SULFOHALITE AND OTHER MINERALS FROM THE OTJIWALUNDO SALT PAN, SOUTH WEST AFRICA

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The mineral sulfohalite was first described by Hidden and Mackintosh[2] as a chlorosulfate of soda from Searles Lake, California. They record at that time but three known specimens; well formed dodecahedrons reaching 3 cm. in diameter associated with hanksite. The finest of these is now in the Bement Collection of the American Museum, another is in the British Museum and a portion of the third crystal in the Brush Collection at Yale. Later, Penfield[3] reinvestigated the chemical composition of the mineral, using material from the crystal in the Brush Collection, and found it to be a compound of the formula: $2Na_2SO_4 \cdot NaCl \cdot NaF$.

Two octahedral crystals were later obtained by Mr. Hoyt S. Gale from Dr. S. P. Sadtler of Philadelphia, one of which was consumed in making an analysis[4] and the second was deposited in the United States National Museum. Since that time this writer has found a few additional crystals in material from Searles Lake, the largest crystal being an octahedron 1.5 cm. across. A considerable quantity of Searles Lake salts from deep well borings have been examined for rare minerals and the conclusion has been reached that sulfohalite is one of the rarest of the species found there.

It is with considerable interest, therefore, to record a new locality for sulfohalite, at Otjiwalundo Salt Pan, S.W. Africa, where to judge from the specimens available it occurs in fair abundance. These specimens were obtained by Mr. George L. English during a collecting trip in South West Africa. According to Mr. English the Otjiwalundo Salt Pan lies west of the great Etosha Pan and about 80 kilometers northwest of Okaukuejo, the police station on the southwest corner of the Etosha. It is about 250 kilometers north of west of Otavi.

The specimens of the suite of minerals from this locality contain trona with sulfohalite, thenardite, both single and twinned crystals, and thenardite with pirssonite.

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] *Am. Jour. Sci.*, **36**, 463, 1888.

[3] *Am. Jour. Sci.*, **9**, 425, 1900.

[4] Gale and Hicks: *Am. Jour. Sci.* **38**, 273, 1914.

Trona

The trona specimens consist of broad blades, coarsely reticulated to form an open mesh of crystals. The individual crystals are rounded and except for their unusually large size are of little special interest. Crystals 8 centimeters long and 3 centimeters wide were observed on some of the specimens. With the trona are associated the crystals of sulfohalite and occasionally poor crystals of thenardite.

Sulfohalite

If one can judge from the sample at hand this rare chloride, fluoride and sulfate of sodium is a common mineral in the Otjiwalundo Salt Pan. In some of the specimens the sulfohalite, although irregular in shape, reach a size of 2 centimeters and is abundantly distributed through the coarsely reticulated trona blades. The smaller crystals are dodecahedral in habit but somewhat distorted. The larger crystals are also dodecahedral but are usually aggregated into roughly parallel groups.

Like the sulfohalite from Searles Lake, the larger crystals have a yellowish cast, or where they inclose muds, a pale gray color. Under the microscope the mineral is isotropic with an index of refraction of 1.455.

An analysis of this mineral gave the following results:

Sulfohalite, Otjiwalundo Salt Pan, S.W. Africa

Na	36.83	F	4.95
SO_4	48.90	H_2O	0.15
Cl	9.20	Insol.	0.50
			100.53

The results of this analysis agree well with those found by S. L. Penfield and W. B. Hicks on the Searles Lake mineral and with the theoretical values for the formula: $2Na_2SO_4 \cdot NaCl \cdot NaF$.

Pirssonite

Pirssonite is a rare double carbonate of calcium and sodium previously found only at Searles Lake. Here this mineral is fairly abundant in certain layers of the playa associated with halite, hanksite, trona, northupite, gaylussite and borax. Crystals reaching a centimeter are unusual and imperfect in development, but smaller ones are abundant in some samples, and present a variety of crystal

habits. Since this mineral is recovered entirely from well drillings, it is not widely distributed in collections, but samples from several scattered parts of the playa of Searles Lake indicate that the mineral is abundant.

On the samples from the Otjiwalundo Salt Pan, pirssonite is only sparingly present but it is associated in such a manner as to suggest that the larger crystals of thenardite and trona grew in a sand of quartz grains and pirssonite crystals. The mud adhering to the trona specimens contained a number of clear but minute crystals. Larger crystals were found in the sandy material attached to or in pockets of a large thernardite crystal. The largest of these pirssonite crystals seldom exceed a millimeter in length and when not distorted have a hexagonal outline. Many of them, however, are elongated along the *a* or the *c* axis or even transversely, so that it is usually necessary to mount a crystal several times before the proper orientation is obtained. The measured crystals show the common forms: *b* (010), *m* (110) and *p* (111). The measurements are given in the following table:

MEASUREMENTS OF PIRSSONITE FROM OTJIWALUNDO SALT PAN

Form	ϕ	ρ	Face
p	60°32′	31°37′	Medium
b	0	90	Large
m	60°35′	90	Small

Their habit is similar to one of the common types from Searles Lake in which the brachypinacoid is broad and the unit pyramid and the prism bevel the edges (Fig. 2).

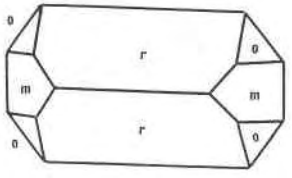

FIG. 1

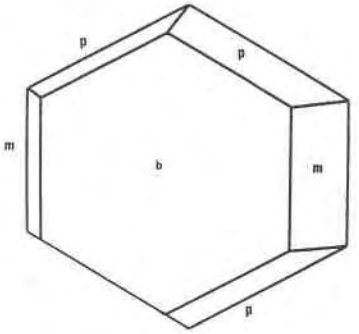

FIG. 2

FIG. 1. Thenardite from the Otjiwalundo Salt Pan. S. W. Africa.
FIG. 2. Pirssonite from the Otjiwalundo Salt Pan.

The following optical properties confirm the crystallographical determination: Biaxial, positive with medium optic angle. Dispersion distinct with ρ less than υ. $\alpha = 1.504$, $\beta = 1.509$, $\gamma = 1.575$.

Thenardite

Two specimens of thenardite were found in the minerals studied, a large group of crystals with no associated minerals other than a few rough crystals of salt, and a large crystal with attached trona and small nests of sand and pirssonite.

The large crystal is 12 centimeters long by 9 centimeters wide and shows the common forms *r* (101), *o* (111) and *m* (110). The habit of this crystal differs from any of those shown in Goldschmidt's Atlas in that the macrodome *r* (101) is by far the most prominent face, the unit pyramid and prism being reduced to modifying faces (Fig. 1).

The large group consists of a mat of small simple crystals of a habit similar to the large one (Fig. 1) over which are scattered large twins up to 5 centimeters long. These twins are made up of crystals with forms similar to the simple crystals twinned on the face *r* (101), giving a habit somewhat similar to the "butterfly" twins of gypsum.

In a modification of this habit, shown only in a few of the smaller twins, the prism is practically missing and the outer face *r* is elongated so that the crystal is rectangular and modified by small grooved terminations. These are similar to many other twins where a marked flattening of the twinned crystals is a common feature.