ISOPACH MAPPING BY PHOTOGEOLOGIC METHODS AS AN AID IN THE LOCATION OF SWALES AND CHANNELS IN THE MONUMENT VALLEY AREA, ARIZONA

By Irving J. Witkind, William R. Hemphill, Charles L. Pillmore and Robert H. Morris

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Trace Elements Investigations Report 431

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

April 3, 1959

AEC-297/9

Mr. Robert D. Nininger
Assistant Director for Exploration
Division of Raw Materials
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Bob:

Transmitted herewith are three copies of TEI-431, "Isopach mapping by photogeologic methods as an aid in the location of swales and channels in the Monument Valley area, Arizona," by Irving J. Witkind, William R. Hemphill, Charles L. Pillmore, and Robert H. Morris, February 1959.

This report is an abstract of a paper with the same title that is planned for publication as a Geological Survey bulletin. A copy of the entire report is in the TEPCO files.

Sincerely yours,

John H. Eric

for W. H. Bradley
Chief Geologist

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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Charles L. Pillmore, and Robert H. Morris

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*This report concerns work done partly on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

USGS - TEI-431

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ISOPACH MAPPING BY PHOTOGEOLOGIC METHODS AS AN AID IN THE LOCATION OF SWALES AND CHANNELS IN THE MONUMENT VALLEY AREA, ARIZONA

by

Irving J. Witkind, William R Hemphill,
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ABSTRACT

In the Monument Valley area of northeastern Arizona, uranium-vanadium deposits are localized in strata of the Shinarump member of the Chinle formation of Triassic age that fill ancient scour channels. Some of these channels are along the axes of broad shallow elongate troughs known as swales. A typical swale near the Monument No. 2 mine is about 3 miles wide, 3 to 4 miles long, and has about 50 feet of relief. This relation between some channels and swales makes the swales useful in the search for hidden channels. Although only about 60 channels have been found, it is possible that many times that number are in areas where the Shinarump is concealed.

Commonly the swales are not visible from the ground but are apparent on isopach maps prepared of selected strata that underlie the Shinarump. In an attempt to determine whether maps prepared from aerial photographs would be equally useful, a test area, previously mapped in the field, was selected and mapped by photogeologic methods. The photogeologic results have been favorable and it is suggested

that photogeologic techniques may be faster and cheaper than field techniques in the search for swales and channels.

Strata exposed in the test area range in age from Permian (De Chelly sandstone member of the Cutler formation) to Late Triassic (Shinarump member of the Chinle formation). These strata form the southeast limb of the Agathla anticline; the strata strike northeast and dip southeast.

The strata in the interval represented by the isopachs are distinctive both in the field and on the aerial photographs. The base of this interval is an unconformity, but it is even and free of relief. Its top is an unconformity accented by the channels and swales now filled with the Shinarump. As the base of the interval is smooth and even, the isopachs reflect irregularities at the top of the interval, the most prominent of which are the channels and swales at the base of the Shinarump.

Photogeologic methods were used to construct a planimetric base map and to determine the stratigraphic thicknesses used in preparing the isopach maps.

Photogeologic techniques seem adequate to locate and give an accurate representation of swales in a minimum of time. Isopach maps made by photogeologic methods were compared with one isopach map and one channel map prepared by field methods. In both areas the photogeologic isopach map delineated both the swale and the channel. This suggests that photogeologic methods are adequate to define swales similar to those in the Monument Valley area. Further, the photogeologic

techniques are independent of weather and logistic problems, and can conveniently precede geologic field work. Many isopach readings can be easily taken in a short time. On the other hand, limitations are imposed by the need for aerial photographs from which suitable photogrammetric measurements can be made. If such photographs are not already available, the cost of obtaining them may be prohibitive. Also, the top and base of the interval being measured must be discernible on the photographs. Accuracy is reduced where observations are widely spaced or where the top and base are widely separated horizontally.