

A FURTHER STUDY ON THE AGE OF GREAT BEAR LAKE PITCHBLENDE¹

JOHN PUTNAM MARBLE, *Chevy Chase, Maryland.*

A sample of siliceous pitchblende from No. 1 Pit, No. 1 Vein, Eldorado Claim, LaBine Point, Great Bear Lake, N.W.T., Canada, presumably taken from the upper 10 feet of the vein, has been studied by Marble (1936). It yielded the ratio $Pb/U + 0.36 Th = 0.201$ as the result of the analyses. If this ratio be corrected for the "common" lead content, as deduced from the atomic weight of the derived lead, 206.05, Marble (1934), assuming that a "pure uranium" lead has the atomic weight 206, it becomes 0.193. This yields an age of 1323 million years.

Hecht and Kroupa (1936) have made similar studies on another sample, whose exact location is not known, but which presumably comes from the same vein, and from near the surface. They obtained a ratio of 0.249, and found the atomic weight of the lead to be 206.08. If we also assume in this case that the excess of the atomic weight over 206 is due to "common" lead from some extraneous source, following Baxter and Alter (1933, 1935), we may calculate a "corrected lead ratio" of 0.232 for the sample of Hecht and Kroupa. This value is somewhat higher than the earlier one, but still indicates an early Pre-Cambrian age for the pitchblende, assuming the absence of alteration. Unfortunately no radiograph of the specimen is available, so more definite evidence on this point is lacking.

Recently Mr. Hugh S. Spence of the Canadian Department of Mines has furnished a further sample of pitchblende, labeled: "Specimen of fresh pitchblende (siliceous type) from depth (below 100 feet), 800 ft. section, No. 2 vein, Eldorado Mine, LaBine Point, Great Bear Lake, N.W.T." It was intended to make analyses and also atomic weight studies on this sample, but the latter work has had to be postponed for some years. Accordingly it is felt that though the age determinations are incomplete, the "lead ratio" should be put on record, in case the atomic weight determinations should be done elsewhere.

The specimen showed no sign of secondary uranium minerals at any point on the surface, or after it had been cut. Reports of microscopic studies kindly made by Professor W. H. Newhouse of Massachusetts Institute of Technology, and by Dr. Charles Milton of the U.S. Geological Survey are on file. An autoradiograph of 48 hours exposure, made on both halves of the specimen after it had been sawed down the middle and the surfaces ground flat, is shown in fig. 1. This indicates that while the pitchblende is brecciated, the distribution of radioactive material seems moderately uniform, and there is little evidence of extensive leaching.

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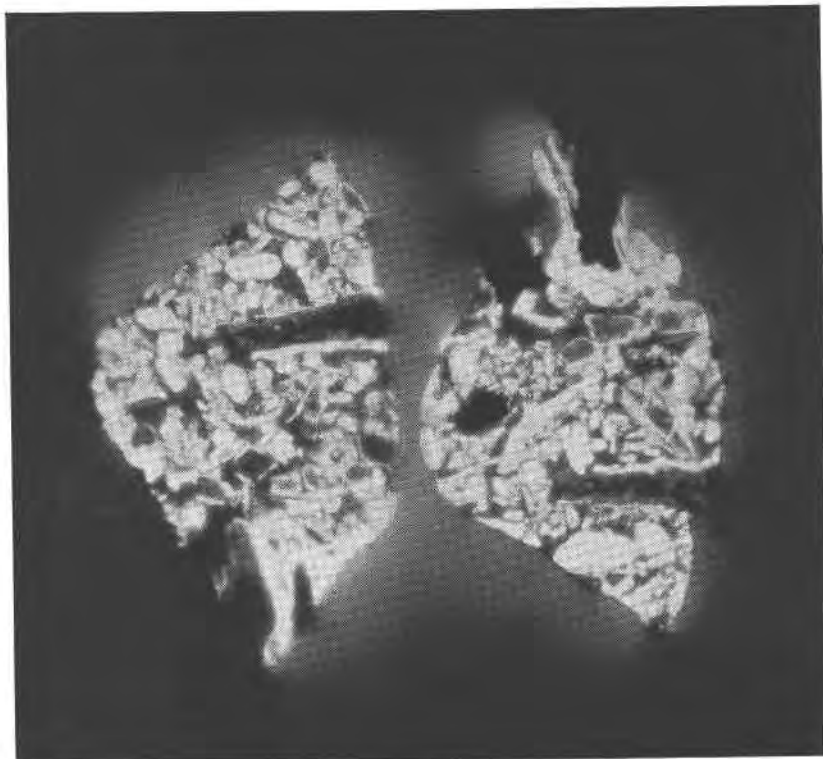


