, Gillette (Wyoming), and Ekalaka (Montana) 1^{o} x 2^{o} quadrangles: Data from a reconnaissance survey: U.S. Geological Survey Open-File Report 80-452, 14 p., 4 plates.

Roper, M. W., and Wallace, A. B., 1980, Geology of the Aurora Uranium Prospect, Malheur County, Oregon: preprint AAPG southwest section, El Paso, Texas.

Rytuba, J. J., and Glanzman, R. K., 1978, Relation of Mercury, uranium, and lithium deposits to the McDermitt Caldera complex, Nevada-Oregon: U.S. Geological Survey Open-File Report 78-926, 28 p.

Figure 1. Map showing geographic location of the McDermitt Caldera area included in the helium soil gas survey. Also included is a brief overview showing some general structure of the survey area (after Roper and Wallace, 1980).

Figure 2. Contour map of helium soil-gas concentrations for the helium survey near the Aurora uranium deposit within the McDermitt Caldera complex. The contour interval is 20 parts per billion (ppb) helium with respect to helium in air (taken as 5240 ppb). Highest helium concentrations are located to the west and to the southeast of the Aurora deposit.

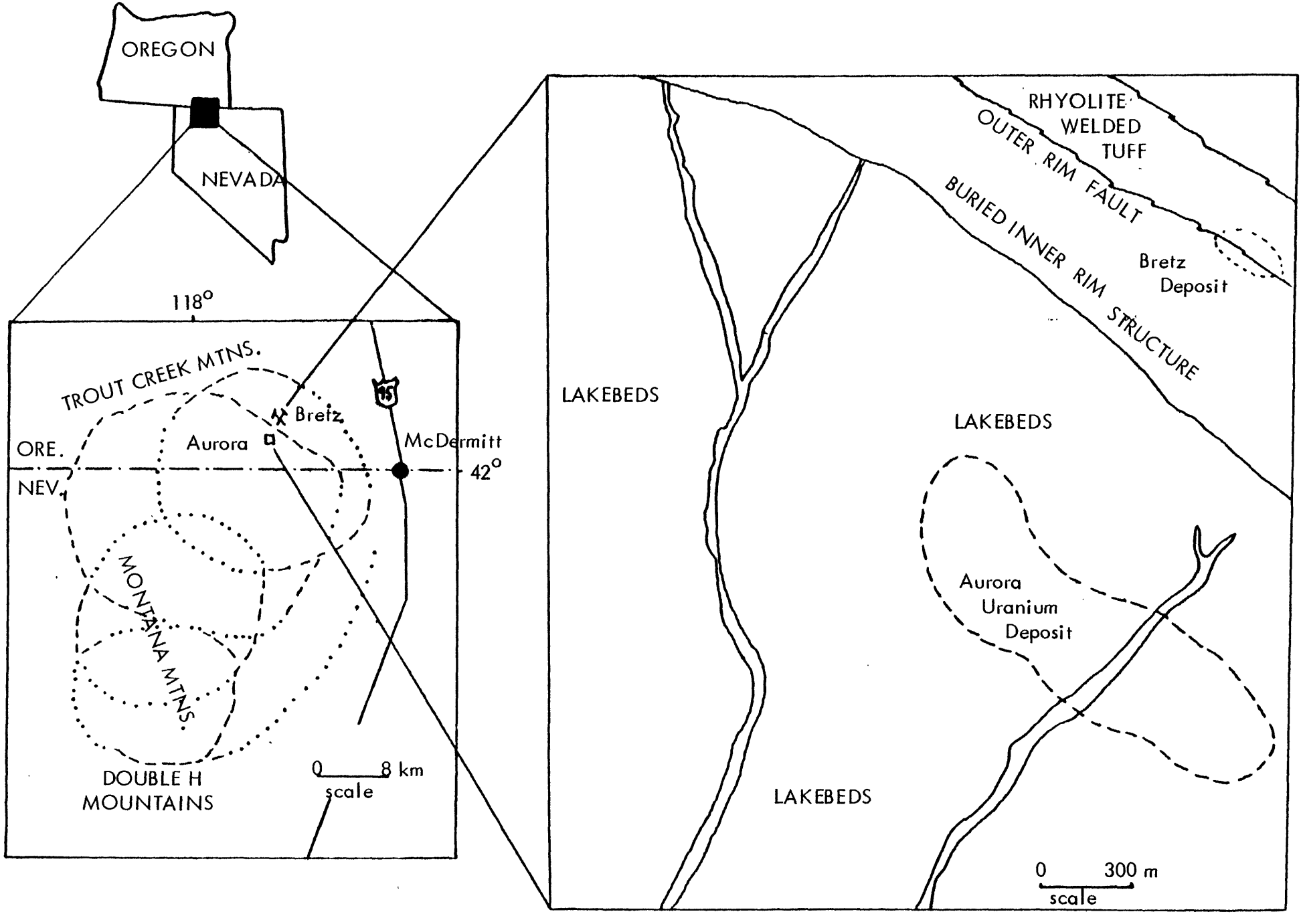
OREGON
NEVADA
118°
TROUT CREEK MTNS.
Bretz
Aurora
McDermitt
ORE.
NEV.
42°
95
MONTANA MTNS.
DOUBLE H MOUNTAINS
0 8 km
scale
RHYOLITE WELDED TUFF
OUTER RIM FAULT
BURIED INNER RIM STRUCTURE
Bretz Deposit
LAKEBEDS
LAKEBEDS
LAKEBEDS
Aurora Uranium Deposit
0 300 m
scale

