URANINITE CRYSTALS WITH A NEW FORM FROM PORTLAND, CONNECTICUT*

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ABSTRACT

Euhedral crystals of uraninite from one of the pegmatites at this locality are octahedra modified by the cube, the dodecahedron, and a new form, the tetrahexahedron {520}. The latter is determined on a matrix specimen by measurement on the microscope stage of the plane angle formed on the (520) face by its intersections with (111) and (11$\bar{1}$), which may be expressed as the interzonal angle [2$\bar{5}$3]$\wedge$[$\bar{2}$53].

The uraninite crystals occur on a matrix of feldspar which proves, on optical examination, to be albite with the approximate composition $Ab_{95}An_5$. The albite is a replacement of microcline, which is present in very small amounts as a relict mineral.

Besides the usual cleavages parallel to {001} and {010}, the albite shows fair cleavage parallel to {110}, (no cleavage parallel to {1$\bar{1}$0}), and both albite and pericline twin-lamellae, as well as pericline parting.

INTRODUCTION

The specimen here described was obtained from Ward's Natural Science Establishment some years ago. It is labeled "Collins Hill, Portland, Conn." An account of the minerals of Strickland's Quarry at Portland has been given by Shannon (1). In view of the present interest in uraninite it seems an appropriate time to describe the specimen.

The specimen consists mainly of buff-colored cleavable feldspar which proves, when examined in thin sections, to be albite. Scattered about the feldspar there is a little pale-green muscovite; some smoky quartz, a little secondary autunite, a few specks of garnet, a fair-sized euhedral crystal of columbite, and, most important of all, the crystallized uraninite.

THE URANINITE

The specimen, reduced in size by careful trimming, furnished several euhedral crystals of uraninite varying from 2 to 5 mm. as well as a number of feldspar cleavages. Figure 1 is a photograph of a portion of the specimen after trimming.

The uraninite crystals are octahedra modified by the cube and dodecahedron. One crystal on the matrix (*u* in Fig. 1) shows a few faces of a tetrahexahedron {*hk*0}. This must be a new form since no tetrahexahedra for uraninite are listed in either Goldschmidt's *Atlas* or the seventh edition of Dana's *System of Mineralogy.*

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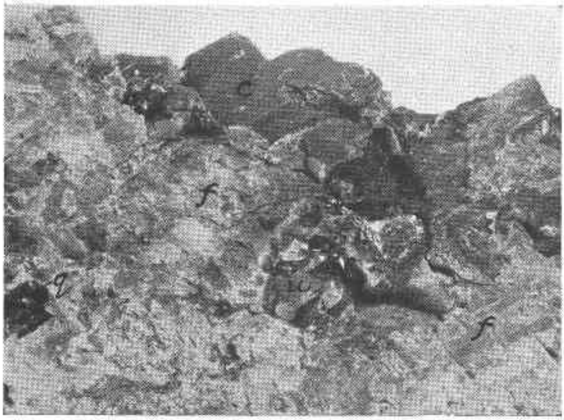

FIG. 1. (×2) Uraninite (*u*) crystal on matrix of feldspar (*f*) (albite, $Ab_{95}An_5$), with columbite (*c*), and quartz (*q*).

In order to keep the museum specimen intact it became necessary to measure the plane angle of the (*hk*0) face on the stage of a microscope. The polarizing microscope with rotating stage may be used as a goniometer with an accuracy intermediate between that attained with a contact goniometer and a reflection goniometer.

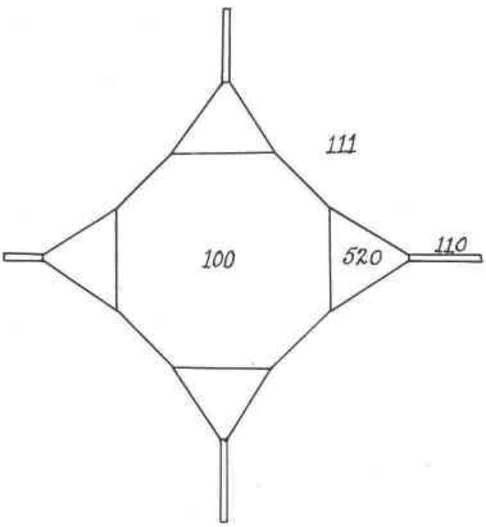

FIG. 2. Front elevation of a portion of idealized uraninite crystal with the forms: {111}, {100}, {520}, and {110}.

