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NOTES ON A NEW OCCURRENCE OF NORSETHITE, $BaMg(CO_3)_2$

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Abstract

The occurrence of norsethite, $BaMg(CO_3)_2$, in large quantities in a newly discovered zinc-lead-copper deposit in South West Africa, is reported. It is one of the major gangue minerals of the deposit, is closely associated with calcite and is apparently of hydrothermal origin. Its optical properties, X-ray powder data and chemical composition are given, and its behaviour towards the staining reagent, sodium rhodizonate, discussed. Associated barium-bearing minerals are celsian, barite, barytocalcite and benstonite.

Introduction

Mrose, Chao, Fahey and Milton (1961) described a new barium-magnesium carbonate which they named norsethite. This mineral, which is structurally related to calcite and dolomite, was discovered in the Westvaco trona mine in Wyoming where it occurs in microscopic quantities.

This rather uncommon mineral has recently been found in large quantities in a newly discovered zinc-lead-copper deposit at Rosh Pinah, situated about 100 miles south-east of Aus in South West Africa (Fig. 1). Although a study of the structure, the mode of formation and the paragenetic relationship of the minerals, contained in the ore deposit is in progress, the occurrence of norsethite in such large quantities is of sufficient interest to warrant a preliminary note.

Mode of Occurrence

The principal gangue of the deposit is dolomite. From data collected from bore-hole cores the norsethite appears to be of hydrothermal origin; it occurs in the dolomite as irregularly shaped veins, as a large body measuring several feet across and is associated throughout with calcite as interlocking aggregates (Fig. 2), the two minerals being present in more or less equal quantities. Except for ore-minerals, dolomite and to a lesser extent quartz are always associated in subordinate quantities with norsethite.

Primary ore-minerals in the deposit are mainly pyrite, sphalerite, galena, chalcopyrite and tennantite, the latter being mainly associated with the norsethite and calcite. Other Ba-bearing gangue minerals present in the deposit are celsian, barite, barytocalcite and benstonite. The latter is an uncommon calcium-barium carbonate described for the first time by Lippmann (1962) from the barite mine in Hot Spring County, Arkansas.

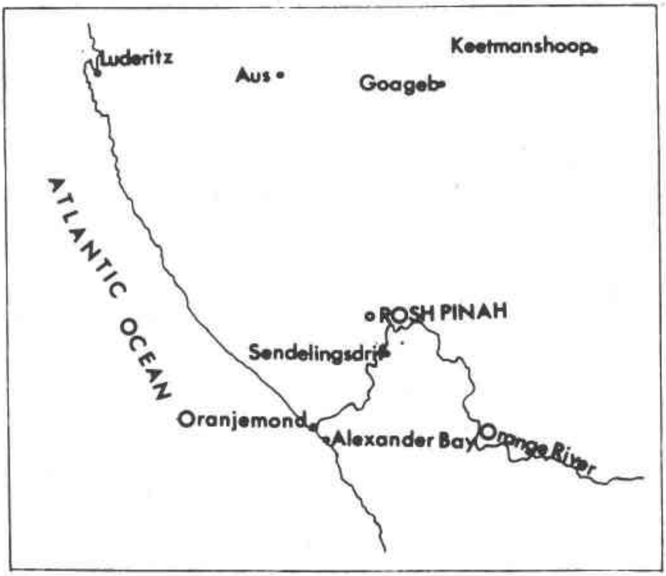

FIG. 1. The south-western corner of South West Africa showing the location of Rosh Pinah.

