

WISAKSONITE IS METAMICT URANOAN THORITE

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ABSTRACT

On very slender evidence Druif has given the name wisaksonite to green isotropic euhedra of what he believed to be a new mineral species. Work just completed leads one to suggest that this name be abandoned since the results of *x*-ray diffraction and other determinations have shown that the mineral in question is undoubtedly metamict uranoan thorite.

DATA REPORTED BY DRUIF

During a study of a heavy mineral residue from a sand sample from Pekoeringan River in Central Celebes, Druif (1948) observed crystals of what he believed to be a new mineral—wisaksonite.¹ In an attempt to identify the green more or less isotropic euhedra, Druif considered in turn the properties of zircon, malacon, and other altered forms of zircon, vesuvianite, nageite,² and oyamalite, and in his opinion the properties of his wisaksonite were distinct from those of the minerals just listed. Undoubtedly he was justified in setting aside identification as true or normal zircon on the basis of the isotropy of the mineral, but less so with malacon since he was under the misapprehension that a green color is never found in the latter.

It might be pertinent to list the properties of wisaksonite as determined or estimated by Druif, since it was on the basis of these that he felt justified in adding a new mineral to the literature:

1. Tetragonal morphology; with considerable similarities to zircon.
2. Green color.
3. Brittleness; that is, apparently, in contra-distinction to what is found for zircon.
4. Refractive index is in excess of 1.80.
5. Isotropic or nearly so, with positive elongation parallel to the longer dimension (*c* axis) of those crystals with faint but perceptible birefringence.
6. Intergrown with zircon.
7. Density about 4.
8. The properties of naegite and wisaksonite were considered to have certain features in common; however, Druif believed that absence of cassiterite in the heavy mineral assemblage that included wisaksonite excluded this possibility, apparently because cassiterite is always associated with naegite in Japan!

It will be noted that Druif has not made available any exact physical

¹ In his review of Druif's paper, Fleischer (1948, p. 787) expressed the opinion that the mineral in question was "low-density zircon."

² Naegite was described by Shibata and Kimura (1923, pp. 3–5) as similar to zircon except that rare earths, thorium, and uranium were important constituents. In the analysis of oyamalite on the other hand, Kimura (1925, pp. 84–85) reported both phosphorus and rare earths in addition to zirconia and silica. Both of these minerals require further study.

datum for his green mineral although such is usually deemed necessary as a basis on which to establish satisfactorily any new mineral species.

The description of wisaksonite interested the present writer to the extent that an enquiry was sent to Dr. Druif asking if some material might be made available for further study, but unfortunately the letter was returned stamped "unknown." However, through the splendid efforts of Dr. F. A. van Baren of the Tropical Institute, Amsterdam, the writer was able to secure a Canada balsam preparation that contained eight minute crystals of wisaksonite. These crystals, none of which exceeded 0.2 mm. in length, were freed from their mounting medium by treatment with xylol; of these, four were set aside for determination of refractive index and specific gravity, and four were segregated for *x*-ray study.

X-RAY INVESTIGATION

Employing a camera of 57.3 mm. diameter and copper radiation filtered by nickel, three rotation photographs were taken. A euhedral crystal that measured 0.2 by 0.04 mm. was set up on the end of a glass fiber in such a manner that the longer axis, the *c* crystallographic direction, was made the axis of rotation. After an exposure of ten hours at 30 KV. and 20 MA. the crystal yielded only diffuse powder haloes with no evidence of orientation. This crystal was now unmounted, heated for four hours at 860° C., being placed in a fully heated electric furnace; after air-quenching the crystal was mounted as before. A ten-hour exposure now yielded faint but well defined lines, namely those of the face-centered cubic lattice of ThO₂; there were no traces of lines due to any crystalline modification of SiO₂.

Once again the same crystal was unmounted but this time it was heated to 1250° C. for four hours, and then remounted. In this instance the ThO₂ pattern was barely detectable and instead lines corresponding to those of the monoclinic modification of thorium silicate—huttonite—were strongly evident. A second crystal was heated for four hours at 860° C., but this time an exposure of twenty-five hours produced lines of better density for evaluation purposes. This film has been measured and the spacings (Table 1) compare satisfactorily with those of ThO₂ although the length of the cell-side, $a = 5.52 \text{ \AA}$, is distinctly smaller than that for pure ThO₂ (*vide* Arnott, 1950, pp. 388–390); this departure is possibly due to replacement of thorium by smaller uranium atoms.

