Gentnerite, $Cu_8Fe_3Cr_{11}S_{18}$, a new Mineral from the Odessa Meteorite†

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Dedicated to Professor Dr. W. GENTNER on the occasion of his 60th birthday

In his paper "Mineralbestand und Strukturen der Graphit- und Sulfideinschlüsse in Eisenmeteoriten" EL GORESY [1] reported the presence of a new Cu-, Cr-sulfide in some graphite-troilite nodules from the Odessa meteorite. No optical or analytical data were, however, published, since the small size of the grains observed did not allow any exact optical studies or quantitative microprobe measurements. He solelay mentioned that it is a reaction product between terrestrial Cu-minerals and daubreelite. Recently we were able to study relatively coarse patches of this questionable mineral in a new nodule from the Odessa meteorite.

The nodule studied possesses a marked texture described before from similar nodules by EL GORESY [1] and MARSHALL et al. [2]. The most inner part of the nodule is formed of a big troilite bleb surrounded by a thick graphite ring. Just in the neighbourhood of the troilite bleb graphite is very massive and is of the "palmetten type" [1]. The compactness of the graphite palmetts fades away towards the center of the graphite ring where it shows intemate intergrowth with fine grained troilite, daubreelite and a little ferroalabandite. The central troilite bleb is continuously intersected by very fine and long exsolution bodies of daubreelite parallel (0001) of troilite. Just behind the graphite ring there are several troilite bars separating this ring from the outer schreibersite and cohenite shells. In these troilite bars daubreelite is noticeably coarser and forms broad exsolution bodies. Some bars contain small patches of native copper. Here troilite is intersected by several chalcopyrite and bornite veins which sometimes truncate the daubreelite lamellae. Such daubreelites were found to be unhomogenous. They are intersected by numerous veinlets of 10 microns diameter of a light brownish green mineral whose reflectivity is slightly stronger than that of daubreelite (Fig. 1 ***). In oil immersion this slight reflectivity difference as well as the distinct brownish tinge becomes clearer. This mineral is slightly softer than daubreelite. In +N no sign of birefringence was recorded, indicating that it may be isotropic.

Microprobe analysis were carried out on several veinlets with an ARL-microanalyser. Copper, iron, chromium and sulfur are the only elements recorded. Figure 2 shows the microprobe scanning photographs indicating the presence of these elements. Quantitative analysis are carried out on some broad veinlets ($\sim 8-10$ microns) using pure Cu, Fe, Cr metals, and pure synthetic FeS as standards. Results are corrected for background, dead time, absorption and fluorescence. The results are given in table 1. From the results it is evident, that Cu, Cr and S are the major elements; Fe is minor. The idealized calculated formula may be $Cu_8Fe_3Cr_{11}S_{18}$ or $4\,Cu_2S \cdot 3\,FeS \cdot 11\,CrS$.

	Wt.-%		Atom-%	
	corrected	$4\,Cu_2S \cdot 3\,FeS \cdot 11\,CrS$ theoretical	corrected	$4\,Cu_2S \cdot 3\,FeS \cdot 11\,CrS$ theoretical
Cu	28.3	28.2	20.0 } 27.3	20.0 } 27.5
Fe	9.1	8.7	7.3 }	7.5 }
Cr	31.4	31.1	27.1	27.5
S	32.6	32.0	45.6	45.0
	101.4	100.0	100.0	100.0

Table 1. Microprobe analysis of gentnerite.

The fact that the ratio metal to sulfur is 1.2 : 1 may suggest that gentnerite possesses a sphalerite structure with sulfur deficiency i. e. it may belong to the chalcopyrrhotite group. A similar synthetic homogeneous. They are intersected by numerous compound is still unknown. X-ray studies and synthesis are in progress.

† Preliminary communication.

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[1] A. EL GORESY, Geochim. Cosmochim. Acta **29**, 1131 [1965].
[2] R. R. MARSHALL and K. KEIL, Icarus **4**, 461 [1965].

*** Fig. 1 and 2 see p. 1160 a, b.

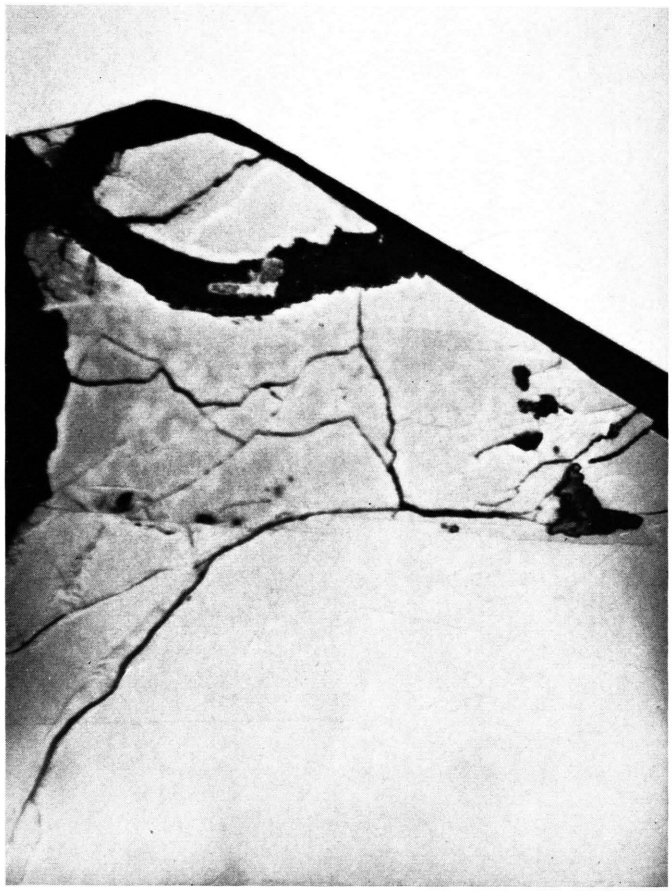

Fig. 1. The photomicrograph shows a daubreelite bar (grey) intensively intersected by gentnerite (light grey) along its cracks. The whole grain lies at the boundaries of schreibersite (white, on the upper side of the photograph) and troilite (pale grey with many scratshes).
Magnif. 800 ×, oil immersion.

