

## NOTES AND NEWS

### CASTANITE FROM CHUQUICAMATA, CHILE

MARK C. BANDY, *Chuquicamata, Chile.*

A very complete description of an occurrence of castanite was given in this journal, by Professor A. F. Rogers.<sup>1</sup> The material used by Professor Rogers came from Knoxville, California. The original material used by Darapsky<sup>2</sup> in establishing the mineral species, came from Sierra Gorda, near Chuquicamata. As stated by Professor Rogers in the introduction to his article, Linck<sup>3</sup> states that castanite is undoubtedly a synonym for amarantite ( $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ ).

A study of the sulphate minerals at Chuquicamata is being made and it is believed that the following data on castanite from this locality would be of interest. Castanite occurs with amarantite and the two are easily distinguished as distinct mineral species.

#### OCCURRENCE AND ASSOCIATION OF CASTANITE

Practically all of the oxide minerals at Chuquicamata have been formed under arid conditions and from solutions high in acid content. As a rule the solutions probably carried a high concentration of mineral salts. At present, it is only once or twice in a decade that sufficient moisture falls to dampen the ground more than six inches below the surface. It is certain that this condition has existed for a very long time. The elevation of the ground water in the vicinity of the mine varies greatly, both because of the nature of the rock and the steep topography. The ground water is encountered from 160 feet to over 600 feet below the surface.

The area in which the castanite is found is one of large, massive pyrite veins, which have been oxidized for a considerable distance below the surface. The castanite is almost entirely limited to the soft gossan of these veins and is rarely found in the intervening country rock. Judging from the present exposures of these veins, water percolating through them from the surface would become saturated with copper, and especially iron and earthy sulphates, within a very short vertical distance, and carry a considerable percentage of free acid.

<sup>1</sup> *Am. Mineral.*, vol. 16, 1931, pp. 396-404.

<sup>2</sup> *N. Jb. f. Min.*, 1890, 2, pp. 267-269.

<sup>3</sup> Hintze's *Handbuch der Mineralogie*, I Band, 1929, pp. 4426-4427.

Castanite has not been observed over 150 feet below the original surface of the ground. It is only found in the larger veins and is always associated with closely allied iron sulphates. All of the specimens so far obtained show the castanite in intimate association with amarantite. This association is so intimate that it was difficult to separate the two minerals for chemical analyses. The castanite occurs as round masses up to one inch in diameter within the amarantite, and in irregular, alternating bands with amarantite, surrounding pieces of wall rock within the vein.

Other iron sulphates that have been identified, which are closely but not intimately associated with the castanite are, copiapite, coquimbite, römerite, melanterite, pisanite, quenstedtite, fibroferrite and a mineral believed to be carphosiderite. Chalcantite is usually associated with the castanite, while kröhnkite and copper bearing gypsum are less common associates.

The castanite consists of massive aggregates of very small, somewhat acicular, subhedral crystals. The largest crystal observed was a twin crystal, slightly under 0.9 mm. in length. The crystals are transparent, with some inclusions of an undetermined material. In the hand specimen the massive castanite is a splendid, burnt-orange mass. The color and effect of the castanite is heightened by the dull, opaque appearance of the associated amarantite. Within five minutes after exposure of a fresh face of a specimen, the amarantite is covered with a dull dehydration film. The individual crystals of the castanite, when placed on a piece of white paper, are a brilliant reddish-brown color.

There are no facilities available for determining any of the geometrical constants of the castanite crystals. Due to the very small size of the crystals and their subhedral character, it is doubtful if material suitable for crystallographic study could be obtained from any of the present occurrences at Chuquicamata. Castanite, as well as practically all of the other iron sulphates, shows partial solution of the crystal faces.

#### PHYSICAL PROPERTIES

All of the castanite observed has the same reddish-brown or burnt-orange color. The luster is vitreous and brilliant. Streak, yellow with a brownish tint. Powder, orange with a reddish tint. Hardness, 2.5. Taste, acid, astringent. Specific gravity was not determined. It is practically stable at room temperature but under-

goes a slight dehydration in a few days time. This dehydration is no doubt due in great part to the extreme aridity of this locality.

