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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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MINES BRANCH INVESTIGATION REPORT IR 59-107

IDENTIFICATION OF RADIOACTIVE MINERALS IN SOME HAND SPECIMENS FROM PRONTO URANIUM MINES LIMITED, ALGOMA MILLS, ONTARIO

by

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EXTRACTION METALLURGY DIVISION

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INTRODUCTION

In a letter dated August 27, 1959 Mr. P.C. Masterman, Chief Geologist, Pronto Uranium Mines Limited, Algoma Mills, Ontario, requested the Radioactivity Division (now part of the Extraction Metallurgy Division) of the Mines Branch, Ottawa, Ontario to identify the radioactive minerals in seven hand specimens. The specimens, numbered 504, 4-14, 50 Dr, 66-1, 501, 502, and 4-12, were received on August 31, 1959. This report includes the work covered in an interim report sent to Mr. Masterman on September 18, 1959, along with additional work done on specimens 66-1, 501, 502 and 4-12.

RADIOACTIVE MINERALS IDENTIFIED IN HAND SPECIMENS

Uranophane $Ca(UO_2)_2 (SiO_3)_2 OH_2 \cdot 5H_2O$

Uranophane occurs as an earthy, lemon-yellow coating on the weathered surfaces of specimen No. 4-14.

Scientific Officer, ~~Radioactivity Division~~, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada

Beta-Uranophane $Ca(UO_2)_2\ (SiO_3)_2\ OH_2 \cdot 5H_2O$

Beta-uranophane occurs as hemi-spherical aggregates of lemon-yellow, needle-like crystals on weathered surfaces or as thin scales on fracture surfaces of specimen No. 504.

Boltwoodite $K_2\ (UO_2)_2\ (SiO_3)_2(OH)_2 \cdot 5H_2O$

Boltwoodite occurs as an earthy lemon-yellow coating on weathered surfaces of specimen No. 504 and as radiating aggregates of lemon-yellow, needle-like crystals on the weathered surfaces of specimen No. 4-14.

Thucholite

Thucholite occurs as vitreous, black nodules in specimen No. 50 Dr.

Liebigite $Ca_2\ U(CO_3)_4 \cdot 10H_2O$

Liebigite occurs as an earthy, greenish-yellow mineral on slip or fracture surfaces of specimen No. 502. The mineral fluoresces a vivid green under ultra-violet light.

RADIOACTIVE MINERALS IDENTIFIED IN POLISHED SECTION

Polished sections were prepared in order to study the finely disseminated radioactive minerals occurring in specimens No. 66-1, 501, 502, and 4-12. These minerals are described in the following paragraphs.

Coffinite $U(SiO_4)_{1-x}(OH)_{4x}$

Coffinite occurs in specimen No. 501 as fine, gangue-like grains usually containing minute specks of pyrite (Figure 1).

Brannerite, A Uranium Titanate

Brannerite was identified in specimens No. 66-1, 501, 502, and 4-12. In specimen No. 66-1 it occurs as diffuse aggregates of needle-like crystals frequently associated with rutile (Figure 2). The brannerite in this specimen usually has an even, light grey colour giving it a fresh, unaltered appearance. Little or no internal glow in or around the brannerite grains (when observed through the crossed nicols of an ore microscope) indicates that there are only small amounts of anatase present.

Brannerite in specimen No. 502 occurs as diffuse feathery areas which are similar in form to those in specimen No. 66-1 but generally exhibits a mottled grey appearance (Figure 3). Grains picked from such areas yield X-ray diffraction patterns of anatase and/or rutile: when the grains are ignited, however, the resulting patterns contain the characteristic lines of brannerite and frequently uraninite. The presence of uraninite in those areas cannot be detected microscopically and it is thought that the uraninite may be secondary resulting from the alteration of brannerite. The anatase is also thought to be an alteration product of the brannerite. In some cases it occurs as fine grains associated

with the brannerite or more frequently as an intimate intergrowth with brannerite in which it can only be distinguished by its internal reflection when observed through crossed nicols. Where rutile is associated with the brannerite the rutile occurs as visible grains and is not thought to be an alteration product of the brannerite.

