THUCHOLITE AND URANINITE FROM THE WALLINGFORD MINE NEAR BUCKINGHAM, QUEBEC

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Thucholite from Parry Sound has been described in an earlier paper.[1] Thanks to the interest of Mr. N. B. Davis, consulting mining engineer of Ottawa, who has been in charge of development at the Wallingford feldspar mine, both thucholite and uraninite have been found in small quantity in this mine also. The finding of these minerals gives point to a statement once made by the writer in which the belief was expressd that if competent observers were available to watch the workings it would probably be found that radioactive minerals occur much more frequently in pegmatites than is generally supposed. The casual visitor to the Wallingford at the present time would be very fortunate indeed if he found a single specimen of either mineral, even though he knew they occurred there and looked particularly for them.

The Wallingford mine is on lot 14, range II of Derry Township, Ottawa County. It is reached by a mine road from the Derry feldspar mine which itself is connected to the main Lièvre river highway by a road over which automobiles can be driven. This is an old mining region noted long ago for its production of apatite and mica, and more recently for its high grade feldspar.

The pegmatite of the Wallingford is a large dike of varying width which it is said can be traced for a mile or more in a north-west south-east direction. Mr. Davis states that the narrower parts consist largely of the usual graphic intergrowth of quartz and microcline with occasional patches of coarse crystal microcline and massive quartz in some of the wider swellings, and further that at the south-east end it becomes narrow and joins or appears to be an offshoot from a large dike of graphic granite perhaps 150 or more feet wide which strikes in a general north-east direction. At the Wallingford mine the dike outcrops for 100 feet or more over the face of a hill, dipping south-west, the actual width being possibly 75 feet. It consists of great masses of white quartz comprising, so far as at present explored, perhaps two thirds of

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[1] This Journal, preceding article.

the whole, the remainder being chiefly a very light colored, in places pure white, microcline containing a small amount of plagioclase as a fine perthitic intergrowth. The mine is worked from a tunnel and also by open cutting at the top of the hill. Both quartz and feldspar are mined and sold, the proportion of quartz being so great that probably the feldspar by itself could not be profitably won. Besides the microcline and the huge masses of white quartz there are patches, as much as several feet in diameter, of greenish gray plagioclase feldspar, in which small masses or veins of pyrite and pyrrhotite an inch or so wide sometimes occur. Masses of granular, dark, smoky quartz several feet in diameter are also present. Thin dentritic crystal growths of black tourmaline are quite often seen and more rarely crystals up to an inch diameter may be found. At one place in the open cut on top there were bodies several feet long of a streaky looking dull grayish black material which qualitative tests indicate to be allanite. This allanite has a peculiar appearance which the writer has never previously seen in connection with this mineral. It shows nowhere the slightest indication of crystal outlines, contains long narrow streaks of plagioclase feldspar, and in general has a coarse fibrous structure parallel to the long direction of the bodies, giving the impression that the structure may have been produced by shearing, or rather by plastic deformation during the crystallization of the mineral. Some of these streaks of allanite have superficially the appearance of veins an inch or more wide and several feet long cutting the feldspar, but on closer examination it is seen that these "veins" have a fibrous structure parallel to the long direction, with included long narrow streaks of plagioclase and in short, every appearance of having been produced mechanically. The allanite is quite radioactive and contains an unusually high percentage of thorium so that it will be possible to make an interesting comparison of the lead ratios of the two minerals. Nodules of both uraninite and thucholite, up to one quarter inch diameter have been found but unfortunately both are usually much altered, the uraninite to yellow gummite so called, the thucholite to a powdery black substance. Even the best specimens of uraninite so far obtained are more or less altered and only small amounts have been secured, so that it has not yet been possible to make an analysis of the highest accuracy using 2 gram portions, as has been done in the case of other Canadian

uraninites. At one time a patch 3×6 feet in area, chiefly microcline, was exposed, which was quite abundantly encrusted with a thin coating of yellowish green uranium (and vanadium?) decomposition products. Within this area were quite a number of nodules of gummite from a millimeter to a quarter inch in diameter and some blackish specks probably representing decomposed uraninite-thucholite intergrowth. Thucolite occurs in various forms in microcline, quartz or plagioclase. Much of it is powdery and dead looking but some retains its original brilliant black lustre exactly resembling the Parry Sound mineral, the description of which applies to this also. Most often it is in rounded grains but it also occurs intergrown with altered uraninite or possibly partly replacing the latter as cubes and octahedrons (Fig. 1) about 5 mm. in diameter. These crystals have a coating of more or less lustrous thucholite next the matrix with altered uraninite inside. A typical example of the cubic form was extracted from the rock and analyzed with results as on page 447. One specimen, the largest and most interesting of all (Fig. 2) is a pseudomorph after tourmaline. So perfectly are some of the faces (*a* and *m*) of the original tourmaline preserved that they could be accurately measured and identified by means of a contact goniometer. The thucholite of this unique tourmaline pseudomorph fortunately is fairly well preserved, solid and brilliant in lustre. Associated with the thucholite in the pseudomorph is

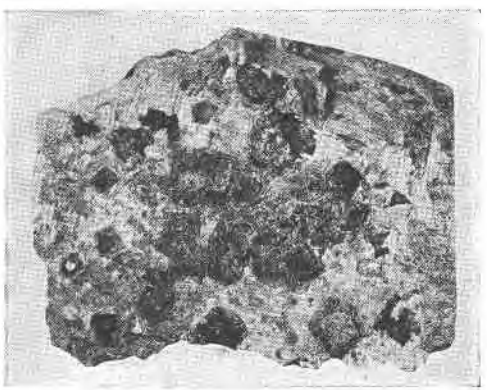

Fig. 1. Photograph showing crude cubic and octahedral crystals of altered uraninite enclosed in darker thucholite.

quite a little pyrite and some soft whitish substances not yet exactly identified, but evidently sulfate decomposition products, which are probably new minerals.