FIGURE 1

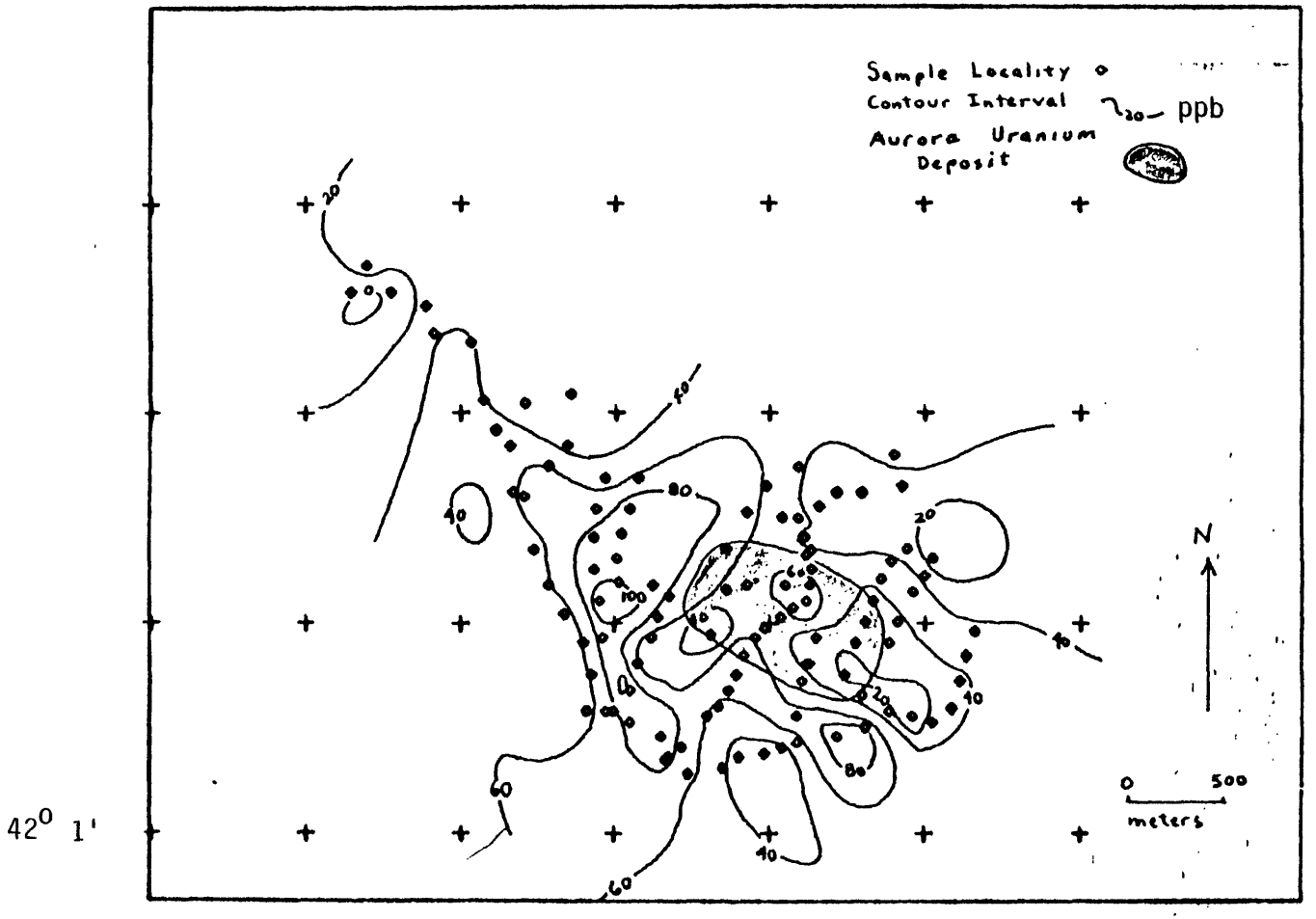
Sample Locality
Contour Interval 20 ppb
Aurora Uranium Deposit
N
0 500
meters
42° 1'
117° 57'

FIGURE 2