In addition to the brannerite described above, coarser, more or less discrete aggregates of brannerite and anatase may occasionally be found (Figure 4).

In specimen No. 4-12 brannerite appears to be more altered than in previously described specimens. It usually occurs in fairly discrete grains which appear to be largely anatase (Figures 5 and 6). In this specimen also, fairly strong uraninite lines were seen in the X-ray diffraction pattern of one of the ignited grains of brannerite. This grain is shown in Figure 5. Fine, needle-like crystals of brannerite, usually in loose aggregates, are also present (Figure 6).

Brannerite is scarce in specimen No. 501. Grains taken from a rather diffuse mottled grey area of indefinite outline (Figure 7) gave X-ray patterns similar to those from specimens 502 and 4-12. Before ignition these grains yielded the diffraction pattern of anatase while after ignition they yielded the diffraction patterns of brannerite and uraninite.

Uraninite

Uraninite is most abundant in specimen No. 501 where it forms the chief uranium-bearing mineral. It occurs as subhedral, brecciated cubic crystals which in many cases appear to be partially altered (Figure 8). X-ray diffraction evidence, as previously mentioned, indicates the presence of what may be secondary uraninite in altered brannerite grains in specimens No. 501, 502, and 4-12.

Monazite (Ce, La, Y, Th) PO_4

In the interim report sent to Mr. Masterman on September 18, 1959, monazite was tentatively identified in specimen No. 4-12. Subsequent work has led to the conclusion that monazite, if present, is very rare.

CONCLUSION

The following table summarizes the radioactive minerals identified in each of the submitted specimens.

TABLE 1

Specimen No.	Radioactive Minerals
504	beta-uranophane, boltwoodite
4-14	uranophane, boltwoodite
50 Dr	thucholite
502	liebigite, brannerite-uraninite
66-1	brannerite
501	brannerite-uraninite, uraninite, coffinite
4-12	boltwoodite, brannerite-uraninite, monazite

With the exception of some subhedral cubic crystals of uraninite in specimen No. 501 the uraninites listed in Table 1 are thought to be of secondary origin derived from the alteration of brannerite. The secondary uraninite is so intimately intergrown with altered grains of brannerite that it could not be detected optically but was found through the use of X-ray diffraction methods.