Figure 2 is a front elevation of a part of the best crystal. The triangular face is (*hk*0); the most likely form is either {210} or {310}. Figure 3*a* is a plan view of the crystal. Figure 3*b* is a supplementary drawing made from the plan. The plane angle *etf* on measurement proves to be 21°9′, which is the average of ten values varying from 20°20′ to 22°0′. The calculated value of the interzonal angle $[2\bar{5}3]\wedge[\bar{2}53]$ is 21°2′, which is proof that the {*hk*0} form is {520}.* One has the impression that this is an unusual isometric form, but it is known on the following minerals: copper, diamond, garnet, gold, fluorite, magnetite, perovskite, pyrite, silver, sperrylite, sphalerite (?), and sylvite, according to the data of Goldschmidt's *Atlas*. The zone-symbol of the edge *et* is $[2\bar{5}3]$ and the zone-symbol of the edge *ft* is $[\bar{2}53]$.

The use of plane angles or interedge angles in the determintion of minerals has been emphasized by the writer in a recent paper on braunite (2).

The matrix crystal also shows line faces between (100) and (520), between (100) and (111), and between (520) and (111).

The common forms on uraninite are the octahedron, the cube, and the dodecahedron. The trapezohedron {411} was found on crystals from Cardiff township, Ont., by Parsons (3) and the trapezohedron {533} on crystals from Grafton Center, N. H., by Shaub (4). The complete form-system† for uraninite, then, is: {111}, {100}, {110}, {411}, {533}, and {520}.

According to Dr. J. D. H. Donnay‡ the space group of a crystal of the hexoctahedral class with these forms is O_h^5-Fm3m. Strunz (5*a*) also gives this space group.

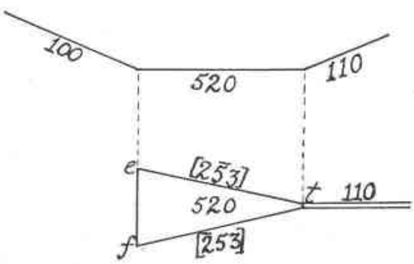

FIG. 3*a*. Plan view of a portion of uraninite crystal.
FIG. 3*b*. Supplementary projection showing (520) face in its true shape.
Plane angle *etf* $=[2\bar{5}3]\wedge[\bar{2}53]$.

* For {210} the corresponding interzonal angle $[1\bar{2}1]\wedge[\bar{1}21]$ is 25°12′, and for {310} the interzonal angle $[1\bar{3}2]\wedge[\bar{1}32]$ is 17°58′.

† V. Goldschmidt's name for the totality of forms known for a given crystal species.

‡ Personal communication, Oct. 30, 1946.

The uraninite shows some evidence of imperfect octahedral cleavage or parting, probably the former since there is no sign of any twinning. Seaman (5), who emphasizes cleavage in the determination of minerals, makes no mention of cleavage or parting for uraninite.

The specific gravity of one of the uraninite crystals weighing a little over a gram is approximately 10.0 as determined on a beam balance.

The uraninite gives a bright green $NaPO_3$ bead test in R.F. It also gives a pale yellow NaF bead which fluoresces a bright yellow in the ultraviolet light given off by a silica-glass mercury lamp (6). This sodium fluoride bead test is probably the best blowpipe test for uranium. Heated in a closed tube the uraninite gives a very small amount of water.

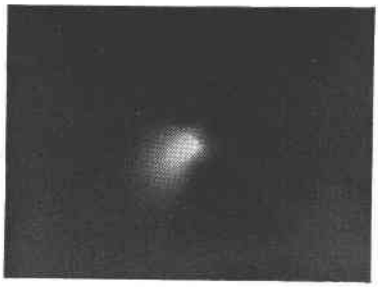

FIG. 4. Radiograph of specimen of Fig. 1.

A spectrographic analysis made by Mr. Kenneth C. Peer of the Multiphase Laboratories of San Francisco gave the following:

U—major constituent
Pb—a few tenths of 1%
Fe—a few tenths of 1%
Si—>a few tenths of 1%, <1%
La—faint trace
Th—present
Zr—a few hundredths of 1%
Al—a few hundredths of 1%
Sr—<0.001%
Ca—<0.001%
Ba—a few hundredths of 1%
Na—trace
Cr—<0.001%
Cb—a few hundredths of 1%
Ta—trace
Ti—a few thousandths of 1%, or less

The uraninite is readily soluble in hot nitric acid. NH_4OH added to the solution gives a yellow precipitate.

The specimen shown in Fig. 1 on a 24-hour exposure to a Wratten photographic plate gave the radiogram reproduced as Fig. 4 at the spot marked "u" which is the uraninite crystal measured.

