ZUNYITE FROM GUATEMALA

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The mineral zunyite is so rare in nature that any information regarding a new occurrence of the mineral seems worthy of record. The following observations gain an added interest perhaps from the unusual circumstances surrounding the discovery of this occurrence.

The excavations of the ruined Maya city of Uaxactun, situated in the plains of northern Guatemala just north of Lake Peten, have been conducted by the Carnegie Institution during the last few years. One of the archeologists in charge of the investigations, Dr. Oliver Ricketson, Jr., brought to the Harvard Mineralogical Laboratory powders which had been taken from pots buried in graves opened during the excavation at Uaxactun. He desired a mineralogical examination of these eight powders of which small samples were submitted, and this the writer undertook. Some of them contained fresh-water shells and in addition a grayish powder which proved to consist largely of calcite. This was interpreted as a limestone spring-deposit or sinter probably introduced into the pots after burial. When the calcite, which varied in different samples from a very small to a very large part of the whole, was removed with dilute acid there remained a small amount of clay material and a brilliant metallic residue which proved to consist very largely of minute crystals of hematite. Most of the powders also contained hematite in the form of a deep red ochre. A further concentration of the residues with the magnet revealed a small nonmetallic fraction consisting of extremely sharp individual crystals of tetrahedral form which, on optical investigation, proved to be the mineral zunyite.

Before describing the hematite and zunyite in detail a few speculations may be permitted on the possible origin of this material and the means by which it reached the place where found. The material is certainly not in any sense a sand since none of the constituents show conspicuous water wear. Both hematite and zunyite are in sharp, brilliant crystals. The hematite is in characteristic scales which are of a habit most familiar in volcanic fumerole deposits; while zunyite has not heretofore been found in such deposits it is elsewhere known as a contact mineral and is related to igneous sources. It seems to be fairly certain that these powders were col-

lected at some volcanic vent possibly because of their brilliant spangled nature or to be used as red pigments and that they may have been deposited in these graves as votive offerings, valuable because of their distant origin. The nearest volcanoes which might have served as a source for the material are far to the south in Guatemala and San Salvador. It so happens that there are in our collections samples of crystalline hematite collected at the volcano Laguna Verde in San Salvador, which are entirely similar to that material in these powders. This volcanic region then is probably the source of the material.

Mr. Ricketson states in a letter:—"The red pigment you describe as derived from powdered hematite is extremely common in graves and used as paint. Often one sees a red hand on plastered walls etc. made by immersing the actual hand in red paint and pressing it on the wall.

As Uaxactun lies very nearly in the geographic center of the Yucatan peninsula, substances of volcanic origin must of necessity have been brought from the Highlands of Guatemala at the nearest. Obsidian is of very common occurrence, but always in cores or chips or finished implements. Granite mauls are also fairly common. Their flint, however, was probably derived from flint nodules, very common in the local limestone throughout the peninsula."

Hematite

The hematite crystals are excessively flat scales, parallel to the basal plane (0001). Very rarely do they exceed a millimeter in diameter and vary from this down to mere dots much less than 0.1 mm. The vast majority are perfect crystals without fracture and show in outline hexagonal, trigonal, or sometimes rectangular forms according to the particular development of the faces bounding the edges of the plates. The basal planes are generally perfectly devoid of striations but in some plates there is a faint trigonal striation and in certain of the scales a number of plates are grouped as subparallel aggregates. In addition to these brilliantly lustrous crystals there are a few scales which are dull due to a thin coating of ochreous hematite. On examination with the goniometer the crystals all show practically the same habit. They are combinations of the forms $c(0001)$, $r(10\bar{1}1)$, $e(01\bar{1}2)$ and $n(22\bar{4}3)$, but the scales are so thin that the forms other than c are all reduced to mere lines on the plate edges. A few minute octahedrons of magnetite are also found in the magnetic fraction.

Zunyite

The zunyite crystals are minute, the largest as much as 1 mm. in diameter, the average about 0.1 mm. and many of them mere dots. All are marvelously sharp in outline and regularly developed; rarely are two crystals attached to one another but in a few of them hematite scales are embedded, proving the simultaneous formation of the two minerals. The color varies from clear white to opaque white, dull pink and red, the latter doubtless due to inclusion of ochreous hematite.

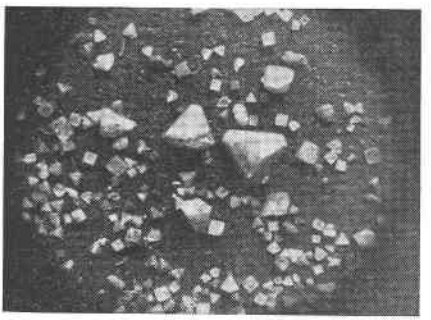

Fig. 1. Photograph of crystals of Zunyite. Magnification about 8 diameters.

The forms present are the cube (100) and the tetrahedrons, positive and negative, (111) and ($1\bar{1}1$). These are present in every possible relative proportion:—simple tetrahedrons; the same with line truncations of their edges by the cube and barely visible facets of negative tetrahedron; cubes with equal or unequal truncation of the corners by both tetrahedrons; in short they present under the binocular a complete series of gradations of fascinating variety. The photograph, figure 1, gives but an inadequate picture of this endless variation. Amid the thousands of tiny crystals were seen two or three perfect interpenetration twins like those recently described by Spencer. With the zunyite in this fraction of the powder were a few quartz crystals, doubly terminated, of the simple form characteristic of high-quartz; and a few brilliant crystals of zircon. An occasional minute grain of dark color proved to be tourmaline.

A sample of the zunyite crystals was purified by means of heavy solutions. About 0.5 grams was obtained and was analyzed by Mr. Gonyer with the result shown below.

For comparison and to show how constant is the composition of this mineral in its three known widely separated localities two other recent analyses of zunyite are also given.

I. Zunyite from Guatemala. F. A. Gonyer, Analyst.
II. Zunyite from the Zuni Mine, Colorado. B. Gossner und F. Mussgnug, *Centralb. für Min.*, A, **1926,** 149.
III. Zunyite from Postmasburg, So. Africa. L. T. Nel, *Min. Mag.*, **22,** 1930, 214. H. G. Weall, Analyst.
IV. Composition calculated for $Al_8Si_3O_{12}(OH \cdot F \cdot Cl)_{12}$.

	I	II	III	IV
SiO_2	25.10	24.15	24.25	25.32
Al_2O_3	57.23	57.68	56.75	57.29
Fe_2O_3	1.58	0.18	1.3	
MgO	—	—	0.4	
CaO	—	—	0.35	
Na_2O	0.18	0.31	1.65	
K_2O		0.18	tr	
Cl	2.75	2.90	3.5	2.99
F	5.43	5.19	0.5	6.40
P_2O_5	0.53	0.52	0.25	
H_2O+	10.61	11.12	11.40	11.37
H_2O-		—	0.4	
	103.41	102.23	100.75	103.37
Less O for Cl, F	2.90	2.83	1.00	3.37
	100.51	99.40	99.75	100.00
Sp. Gr.		2.878	2.88	

The formula derived from this analysis is:

$$Al_8Si_3O_{12}(OH \cdot F \cdot Cl)_{12} \text{ with } OH:F:Cl = 15:4:1.$$

This is the formula given by Hillebrand originally and used in a modified form by Groth. A summary of recent discussions of the formula of zunyite may be found in the paper of Dr. Nel from which analysis No. III was taken. The writer feels that until a complete structure analysis of the mineral is worked out the above empirical formula suffices as well as any to express its composition.