PHOTOMICROGRAPHS

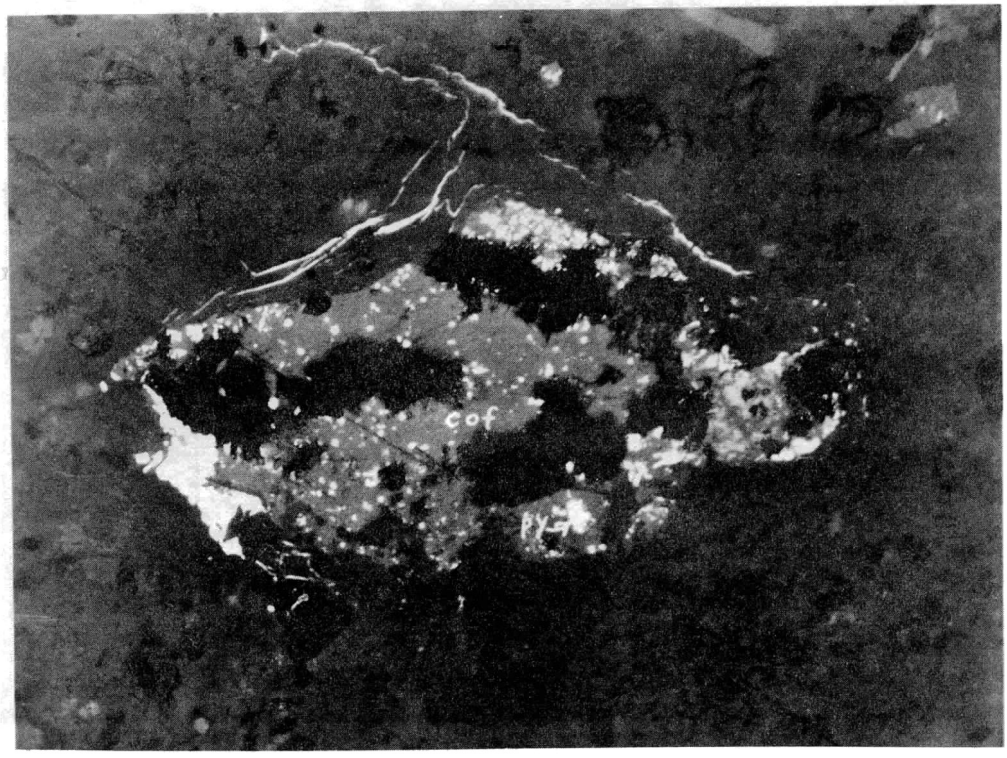

FIGURE 1 - A grain of coffinite (cof) containing fine inclusions of pyrite (py). Specimen No. 501. X250

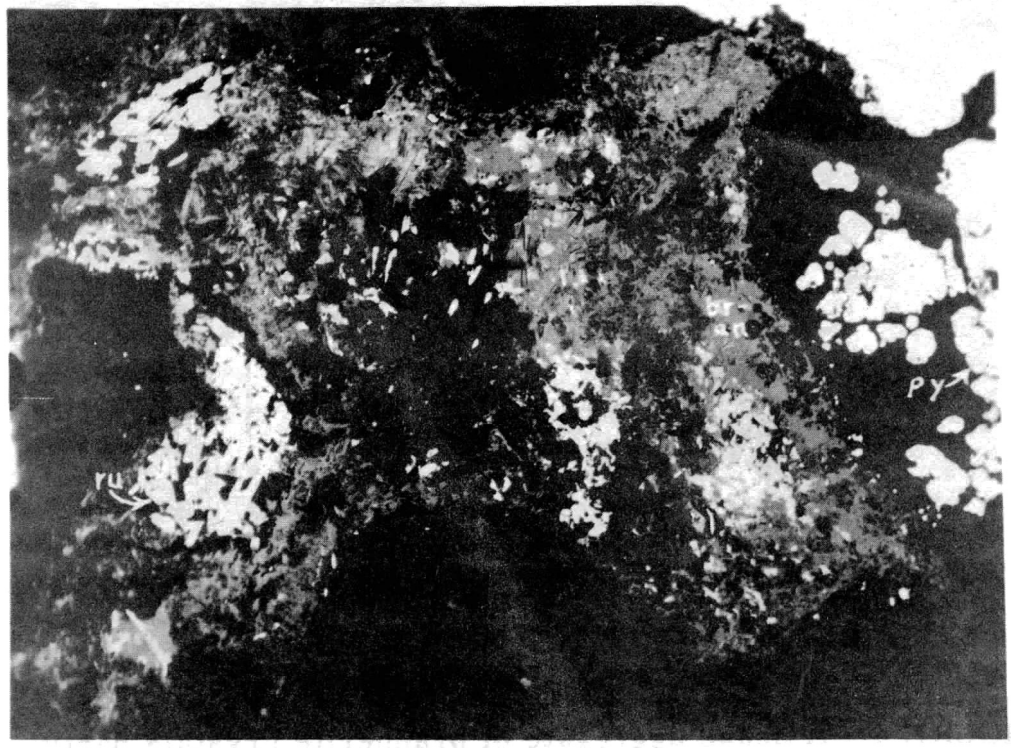

FIGURE 2 - Brannerite and anatase (br-an) with associated rutile (ru) and pyrite (py). Specimen No. 66-1. X150

FIGURE 3 - Intimately intergrown brannerite and secondary uraninite (br-u). Anatase (an) is also present. Specimen No. 502. X100