Additional evidence of radioactivity was furnished by a test with a Geiger-Müller counter. Using a lead shield with an opening placed over "u" in the photograph of Fig. 1, the "clicks" were very noticeable and less evident when placed over "c", the columbite.

The Feldspar

The feldspar proves to be almost as interesting as the uraninite. At sight it greatly resembles microcline, but thin sections prove it to be albite. A few patches of microcline, with the characteristic gridiron structure, oriented parallel to the main albite section are interpreted as evidence that the albite has replaced microcline (see Fig. 5). There is nothing in the thin sections to suggest antiperthite.

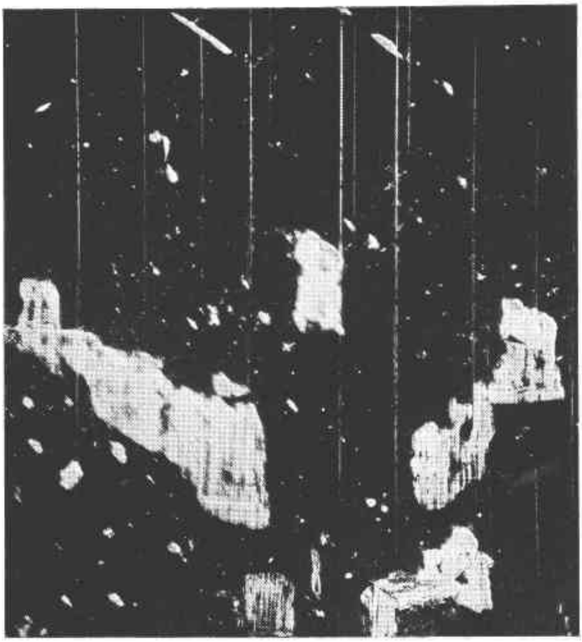

Fig. 5. (×60) Photomicrograph of a thin section of the feldspar cut parallel to (001) to show newly formed albite ($Ab_{95}An_5$) with relict microcline.

The feldspar shows perfect (001) and (010) cleavage and imperfect (110) cleavage but no ($1\bar{1}0$) cleavage. The absence of the $M(1\bar{1}0)$ cleavage, which is usually mentioned for plagioclase feldspars, was verified by the measurement of the $c\ (001) \wedge b(010)$ cleavage angle on a reflection goniometer with four different cleavage fragments. For example, in the specimen represented in Fig. 6 the angle $c\ (001) \wedge b(010)$ is about 86° and so the cleavage face m is (110) and not $M\ (1\bar{1}0)$. If this were $M\ (1\bar{1}0)$, the angle $c\ (001) \wedge b(010)$ would be about 94°. The intersection of the (010) and (110) cleavages determines the c [001] zone-axis and thus enables one to orient the feldspar, as has been emphasized by the writer, (7, p. 206). Faint albite twin-lamellae are noticed on the (001) cleavage face and pericline twin-lamellae are noticed on some portions of the (010) cleavage faces as shown in Fig. 6.

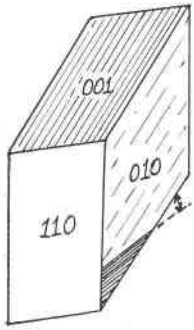

FIG. 6. Albite ($Ab_{95}An_5$) cleavage fragment showing cleavage parallel to {001}, {010}, and {110}, with albite twin-lamellae on (001) and pericline twin-lamellae on (010). The angle of the rhombic section is indicated by the arc.

The angle of the rhombic section, *i.e.*, the angle between the trace of the (001) cleavage and the outcrop of the pericline twin-lamellae measured on the (010) cleavage, is +24°0′ (the average of five measurements varying from +22°50′ to +25°0′). This places the albite at $Ab_{95}An_5$ according to the curve of Schmidt (8) which is reproduced as Fig. 223 on page 245 of Rogers and Kerr (9). This is verified by the extinction angle of +16°0′ (average of ten readings varying from +14°10′ to +16°50′) measured on a thin section cut parallel to the (010) cleavage with the (001) edge as a reference line. There is additional verification in the extinction angle of −13°52′ (average of ten readings varying from −13°5′ to −15°0′), obtained in an oriented section cut normal to the (001:010) =[100] edge. According to Duparc and Reinhard's (10) curve the extinction angle of a section of $Ab_{95}An_5$ cut normal to [100] is −13°0′.

The specific gravity of a specimen of the albite weighing about 18 g. is 2.62, which furnishes a good check on the optical determinations.

ACKNOWLEDGMENTS

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