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*Wulfenite from Poddy Gill, Caldbeck Fells*

WULFENITE has been recorded from the Caldbeck Fells by Goodchild<sup>1</sup> in the last century and, more recently, by Sir Arthur Russell.<sup>2</sup> In the latter instance an exact locality is given ('a small dump derived from a trial level, three-quarters of the way up Brandy Gill') and the mineral is described as small, thin, honey-yellow rounded plates on tapering prisms of pyromorphite or on more or less iron-stained drusy quartz. Some material we have recently collected from a small weathered dump at the foot of Poddy Gill, Grid Reference NY/328328, consists of very similar matrix studded with orange-yellow thick rectangular and often elongated (bar-shaped) tablets of wulfenite of very simple crystal habit, up to 2 mm in length. Anglesite, mentioned by Goodchild as an associated mineral, is absent on our specimens and on those described by Sir Arthur Russell. We thank Dr. R. J. Davis and Miss E. E. Fejer of the British Museum (Natural History) for identifying an X-ray powder photograph of the wulfenite.

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<sup>1</sup> J. G. Goodchild, *Geol. Mag.* 1875, decade 2, vol. 2, p. 565.

<sup>2</sup> A. Russell, *Min. Mag.* 1936, vol. 24, p. 321.

*Mercurous nitrate in mineral separation*

MANY important silicate minerals, in particular pyroxenes, amphiboles, garnets, and epidote, have densities above 3.3 gm/cm<sup>3</sup> and below 4.3 gm/cm<sup>3</sup>. Separation of these minerals cannot be carried out with

organic heavy liquids, and recourse must be had to magnetic separation or to inorganic heavy liquids. Magnetic properties of pyroxene, amphibole, and epidote are often similar, so that magnetic separation is difficult or impossible.

Examination of the literature suggests that relatively little use is made of mercurous nitrate, a substance that is much cheaper than Clerici solution, less toxic, and easier to use.

Johannsen (1914), Holmes (1921), and Smales and Wager (1960) give general descriptions of the use of inorganic heavy liquids, but do not mention the possibility of using mercurous nitrate as a liquid with a range of densities, rather than as a liquid capable only of separating minerals with densities above 4.3 from those of lesser density.

The technique used by the writer is: A flat-bottomed, thin-walled glass tube, about  $5 \times 1$  cm, is four-fifths filled with solid mercurous nitrate; a little 10 % nitric acid is then added, and the tube is heated on the water bath until the contents are molten. A diffusion column forms, with a density ranging from about 1.0 at the top to 4.3 at the bottom. The material to be separated is then added, and a number of bands of different density are formed. When separation is complete, the tube is allowed to cool slowly, and is then carefully smashed: the desired portions are cut out and dissolved in 10 % nitric acid. The separated minerals must be washed well with dilute nitric acid (to avoid hydrolysis); the washings are placed in a mercury residues bottle for recovery.

The writer has separated as many as six different minerals at once, with the expenditure of only 10–12 g of mercurous nitrate. The technique becomes more useful as experience is gained in assessing the right amount of nitric acid to use, the necessity for stirring, and the time needed for separation. Used on wooden or plastic-topped benches, by an operator wearing rubber gloves, mercurous nitrate is a relatively harmless substance, but if used carelessly, it attacks the skin and clothing, stains most organic substances, deposits mercury on more electropositive metals, and causes particularly severe corrosion of aluminium, since the amalgam formed does not permit the growth of a protective oxide skin. It should therefore be handled with the same care as is used with concentrated solutions of silver nitrate. The method works best with samples of 60–100 mesh B.S.S., but the 100–150 mesh fraction may also be used.

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*Pyromorphite as a possible primary phase*

WITHIN the Newlands mining field, Cumberland, pyromorphite is particularly common in the outermost part of the lead-zinc zone, for example, in the Barrow vein system, and at Goldscope, Old Brandlehow, and Yewthwaite. This apparent connexion between the zoning of the primary and secondary mineralization, suggests that the pyromorphite may have been an original (primary) phase.

Removal of  $H_2S$  by precipitation of sulphides, by evaporation and by oxidation, will ultimately lead to the production of an ore fluid from which galena could not be precipitated, even with a high concentration of lead in solution. In these circumstances, minerals such as cerussite, anglesite, and pyromorphite could be precipitated as primary minerals. In the presence of soluble sulphide, these minerals would be converted to galena; they would not appear until the partial pressure of  $H_2S$  reached a very low value.

The ability of pyromorphite to form from aqueous chloride solutions was tested over the temperature range 20 to 480° C, at pressures up to 550 atm; details are given in table I.

TABLE I. Pyromorphite syntheses

Reactants	<i>P</i> (atm)	<i>T</i> (° C)	Time	Products
Cl,P ... ..	1	20	3 m	Pyr
Cl,P ... ..	1	100	3 d	Pyr
Cl,P,V ... ..	1	100	3 d	Pyr
Cl,V ... ..	1	100	3 d	Pyr
OH,P ... ..	1	100	3 d	Pyr
CO <sub>3</sub> ,P ... ..	1	100	3 d	Pyr
Cl,P ... ..	150	200	30 h	Pyr
Cl,P ... ..	180	340	13 h	Pyr
Cl,P ... ..	300	410	12 h	Pyr
Cl,P ... ..	550	480	12 h	Pyr unstable.

Cl—PbCl<sub>2</sub>; OH—Pb(OH)<sub>2</sub>; CO<sub>3</sub>—basic lead carbonate; Pyr = pyromorphite; V = ammonium metavanadate; P = ammonium dihydrogen phosphate; m = months; d = days; h = hours.

It was concluded that pyromorphite could form from such solutions up to about 450°C; consequently, there appears to be no reason why