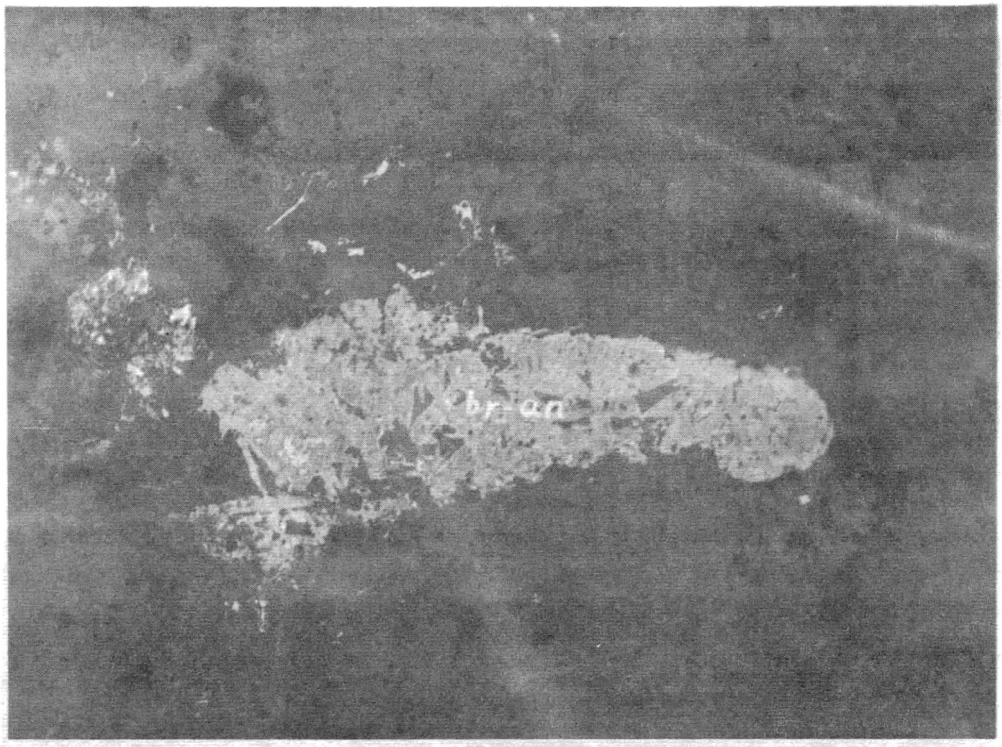

FIGURE 4 - A dense aggregate of brannerite crystals partly altered to anatase (br-an). Specimen No. 502. X150

