

## MINERALOGICAL NOTES

### Magnetite, pyrrhotine and pentlandite from the Leadhills—Wanlockhead mining district, Scotland

THE Leadhills–Wanlockhead ore field is a well known locality for fine mineral specimens (Gillanders, 1981); to date more than 70 species have been recorded including the only known occurrence of a natural sulphite, scotlandite (Paar *et al.*, 1984). However, magnetite, pyrrhotine and pentlandite, have not previously been recorded from this area.

Magnetite occurs in reddish-brown blocks on the mine dumps near Whyte's Cleugh [NS 870 138]. These blocks also contain abundant vugs which are lined with euhedral quartz crystals. The mineral was identified initially by its optical characteristics in reflected plane polarised light, which are similar to those given in Uytendogaardt and Burke (1971). Subsequently, the blocks were crushed and the magnetic material separated prior to analysis by X-ray powder diffraction. This confirmed that the mineral was magnetite and not maghemite which has similar optical properties. Lamellae of hematite were commonly observed within the magnetite.

Pyrrhotine occurs as small grains up to 250  $\mu\text{m}$  long in samples of greywacke collected from the Glencrief Burn, adjacent to several small quartz veins [NS 867 128]. Marcasite, pyrite, chalcocopyrite, sphalerite and galena are disseminated through the greywacke, being particularly concentrated near these veins. Identification by reflected light microscopy was confirmed by semi-quantitative electron microprobe-EDS analyses. These gave a range of compositions: Fe 61.1–58.5 wt. %, 48.0–45.1 at. %; S 38.1–41.0 wt. %, 52.0–55.0 at. %.

A comparison with the theoretical pyrrhotine composition range of  $\text{FeS}$  to  $\text{Fe}_7\text{S}_8$  gives Fe 63.5–60.4 wt. %, 50.0–46.7 at. %; S 36.5–39.6 wt. %, 50.0–53.3 at. %; and to that of smythite  $\text{Fe}_3\text{S}_4$ , Fe 56.7 wt. %, 42.9 at. %; S 43.3 wt. %, 57.1 at. %.

This demonstrates that the Leadhills examples vary in

composition from that of hexagonal pyrrhotine (48.1–47.5 at. % Fe, Uytendogaardt and Burke, 1971) through that of the monoclinic phase (46.5 at. % Fe) towards that of smythite, which is never quite attained. Although such a compositional range is unusual, examples of pyrrhotine with up to 57 at. % S have been recorded (Deer *et al.*, 1965). Co and Ni were detected in some grains up to maximum concentrations of 1.7 wt. % and 0.7 wt. % respectively. Chalcocopyrite is commonly both intergrown with, and included in, pyrrhotine, as distinct masses up to 64  $\mu\text{m}$  across. Sphalerite grains up to 32  $\mu\text{m}$  in diameter are also frequently included within pyrrhotine. In some cases all three minerals are observed in close association; in one such instance, a pyrrhotine grain 180  $\mu\text{m}$  across includes grains of chalcocopyrite and sphalerite 96  $\mu\text{m}$  and 32  $\mu\text{m}$  in length respectively.

Pentlandite occurs as flame-like exsolution lamellae within pyrrhotine. These achieve a maximum width of about 2  $\mu\text{m}$  and are up to 10  $\mu\text{m}$  in length. Identification was confirmed by microprobe analyses, which revealed Co and Cu concentrations of up to 6.8 wt. % and 1.6 wt. % respectively.

The increasing abundance of pyrrhotine and other sulphides in the greywacke as the veins are approached implies that these minerals are the product of wall rock reactions. Further, the presence of pyrrhotine indicates that these reactions occurred in an environment with a low sulphur fugacity. No pyrite–sphalerite–pyrrhotine intergrowths were observed; however if these do exist it would permit the use of the sphalerite geobarometer, enabling the mineralising environment to be further characterised. The presence of pyrrhotine and magnetite opens up some possibilities for mineral exploration. Monoclinic pyrrhotine is magnetic, therefore if this phase and/or magnetite is present to any extent, magnetic surveys could locate concealed mineralisation in the Leadhills–Wanlockhead area.

*Acknowledgements.* The authors are grateful to Allan Hall (Strathclyde) for helpful comments on the original manuscript.