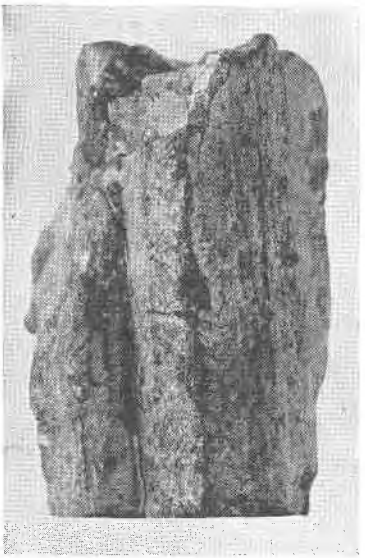

Fig. 2. Pseudomorph of thucholite after tourmaline. About twice natural size Faces *a* and *m* in front are quite sharp and measurable. The photograph does not do justice to the specimen.

A small crystal of zircon or more probably cyrtolite can be seen embedded in the pseudomorph and similar small crystals or crystal aggregates of this mineral can usually be found in the rock close to or touching thucholite nodules.

The similarity of the Parry Sound and Wallingford thucholite occurrences is evident. At both places thucholite, uraninite and cyrtolite occur in close association. At the Wallingford, however, though some of the thucholite apparently was formed at the same time as uraninite, there is evidence of considerable late pneumatolytic activity in the replacement of tourmaline and possibly uraninite by thucholite, whereas at Parry Sound thucholite seems to be entirely contemporaneous with uraninite.

The thucholite for analysis was from nodules of the best preserved materials carefully examined under the bincular microscope. The small amount of good material obtained did not

yield sufficient ash to permit making a complete analysis. Results were as follows:

ANALYSIS OF 0.1411 GRAM THUCHOLITE FROM THE WALLINGFORD MINE.

	Grams	Per Cent
Loss in 3 days over conc. H_2SO_4	0.0122	8.64
Loss in 3 hrs. at 110°	0.0069	4.89
Loss in 1 minute at red heat in covered Pt. crucible, CO_2 passing	0.0405	28.70
Residue after combustion	0.0280	19.84
	0.0876	62.07

Hence, approximately:

	Per Cent
H_2O	13.53
Gases	28.70
Ash	19.84
Fixed Carbon	37.93
Heavy Hydrocarbons	Not detected
	100.00

From the 0.0280 g. ash the following minimum amounts of pure substances were obtained:

	Grams	Per Cent
PbO	Undeterminable	
U_3O_8	0.0051	18.2
ThO_2	0.0029	10.4
$(Ce, La, Di)_2O_3$	0.0064	22.8
$(Yt, Er)_2O_3$	0.0036	12.8
CaO	0.0044	15.7
Fe_2O_3, Al_2O_3, etc.	0.0012	4.3
SiO_2	0.0018	6.4
P_2O_5	Present—Not determined	
	0.0254	90.6

The analytical examination suffices to show the resemblance of this mineral to the Parry Sound thucholite. The variations in composition of the mineral from the two localities are probably no greater than the differences between individual nodules from either locality.

The Wallingford thucholite is particularly interesting because it not only is intimately associated with uraninite, but it actually

replaces tourmaline showing that it is not confined to relatively high temperature conditions but can also be produced by late pneumatolytic action. Thus it appears that carbon must be included with boron, fluorine, sulfur, water, etc., as one of the constituents of the residual solutions of granite magmas.

Analysis of Uraninite–Thucholite Crystal From the Wallingford Mine

A typical crystal as seen in Fig. 1 was extracted and analyzed with results as follows:

Wt. of substance	0.1328 g.
Loss on ignition	0.0115 g.

Thucholite + H_2O, He, etc. = 8.66 per cent approx.

Allowing for water present there probably is not more than 6 or 7 per cent thucholite by weight in this specimen though others might have been selected which would show considerably more.

On heating the black ignited material with HNO_3 it behaved exactly like uraninite, dissolving with effervescence accompanied by evolution of red nitrous fumes and the production of a strongly yellow colored solution. A certain amount of reddish colored material, probably thorium and cerium oxides remained undissolved however, so the whole was heated for several hours with H_2SO_4, after which treatment everything appeared to dissolve except silica, etc., and lead sulfate. A careful analysis was then carried out with results as follows:

	Per Cent
PbO	9.88
(Pb = 9.17)	
U_3O_8	68.92
(U = 58.46)	
ThO_2	6.76
(Th = 5.94 × 0.38 = 2.26U equivalent)	
$(Ce, La, Di)_2O_3$	0.66
$(Yt, Er)_2O_3$	4.04
Fe_2O_3, Al_2O_3, MnO	2.55
CaO	0.93
SiO_2	3.46
	97.20

$$\frac{Pb}{U+0.38\ Th}=0.151$$

A certain amount of decomposed feldspathic and micaceous material from the matrix adhering to the uraninite-thucholite crystal doubtless accounts for the high alumina, iron and silica.

Though the amount of substance taken was small the percentages of Pb, U and Th are such that the results may be considered sufficiently accurate to demonstate that this uraninite agrees perfectly in its age indications with those of other Canadian uraninites examined by the writer.