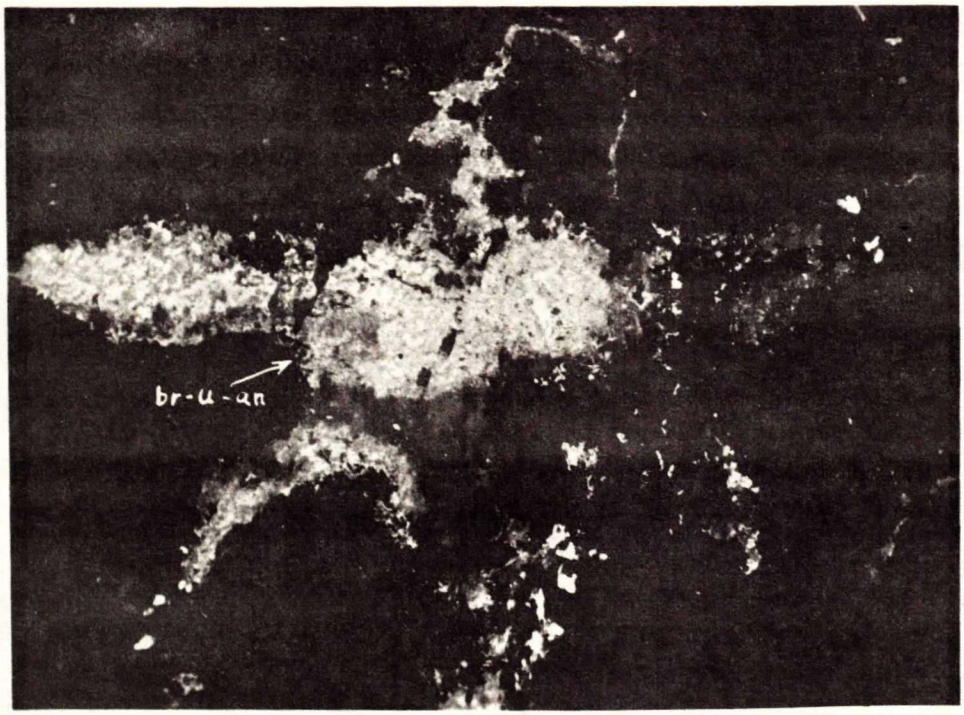

FIGURE 5 - A partly altered grain of brannerite intimately intergrown with secondary uraninite and anatase (br-u-an). Specimen No. 4-12. X150

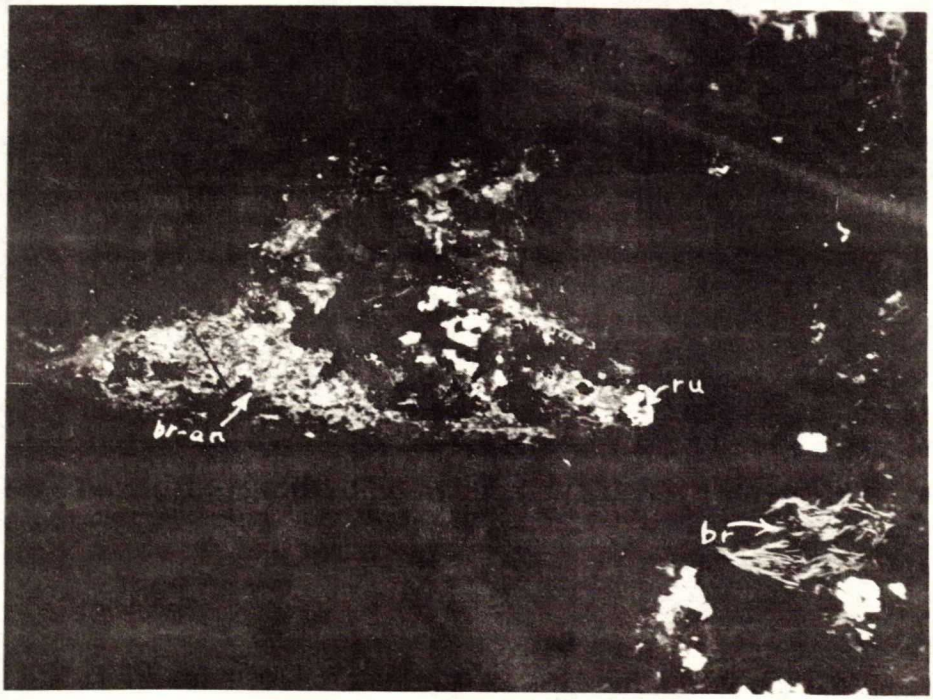

FIGURE 6 - A grain of brannerite considerably altered to anatase (br-an) with associated rutile (ru). A small aggregate of brannerite crystals (br) occurs on the right. Specimen No. 4-12. X150