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**KEYWORDS:** pentlandite, pyrrhotine, magnetite, smythite, Leadhills, Wanlockhead, Scotland.

TABLE 1: Mean electron microprobe (EDS) analyses.

	PYRRHOTITE (n=23)		PENTLANDITE (n=5)	
	wt%	at%	wt%	at%
Fe	53.91	40.76	28.99	22.88
Co	1.27	0.91	6.36	4.41
Ni	0.96	0.69	1.54	2.61
S	43.77	57.64	22.54	16.92
			39.77	54.66
Total	99.91	100.00	Total	99.20 101.48

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[Manuscript received 10 July 1986;  
revised 10 September 1986]

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### Mineral nomenclature: scapolite

ACCORDING to Shaw (1960), the names scapolite and wernerite were introduced in 1800 by d'Andrada. In most European countries, wernerite was used as a family name throughout most of the nineteenth century, and scapolite was used either synonymously with wernerite or as a varietal name. Following Tschermak (1883) and Dana (1892), scapolite has come into more general use as the group name.

After Winchell (1924), scapolite compositions have generally been expressed in terms of the end-members marialite ( $\text{Na}_4\text{Al}_3\text{Si}_9\text{O}_{24}\text{Cl}$ ) and meionite ( $\text{Ca}_4\text{Al}_6\text{Si}_6\text{O}_{24}\text{CO}_3$ ). The sodian meionite ( $\text{Ca}_3\text{NaAl}_5\text{Si}_7\text{O}_{24}\text{CO}_3$ ) of Evans *et al.* (1969) does not lie exactly between the end-member compositions, and substantial  $\text{SO}_4$  solid substitution for  $\text{CO}_3$  is also possible. Intermediate members of the marialite (Ma)-meionite (Me) series are given by Strunz (1970) as dipyre ( $\text{Ma}_8\text{Me}_2$ - $\text{Ma}_5\text{Me}_5$ ) and mizzonite ( $\text{Ma}_5\text{Me}_5$ - $\text{Ma}_2\text{Me}_8$ ).

During the 1959-60 period, the Commission on New Minerals and Mineral Names of the International Mineralogical Association (CNMMN) decided that scapolite should be used as a group name, and wernerite should be used as the species name (Hey, 1962). This terminology is confusing since the compositional limits of wernerite were not specified, and therefore the name can presumably apply over the entire compositional range for marialite to meionite. This usage appears to make the name wernerite into a group name synonymous with scapolite. Probably because of this confusion, the name wernerite does not appear to have been widely used as a species name after publication of the decision by the CNMMN.

In order to eliminate the confusion in the scapolite nomenclature, the CNMMN has approved in 1986 the proposals as follows:

- (a) the name scapolite should be retained as a group name to encompass minerals in the marialite-meionite series;
- (b) the names of marialite ( $\text{Na}_4\text{Al}_3\text{Si}_9\text{O}_{24}\text{Cl}$ ) and meionite ( $\text{Ca}_4\text{Al}_6\text{Si}_6\text{O}_{24}\text{CO}_3$ ) be given species status;
- (c) the names of dipyre and mizzonite be regarded as varietal names;
- (d) the name wernerite be discarded as being synonymous with scapolite.

*Acknowledgement.* Dr E. H. Nickel, vice-chairman of CNMMN, provided advice.

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KEYWORDS: dipyre, marialite, meionite, mizzonite, scapolite, wernerite, nomenclature, mineral species.

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[Manuscript received 11 June 1986]

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### Mineral nomenclature: rozenite

ROZENITE,  $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$ , was originally inadequately described by Kubisz (1960). During the 1959-1960 period, the Commission on New Minerals and Mineral Names of the International Mineralogical Association (CNMMN) rejected the name rozenite (Hey, 1962). Subsequently, Jambor and Traill (1963) have described another occurrence of rozenite and differentiated rozenite from siderotil,  $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$ . In 1986, the CNMMN reversed their original decision and approved that rozenite is a valid name.

*Acknowledgement.* Dr E. H. Nickel, vice-chairman of CNMMN, provided advice.

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KEYWORDS: rozenite, nomenclature, mineral species.

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[Manuscript received 11 June 1986;  
revised 4 August 1986]

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