PHYSICAL PROPERTIES

The results of the determinations of refractive indices on heated and unheated crystals may be summed as follows:

TABLE 1. POWDER PATTERNS OF THORITES HEATED TO 860° C. FOR FOUR HOURS. Cu/Ni radiation with $\lambda=1.5418 \text{ \AA}$

A			B	
$d_{\text{obs.}}$	I^*	hkl	$d_{\text{obs.}}$	I^*
3.16	10	111	3.23	10
2.75	6	200	2.78	6
1.95	7	220	1.96	7
1.66	8	311	1.69	8
1.60	2	222	1.62	2
1.38	2	400	1.40	2
1.27	4	331	1.29	4
1.23	4	420	1.26	3
1.13	4	422	1.15	3
1.06	4	{ 511 333	1.08	3
0.98	v. faint	440	0.99	v. faint
0.93	2	531	0.95	2
0.92	2	{ 600 442	0.94	2
0.87	1	620	0.885	1

A. "Wisaksonite," Celebes.

B. Uranoan thorite, mouth of Año Nuevo Creek, San Mateo Co., California.

* Intensities were determined visually.

1. Clear green isotropic crystal: $n=1.88 \pm 0.005$.
2. Green crystal with some opacity due to alteration or inclusions: $n=1.795$.
3. Green crystal, slightly more translucent than crystal 2: $n=1.82$.
4. A clear green isotropic crystal with semi-translucent patches ($n=1.87$ but with some parts of the crystal with $n=1.84$ ca.) became opaque after heating to 860° C for four hours. On fracturing, however, the grain was found to be quite heterogeneous and to be composed of deep reddish-brown areas, with $n=1.79$, that are intimately associated with dark greenish-brown material with $n=1.835$; the latter material was quite translucent, whereas the former was heavily clouded with minute dust-like particles. It is suggested that the dark greenish-brown phase is derived from the clear portions of the original crystal and the reddish-brown portions from the altered or inclusion-bearing zones. It is not known whether these two phases taken separately would give distinct x -ray patterns but it does remind one of a similar situation found in priorite (Hutton, 1953, p. 7). Heating of wisaksonite, that is uranoan thorite, in this instance appears to bring about a lowering of refractive index.

It is interesting to note that thorites of initially low refractive index exhibit a distinct rise in the value of that property when heated (Pabst, 1952). The rise of refractive index in one instance and the decrease in another might be due in some measure to the water content of the metamict minerals. Thorites with initially a high percentage of water

could be expected to show an increase of refractive index with dehydration, for certainly, originally anhydrous metamict thorites, the California type, show the reverse effect.

The minute quantity of the mineral did not permit determination of specific gravity; however, each of four crystals was found to sink quite rapidly in a melt of thallos formate and thallos malonate. Therefore all that one is prepared to say in this connection is that the specific gravity of each of these crystals is considerably in excess of 5.

URANIUM CONTENT

Two euhedra of wisaksonite, a grain of monazite ($U_3O_8=1.23$ per cent), and a crystal of metamict uranoan thorite ($UO_2=6.95$ per cent), each of the two latter had particle sizes approximately equivalent to that of wisaksonite, were placed on the surface of a thin film of solidified Na_2CO_3-NaF fusion mixture. The film was heated carefully to permit momentary melting and then quickly cooled. When this preparation was obliquely illuminated with short-wave ultraviolet light and viewed with a binocular microscope a fluorescent halo was noted surrounding wisaksonite, and this was comparable in intensity to that surrounding the thorite with a known content of uranium, and yet distinctly stronger than that adjoining monazite.

SUMMARY

The α -ray study of crystals of a mineral named wisaksonite by Druif leaves no doubt that this mineral is metamict thorite. The physical data, although not conclusive when taken alone, are in support of this opinion. Finally a not inconsiderable content of uranium would seem to be present. Therefore the mineral is considered to be metamict uranoan thorite, and it is suggested that the name wisaksonite be deleted from mineralogical literature.

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