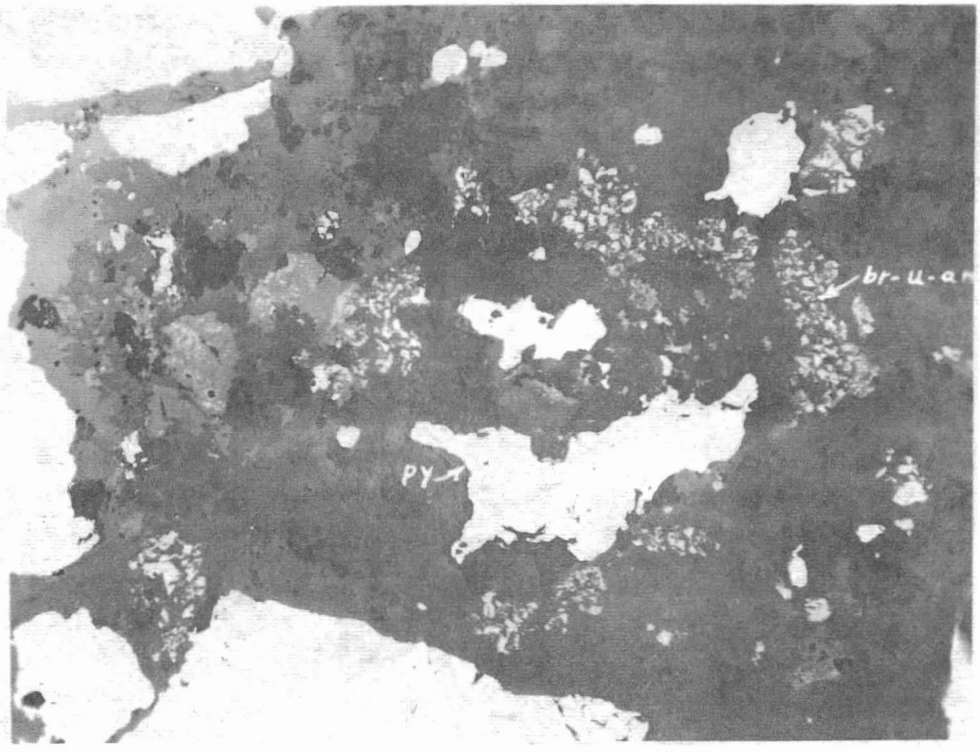

FIGURE 7 - Highly altered brannerite intimately intergrown with secondary uraninite and anatase (br-u-an). The white grains are pyrite (py). Specimen No. 501. X100

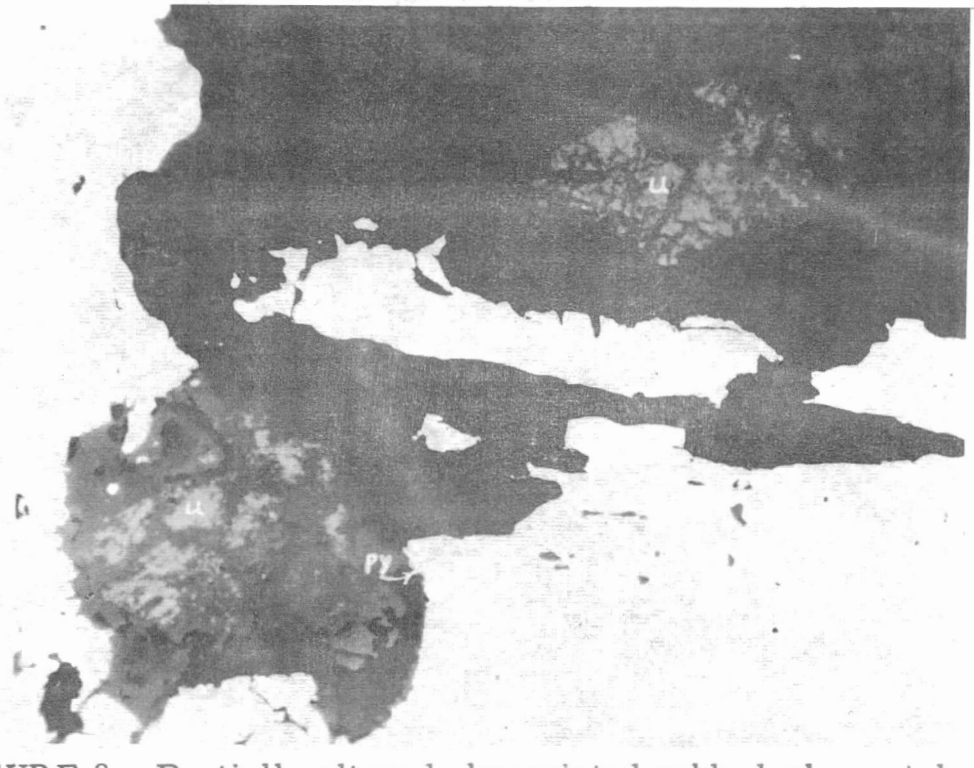

FIGURE 8 - Partially altered, brecciated subhedral crystals of uraninite (u). The white grains are pyrite (py). Specimen No. 501. X250