

## Gortdrumite, a new sulphide mineral containing copper and mercury, from Ireland

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**ABSTRACT.** Gortdrumite superficially resembles chalcocite but is more distinctly anisotropic, and is present in a vein containing ferroan dolomite and baryte which cuts dolomitized limestones from the Gortdrum Orebody of County Tipperary, Ireland. It has an empirical formula of approximately  $(\text{Cu,Fe})_6\text{Hg}_2\text{S}_5$ . A distinctive powder diffraction X-ray pattern has been obtained which indicates a probable orthorhombic crystal lattice with  $a$  14.96,  $b$  7.90, and  $c$  24.1 Å. The reflectivity at 589 nm is 25.1 to 27.9% and the  $\text{VHN}_{10}$  hardness range 186 to 230.

THE Gortdrum orebody lies in basal Carboniferous sedimentary rocks adjacent to a major east-north-east trending normal fault. In the near-surface zone the mineralization consists dominantly of chalcopyrite and mercurian tennantite, and occurs as disseminations and veinlets within shattered massive bioclastic limestones. At greater depths the limestones are comparatively shaly and less competent and the mineralization is more finely disseminated and composed primarily of bornite and chalcocite. Pyrite is a minor constituent of the ores but other sulphides are uncommon. Very small amounts of cinnabar are present, mainly as smears on fracture surfaces, and the accessory minerals include native amalgam, stromeyerite, sphalerite, wittichenite, and cobaltite (Steed, 1975). The orebody was mined for copper, mercury, and silver from 1967 to 1975 but the open-pit workings are now flooded.

In locally dolomitized limestones about 75 feet below the pre-mining rock surface, a small composite ferroan dolomite-baryte vein containing disseminated cinnabar occurred. Three samples from this vein were studied in polished section and it was observed that in addition to cinnabar there are small grains, some separate and some intergrown, of chalcopyrite, bornite, chalcocite, and the unknown phase. Such an intimate association of copper sulphides and cinnabar is notably atypical for the deposit.

The grains (less than 200  $\mu\text{m}$  by 50  $\mu\text{m}$ ) of the unknown mineral are present in all three polished sections, and are generally isolated within the

dolomite or intergrown with bornite. In reflected light the phase resembles chalcocite in colour and reflectivity, and it has a similar polishing hardness. In contrast to chalcocite, however, it is strongly anisotropic and in some grains shows finely developed lamellar twinning. The polarization colours in air range from grey-white with a bluish tint to blue and there are no internal reflections.

**Reflectivity and hardness.** Reflectivity determinations were made on ten separate grains in random orientations, using a C.O.M. approved tungsten carbide standard (calibrated by the German Physical Standards Laboratory, Göttingen) for comparison. The  $R\%$  range determined in air at 589 nm is 25.1 to 27.9%.

These results indicate a slightly lower reflectivity than that for chalcocite, given by Bowie *et al.* (1975) as 31.1% at 589 nm, and by the Commission on Ore Microscopy (1977) as 31.5 to 31.8% at 589 nm.

Vickers microhardness determinations were made on six of the larger randomly orientated grains. Loadings of 10 gf were used to ensure that indentation diameters did not exceed one-third of the grain widths. The  $\text{VHN}_{10}$  range so determined was 186-230. This implies a comparable indentation hardness to chalcopyrite, for which the Commission on Ore Microscopy (1977) give  $\text{VHN}_{100}$  from 181 to 203.

**Chemistry.** Electron probe microanalysis was carried out on a Cambridge Instruments Microscan III at the Department of Mineral Exploitation, University College, Cardiff. Analyses were obtained from four separate grains, two from one polished section, two from a second. A comparatively low probe current of 10 nA at 20 kV was used since thermal breakdown of the phase began to be evident at currents in excess of 30 nA. The standards used were pure metals for Cu and Fe,  $\text{FeS}_2$  (a pure and stoichiometric pyrite from Kassandra, Greece) for sulphur, and  $\text{HgS}$  (associated cinnabar in the specimens and a separate cinnabar standard) for Hg. Corrections for inter-atomic effects were made

TABLE I. Electron probe analyses of gortdrumite

	1	2	3	4
S	16.93	16.83	16.87	16.61
Fe	2.08	2.37	2.40	1.41
Cu	38.35	38.45	38.33	39.59
Hg	41.60	41.88	41.37	41.35
Total	98.96	99.53	98.97	98.96

  

Atomic proportions on the basis of five atoms sulphur.				
	5	5	5	5
S	5	5	5	5
Fe	0.35	0.40	0.41	0.24
Cu	5.71	5.76	5.73	6.01
Hg	1.96	1.99	1.96	1.99

No other elements detected.

using a slightly modified version of the computer program written by Frost *et al.* (1972). The corrected analytical results, given in Table I, suggest an empirical formula of  $(\text{Cu,Fe})_6\text{Hg}_2\text{S}_5$ .

**Structure.** Three of the largest grains were selectively broken up using a diamond indenter mounted on a microscope and then separately crushed and collected in small rubber cement balls. Each was then photographed using a Debye-Scherrer 114.6 mm diameter diffraction camera, in two cases with filtered  $\text{Cu-K}\alpha$  radiation, in one with filtered  $\text{Co-K}\alpha$  radiation. The three patterns obtained are almost identical, and the  $d$ -spacings and relative intensities are given in Table II.

The pattern does not correspond with that for any mineral listed in the JCPDS Powder Diffraction Data File for Minerals, 1974. With only the above data the author was unable to index the pattern. This was, however, achieved by A. Kato (pers. comm.). He obtained an orthorhombic unit cell with  $a$  14.958,  $b$  7.900, and  $c$  24.10 Å; and on the basis of valency relations he further suggested that the unit cell content should be  $4[\text{Cu}_{18}\text{FeHg}_6\text{S}_{16}]$ .

**Discussion.** Baryte in this and other veins at Gortdrum postdates almost all the copper sulphide mineralization. Within a few such veins small amounts of cinnabar and sometimes native amalgam are present, but associated copper sulphides are rare. On the basis of sulphide mineral compositions and assemblages it is considered that temperatures of deposition during the main phase of mineralization ranged from 200 to 100 °C or even less. It is thus unlikely that the minerals in the later baryte veins, including the Cu-Hg sulphide, were laid down at temperatures much in excess of 100 °C.

The Cu-Hg sulphide here described, when bombarded in the electron-probe, showed thermal breakdown at a temperature estimated to be less

TABLE II. X-ray powder diffraction pattern for gortdrumite

$l$	$d$ (Å)	$hkl^*$
20	7.41	200, 011
40	6.03	112, 004
100	4.58	302, 105
70	3.38	410, 403
30	3.08	117, 321
30	3.02	224, 008
50	2.88	323
50	2.78	511
25	2.71	420
30	2.67	317
20	2.63	030, 218, 226
20	2.41	219, 417, 0.0.10
15	2.22	524, 029
15	1.946	
20	1.877	
20	1.797	
20	1.758	
20	1.662	
10	1.540	
10	1.510	
10	1.385	
10	0.928	

\* A. Kato (pers. comm.).

than 200 °C. This further suggests that deposition was from comparatively cool solutions.

The mineral has been named for the discovery site, the Gortdrum orebody. (The new mineral and proposed name were accepted by the International Mineral Association Commission on New Minerals and Mineral Names in August 1979.) A type sample is now housed at the British Museum (Natural History), London.

#### REFERENCES

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