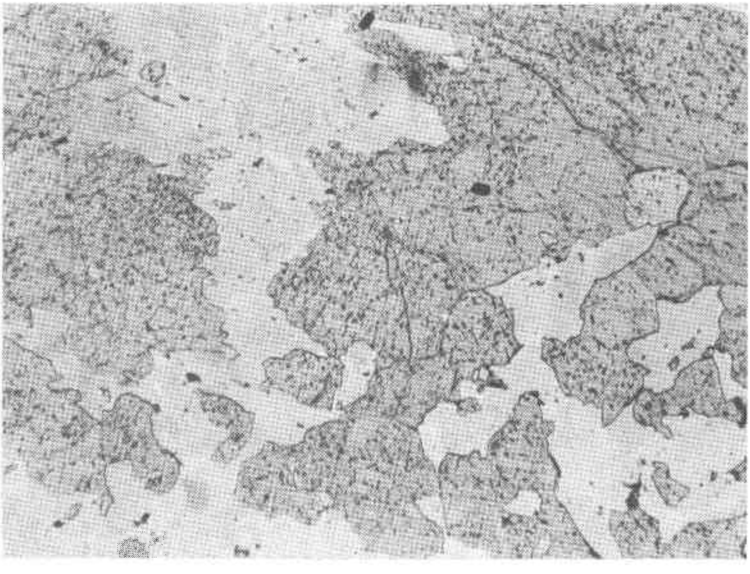

FIG. 2. Interlocking norsethite (light-grey, stained) and calcite (dark-grey, etched). Etched with sodium rhodizonate solution. Reflected light. ×85.

OPTICAL PROPERTIES

The norsethite from Rosh Pinah is milky-white in color and resembles calcite in thin section and in hand-specimen. Like calcite it also dissolves with brisk effervescence in cold diluted acids; it can, therefore, be easily overlooked and the authors are of the opinion that it may be more common in barite-carbonate deposits than is presently known.

TABLE 1. X-RAY POWDER DIFFRACTION DATA FOR NORSETHITE

Norsethite, Rosh Pinah, S.W.A. Present Study		Norsethite, Westvaco trona mine, Wyoming. Mrose et al. (1961)		Norsethite, Rosh Pinah (Continued)		Norsethite, Wyoming (Continued)	
$d_{meas.}$	$I_{est.}$	$d_{meas.}$	$I_{est.}$	$d_{meas.}$	$I_{est.}$	$d_{meas.}$	$I_{est.}$
5.588	4	5.584	25	1.222	1	1.222	9
4.205	5	4.210	30	1.202	0.5	1.203	3
3.857	5	3.860	35	1.195	0.5	1.193	4
3.018	10	3.015	100	1.177	0.5	1.173	4
		2.795	3	1.157	1	1.160	9
2.656	5	2.656	35			1.154	3
2.510	4	2.512	35	1.144	1	1.144	4
2.288	4	2.290	25	1.136	1	1.135	6
2.155	4	2.154	25			1.119	3
2.102	5	2.104	35			1.108	3
1.928	2	1.931	35	1.084	0.5	1.086	3
1.887	2	1.890	25	1.078	1	1.077	6
1.866	5	1.864	35	1.052	0.5	1.051	3
		1.824	3	1.045	1	1.046	6
1.635	0.5	1.636	6			1.042	3
1.612	3	1.612	18			1.033	3
1.562	0.5	1.563	6	1.020	0.5	1.020	4
1.529	2	1.530	25			1.015	3
1.509	0.5	1.510	6	1.006	1	1.006	6
1.495	0.5	1.496	6	0.991	1	0.9893	3
1.476	1	1.475	9	0.980	1	0.9799	3
1.447	1	1.448	9	0.971	1	0.9717	6
		1.437	2			0.9683	6
1.401	1	1.404	6	0.957	0.5	0.9559	3
		1.398	6	0.949	0.5	0.9499	3
1.354	1	1.356	9			0.9469	3
1.328	1	1.328	9	0.935	1	0.9343	4
1.293	1	1.295	9			0.9223	3
1.287	1	1.286	9			0.9117	3
1.254	1	1.256	6	0.901	1	0.9017	4
		1.248	4	0.899	1	0.8989	6
1.236	0.5	1.237	3			0.8961	3

The mineral fluoresces rose-red under ultraviolet radiation. Its indices of refraction, determined on cleavage fragments using the immersion method with sodium light, are similar to those of the Wyoming norsethite, $\omega = 1.694 \pm 0.001$ $\epsilon = 1.520 \pm 0.003$; ϵ was derived from $\epsilon'_{10\bar{1}1}$ using the method introduced by Loupekine (1947) for rhombohedral carbonates.

X-RAY POWDER DIFFRACTION DATA

An X-ray powder pattern of material purified for chemical analyses was obtained, using a 114.59 mm camera with iron filtered cobalt radiation. Measurements were corrected for film shrinkage and intensities were estimated visually. The *d*-values obtained are given in Table 1, together with those for the Wyoming norsethite. The agreement is excellent and needs no further comment.

STAINING REACTION

Since it is almost impossible to differentiate between carbonate minerals using normal petrographic methods, stained polished sections were used to evaluate the mineralogical make-up and textural relationship of the minerals in the samples containing norsethite.