### CHEMICAL PROPERTIES

Castanite is slightly soluble in cold water, 20°C. In warm and hot water the castanite is soluble, with decomposition, yielding free sulphuric acid and precipitating basic iron salts. It is completely soluble in hydrochloric and nitric acids, and is partially soluble in sulphuric acid.

Chemical analyses by Mr. B. W. Carter gave the following results,

ANALYSES OF CASTANITE BY B. W. CARTER

	I*	II**
SiO <sub>2</sub> . . . . .	tr.	0.3
Al <sub>2</sub> O <sub>3</sub> . . . . .	0	0.4
Fe <sub>2</sub> O <sub>3</sub> . . . . .	34.1	31.4
FeO . . . . .	0	0
CaO . . . . .	tr.	0
MgO . . . . .	tr.	0
H <sub>2</sub> O+100°C . . . . .	} 29.2 }	15.7
H <sub>2</sub> O-100°C . . . . .		13.1
CuO . . . . .	0	3.9
MnO . . . . .	0	0
SO <sub>3</sub> . . . . .	36.7	33.3
Cl . . . . .	tr.	0
Ignition loss . . . . .		2.2
Total . . . . .	100.0	100.3

\* I. Carefully picked sample of almost pure material. Water obtained by difference.

\*\* II. Relatively impure sample.

KNOXVILLE, CAL.		CHUQUICAMATA, CHILE		MOLECULAR RATIOS		THEORETICAL
		II	I	I		
Fe <sub>2</sub> O <sub>3</sub>	34.47	33.6	34.1	.214	1.00	34.58
SO <sub>3</sub>	35.11	35.6	36.7	.459	2.15	34.58
H <sub>2</sub> O	30.31	30.8	29.2	1.622	7.59	30.84

In the following table these analyses are compared with the analysis reported by Rogers.

It is of interest to note that the material from both localities is low in water and iron, and high in sulphur. The low percentage of water in the Chuquicamata material is unquestionably due in part to slight dehydration. Analysis No. II contained so much amarantite that there is too great an error in the figures given in the above table to be of use in deriving a formula.

While the analysis given above, No. I, shows a low water ratio for castanite and would indicate a formula,  $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 7\frac{1}{2}\text{H}_2\text{O}$ , it is believed that this is too low in water content and the formula as assigned to castanite by Darapsky,<sup>4</sup>  $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 8\text{H}_2\text{O}$ , is correct.

#### PYROGNOSTIC TESTS

When castanite was heated in a closed tube at a low temperature, it gave off water which by analysis contained considerable free sulphuric acid. At higher temperatures  $\text{SO}_2$  fumes were given off. During heating the castanite turned from a light orange color to brown, then reddish-brown and finally black. Upon ignition the castanite yielded a black, somewhat magnetic residue and lost, by weight, 64 per cent of its mass.

#### OPTICAL PROPERTIES

The following optical properties were determined. The crystals were negative. Pleochroism was fairly strong with  $N_o$  reddish brown and  $N_p$  light yellow. Dispersion was high with  $\rho > \nu$ . Chuquicamata material yields a slightly eccentric biaxial interference figure, as shown by Rogers for the Knoxville material. The indices of refraction as found by the immersion method are;  $N_p$ ,  $1.550 \pm .005$ ;  $N_m$ ,  $1.645 \pm .005$ ;  $N_o$ ,  $1.660 \pm .005$ .  $N_o - N_p = 0.110 \pm .01$ .

#### ORIGIN OF CASTANITE

From the occurrence and associations of castanite at Chuquicamata, Chile, it is believed that it is formed under conditions of low temperature. It probably crystallizes from solutions high in both ferric iron and free sulphuric acid. It forms at comparatively shallow depths, less than 150 feet at Chuquicamata, and probably at even shallower depths in less arid localities.

<sup>4</sup> *Op. cit.*