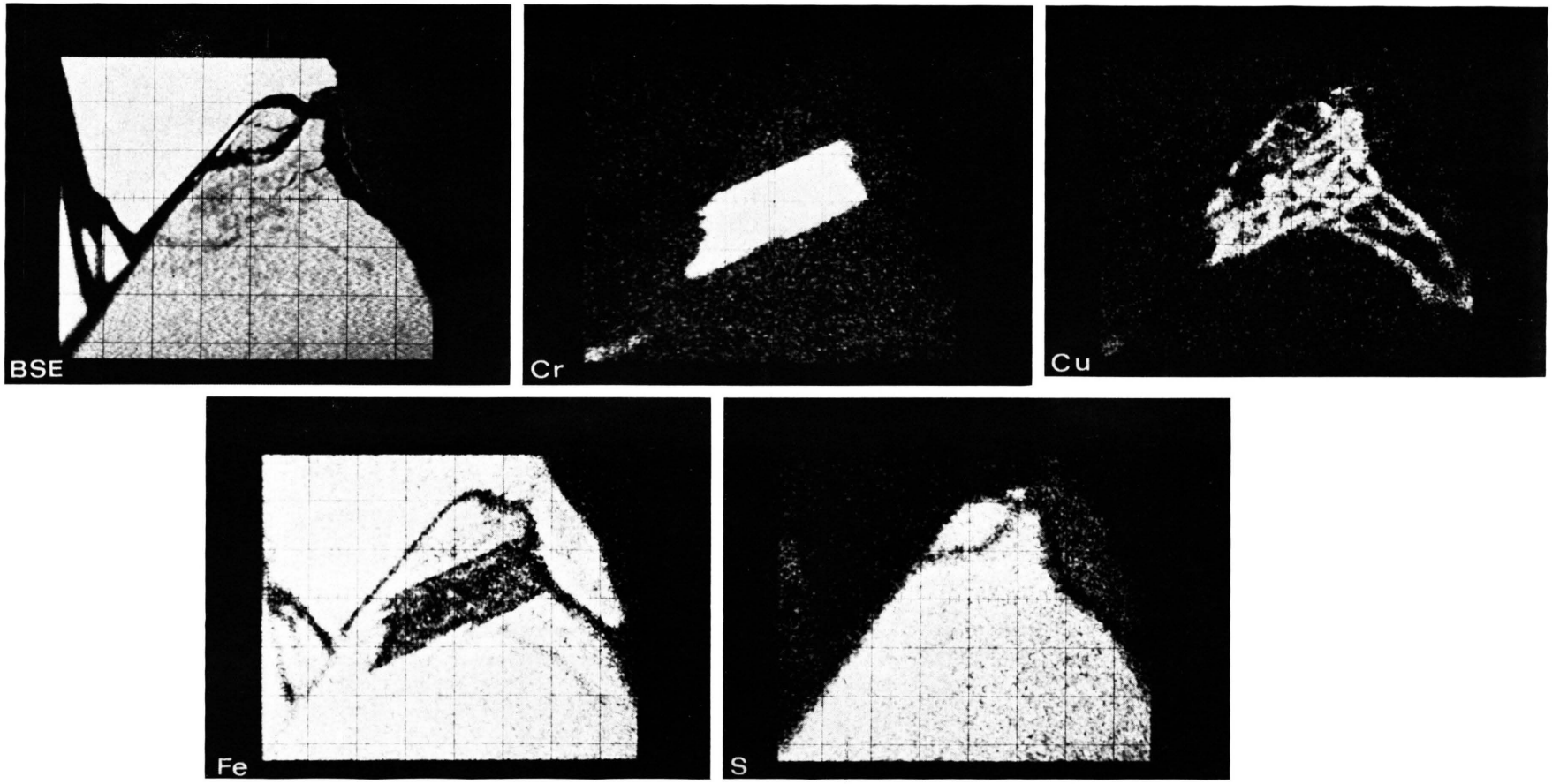

Fig. 2. Back scattered and electron beam scanning pictures of gentnerite. The pictures show high copper, chromium, sulphur, and low iron intensities of gentnerite. The high intensities seen on the lower right side of the copper scanning picture is due to the presence of small veinlets of chalcopyrite and bornite; 15 keV accelerating potential. The length of every scanning picture is 50 microns.

Gentnerite is probably a low temperature mineral. Former studies on the system Fe-Cu-S indicate, that native Cu is expelled from FeS below 457 °C (KULLERUD, personal communication). The fact that gentnerite always occures together with native Cu, chalcopyrite and bornite indicates its formation below this temperature by reaction of these minerals with daubreelite.

For $Cu_8Fe_3Cr_{11}S_{18}$ we propose the name gentnerite after WOLFGANG GENTNER of the Max-Planck-Institute for Nuclear Physics in Heidelberg, initiator of meteorite research in this Institute.

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