Sodium rhodizonate gives satisfactory staining of Ba-bearing carbonates because of its sensitivity towards barium ions. The use of this reagent as a spot test for barium has been described by Feigl and Suter (1942) and Feigl (1958) and has subsequently been applied to stain Ba-bearing minerals such as witherite (Warne, 1962) and barylite (Nickel and Charette, 1962).

The rhodizonic solution used in this study was prepared by dissolving 200 mg of sodium rhodizonate in 100 ml cold distilled water containing 0.15 ml concentrated HCl. Care should be taken not to exceed the HCl concentration suggested. Furthermore, the stock solution should not be kept for prolonged periods and it is advisable to use a fresh quantity of the stock solution for every staining test.

The best results were obtained when the polished surface was immersed in the solution for 5–10 seconds, washed briefly in distilled water and then in alcohol before drying in a blast of warm air. This treatment had no effect on dolomite, while it etched calcite with the development of scratches and stained the Ba-bearing carbonates (Fig. 2). Visually the stain was reddish in color, whereas under the microscope using reflected light it varied from green to purple, the former being the most prominent.

No success was achieved in distinguishing between the individual Ba-bearing carbonates using this staining reagent.

CHEMICAL COMPOSITION

The selection of material free from barytocalcite offers no problems since this mineral is easily recognizable in hand specimen and under the stereoscopic microscope by its resinous lustre, greenish-yellow tint and mode of occurrence, *viz.*, as clearly defined coarse-grained veins of later origin than norsethite. The position with benstonite is more difficult. However, the distribution of this mineral in the deposit appears to be limited and it was possible to select samples from portions of the large norsethite-calcite body in which benstonite, if present, was below the detection limit of X-ray diffraction techniques.

To prepare a sample for chemical analysis, the selected material was crushed and sieved (−100+200 Tyler Standard) after which handpicking under a stereoscopic microscope was carried out in order to obtain a sample free from ore minerals and dolomite (this dolomite is slightly greyish in color in contrast with the milky-white calcite and norsethite). To remove calcite and quartz the selected material was given a preliminary separation in bromoform. The resulting concentrate was pulverized in a mechanical agate mortar, then dispersed in bromoform and separated in a centrifuge. A chemical analysis on this concentrate still yielded a CaO content of 2.6 percent. As no benstonite could be detected in this sample by X-ray diffraction, most of the CaO is considered to result from the incomplete separation of calcite. Another −100+200 mesh sample was then purified by handpicking and heavy media separation. One portion of this sample was first tested by X-ray diffraction for the presence of benstonite and was then submitted for chemical analyses whereas a second portion was mounted in perspex, polished, stained and subjected to a micrometric analysis using a Leitz integrating stage.

TABLE 2. CHEMICAL ANALYSES OF NORSETHITE
Analyst: T. L. Sandrock

	1	2	3
BaO	50.4%	53.1%	53.5%
CaO	3.5	0.6	0.5
MgO	12.9	13.6	14.0
FeO	0.1	0.1	0.4
MnO	1.5	1.6	0.1
CO_2	31.7	31.0	31.5
SiO_2	0.1		
	100.2	100.0	100.0

1. Analysis on purified −100 +200 mesh material from Rosh Pinah, South West Africa.
2. Analysis, corrected for quartz and calcite and recalculated to 100.
3. Recalculated analysis of norsethite from Westvaco trona mine, Wyoming (Mrose, *et al.*, 1961).

Chemical analysis of this material (Table 2, column 1) gave a CaO content of 3.5 percent. The micrometric analysis reveals the presence of 7.2 volume percent calcite. This value becomes 5.2 weight percent calcite or 2.9 weight percent CaO, assuming a specific gravity of 2.72 for calcite and 3.84 (Mrose *et al.*, 1961) for norsethite. The analysis corrected for quartz and 5.2 percent calcite (Table 2, column 2) shows remarkable agreement with that of norsethite from Wyoming listed in column 3 of Table 2.

Some of the remaining CaO in the recalculated analysis may be ascribed to the presence of benstonite in quantities below the detection limit of X-ray diffraction.

The specific gravity determined on material purified for chemical analysis is 3.75 ± 0.01. This value becomes 3.83 after correcting for 5.2 weight percent calcite.

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