FIG. 1. Auto-radiograph of Pitchblende-Silica Ore, No. 2 Vein, Eldorado Claim, LaBine Point, Great Bear Lake, N.W.T., Canada; 48 hours exposure.

Determinations of lead, uranium, and thorium were made, using previously described methods, with results listed in Table 1.

TABLE 1. ANALYSIS OF PITCHBLLENDE-SILICA ORE, NO. 2 VEIN, ELDORADO CLAIM, LABINE POINT, GREAT BEAR LAKE

Anal.	Wt. Sample	Wt. PbSO ₄	≈%Pb	Wt. ThO ₂	≈%Th
1	2.40925 gm.	0.20578 gm.	5.826	<0.00008 gm.	<0.003
2	2.69756	0.23296	5.890	<0.00007	<0.002
3	1.18019	0.10152	5.867	<0.00010	<0.008
4	1.16146	0.10089	5.925	<0.00015	<0.011

Anal.	Wt. U ₃ O ₈	≈%U	Pb/U	Averages
1	0.83395 gm.	29.354	0.198	%Pb= 5.877
2	0.93488	29.391	0.200	%U=29.386
3	0.40933	29.413	0.199	Pb/U= 0.199
4	—	—	—	5.877/29.386= 0.200

As a first approximation, 206.05 has been used for the atomic weight of the lead, as for the earlier sample. Any change in this figure may be expected to be small, and would not affect the analytical results by more than about one per cent.

No correction for the trace of thorium reported is made in the computation of the "lead ratio," as in all cases the tiny, barely weighable residue carried some of the rare earth oxides, as shown by its buff to pale yellow color. The weight of ThO₂ reported is thus a maximum. Measurements by other methods on other samples indicate a maximum thorium content of 0.02 per cent, which would affect the "ratio" by not more than one unit in the third decimal. This is no greater than the uncertainty of the other determinations.

The "uncorrected age" calculated from the above figures, using the logarithmic formula of Holmes (1931) and others, is 1368 million years.

A complete analysis of this sample was made, with lead and uranium sought at some point in all other separations, but they could never be detected. An analysis of such a mixture of pitchblende and silica, with traces of other materials, is of insufficient mineralogical interest to warrant publication.

The "lead-ratio" and age calculated therefrom are in reasonable agreement with those found for the first sample studied, and of the same order as those found by Hecht and Kroupa. It should be noted that samples from different veins and different levels yield nearly the same results, thus indicating a general uniformity of the age of the whole ore body, as previously suggested by the writer. These latest figures, bearing out this tentative conclusion, indicate that the Great Bear Lake pitchblende was apparently deposited in early Pre-Cambrian time. The need for further analyses and studies of the isotopic composition of the contained lead is still urgent.

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REFERENCES

- MARBLE, J. P. (1934): *Jour. Amer. Chem. Soc.*, **56**, 854-856.
—— (1936): *Jour. Amer. Chem. Soc.*, **58**, 434-437.
HECHT, F., and KROUPA, E. (1936): *Zeit. anorg. allgem. Chem.*, **226**, 248-256.
BAXTER, G. P. and ALTER, C. M. (1933): *Jour. Amer. Chem. Soc.*, **55**, 1445-1448; 2785-2792.
—— (1935): *Jour. Amer. Chem. Soc.*, **57**, 467-471.
HOLMES, A. (1931): *Nat. Research Council, Washington, Bull.* **80**, 207.