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IN REPLY REFER TO:

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

May 29, 1959

AEC - 386/9

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-359, "Autunite from Mt. Spokane, Washington," by G. W. Leo, May 1959.

This report is an abstract of a paper with the same title that is planned for publication in The American Mineralogist. A copy of the entire report is in the TEPCO files.

Sincerely yours,

John H. Eric
for Montis R. Klepper
Assistant Chief Geologist



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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

AUTUNITE FROM MT. SPOKANE, WASHINGTON*

By

G. W. Leo

May 1959

Trace Elements Investigations Report 359

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.



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

USGS - TEI-359

GEOLOGY AND MINERALOGY

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AUTUNITE FROM MT. SPOKANE, WASHINGTON

By G. W. Leo

ABSTRACT

Near Mt. Spokane, Washington, coarsely crystalline autunite is developed in vugs, fractures, and shear zones in granitic rock. With the exception of dispersed submicroscopic uraninite particles, autunite is the only ore mineral in the deposits. A study of associated granitic rocks reveals that apatite, the most abundant accessory constituent, has been preferentially leached and corroded in mineralized zones, suggesting that it may have provided a source of lime and phosphate for the formation of autunite. Leaching may have been effected partly by meteoric water, but more probably was due to the action of ascending connate solutions that may also have carried uranium from unoxidized, as yet undiscovered deposits at depth.

Autunite from the Daybreak mine has been studied optically, chemically, and by X-ray diffraction. The autunite is commonly zoned from light-yellow margins to dark-green or black cores, and autunite from the inner zone has a higher specific gravity and higher refractive indices than peripheral light material. X-ray powder diffraction patterns of dark and light meta-autunite formed from this autunite show no significant differences in the "d" spacings; however, diffraction patterns of nine zoned samples each show uraninite to be present in the dark, and absent from the light, phase.

UO₂ and UO₃ determinations range from 0.66-0.70 percent and 57.9-58.0 percent, respectively, for light autunite, whereas dark autunite shows a range (in seven determinations) of UO₂ from 1.2 to 4.0 percent, and UO₃ from 55.1 to 58.8 percent. The wide range of UO₂ values in dark autunite is tentatively attributed to nonuniform distribution of discrete uraninite particles, which may also account for the dark color and higher density.

Thermogravimetric and differential thermal analyses of autunite suggest discrete water losses at about 90^o, 145^o, and 220^o C. The first water loss probably represents dehydration to meta-autunite II, also recognizable by marked changes in optical properties and the X-ray diffraction pattern. The form of the DTA curve above 90^o C resembles that of montmorillonite, suggesting that the dehydrations at about 145^o and 220^o C may involve interlayer water as in montmorillonites, and the analogy with montmorillonite is further indicated by X-ray patterns of meta-autunite II heated just above these temperatures. Autunite heated to red heat shows a diffraction pattern distinct from all others. The cation exchange capacity of autunite, about 2.5 milliequivalents per 100 grams, is substantially lower than that previously reported for artificial material.