

batches of CoCO_3 , NiCO_3 and MgCO_3 were treated in a furnace at 110°C . under approximately 1 atmosphere of CO_2 for 3 hours before weighing. Equimolar mixtures of four combinations in the systems $\text{BaCO}_3\text{-MnCO}_3$, $\text{BaCO}_3\text{-NiCO}_3$, $\text{BaCO}_3\text{-CoCO}_3$, and $\text{BaCO}_3\text{-MgCO}_3$ were carefully prepared by grinding in alcohol in an agate mortar. Experiments were carried out at 500°C . and 15 kilobars in a squeezer device (Griggs and Kennedy, 1956, 1956) for a period of 25 hours. Samples were quenched and examined by x -ray diffraction.

The results show that 1:1 binary compounds are formed in the systems $\text{BaCO}_3\text{-MnCO}_3$ and $\text{BaCO}_3\text{-MgCO}_3$. A comparison of the x -ray diffraction data of natural norsethite and the synthetic $\text{MgBa}(\text{CO}_3)_2$ compound is given in the first and second columns of Table 1. The agreement is fair.

The interplanar spacings and x -ray diffraction intensities obtained from the synthetic $\text{MnBa}(\text{CO}_3)_2$ make it obvious that this compound is isostructural with norsethite, and calcite-like in structure. These x -ray data are listed in the third column of Table 1.

Similar compounds of BaCO_3 with CoCO_3 and NiCO_3 were not observed to form under the conditions of these experiments.

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REFERENCES

- CHANG, L. L. Y. (1964) Subsolidus phase relations in the systems $\text{BaCO}_3\text{-SrCO}_3$, $\text{SrCO}_3\text{-CaCO}_3$, and $\text{BaCO}_3\text{-CaCO}_3$. *Jour. Geol.* (in press)
- GRIGGS, D. T. AND G. C. KENNEDY (1956) A simple apparatus for high pressures and temperatures. *Am. Jour. Sci.* **254**, 722-735.
- MROSE, M. E., E. T. CHAO, J. J. FAHEY AND C. MILTON (1961) Norsethite, $\text{BaMg}(\text{CO}_3)_2$, a new mineral from the Green River formation, Wyoming. *Am. Mineral.* **46**, 420-429.
- PALACHE, C., H. BERMAN AND C. FRONDEL (1951) *The System of Mineralogy, 7th ed.*, vol. II, 132-221. John Wiley & Sons, New York.

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A NEW OCCURRENCE OF LANGITE

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Langite, $\text{Cu}_4(\text{SO}_4)(\text{OH})_6 \cdot \text{H}_2\text{O}$ (?), has been found in a complex suite of supergene lead and copper minerals occurring in the Caroline tunnel of the Ward mine, about 18 miles south of Ely, Nevada.

Langite occurs as minute crystals which coat superficially altered chalcopyrite in a quartz gangue. Other hypogene sulfides in the ores include galena, sphalerite, pyrite, and hessite. Incipient oxidation of the

chalcopyrite has turned the surface of the crystals to an earthy mixture of sooty chalcocite, covellite, and goethite, and much of the langite occurs in such material. Among the other supergene minerals present, brochantite and cerussite are the earliest to crystallize. These are followed by approximately contemporaneous serpierite $(\text{Cu,Zn,Ca})_5(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$ (?), langite and linarite. Langite and serpierite may be replaced by devillite, $\text{Cu}_4\text{Ca}(\text{SO}_4)_2(\text{OH})_6 \cdot 3\text{H}_2\text{O}$; the replacement is contemporaneous with the beginning of alteration of sphalerite. Other species found in the assemblage include gypsum, greenockite, wire silver and paratellurite. The close relation between langite and chalcopyrite is similar to that described by Pierrot and Sainfeld at Mollau, Haut-Rhin (1958).

Although the langite crystals are small (up to 5 mm) they are eminently suited for morphological study. The larger crystals, which are generally a fine sky-blue color, are often twinned repeatedly on $\{110\}$. The twins are tabular or scaly on $\{001\}$ and occur as crusts on chalcopyrite.

Smaller crystals are generally untwinned and are blue-green. These crystals are elongate on $\{100\}$ and may occur in parallel growth with serpierite of similar habit. In such cases the crystals are joined on a common $\{001\}$.

Examination of a number of langite crystals on the two-circle goniometer showed the following forms: $\{001\}$ c, $\{010\}$ b, $\{120\}$ n, $\{110\}$ m, $\{021\}$ f, $\{102\}$ t, and $\{241\}$ p. Serpierite of similar habit showed the following forms: $\{001\}$, $\{010\}$, $\{110\}$, $\{210\}$, and $\{112\}$. Two langite crystals are shown in Fig. 1. The upper one is typical of the small, blue-green crystals and the lower, twinned crystal is typical of the larger, sky-blue crystals.

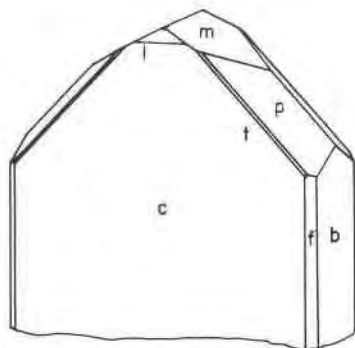
The optical orientation is as reported by other workers, *i.e.* $X=c$, $Y=b$, and $Z=a$. Absorption is in blue with $Y > Z > X$.

Other optical properties of the langite are tabulated below:

sky-blue crystals	blue-green crystals
$\alpha = 1.641 \pm .002$	$\alpha = 1.641 \pm .002$
$\beta = 1.690 \pm .001$	$\beta = 1.690 \pm .001$
$\gamma = 1.712 \pm .001$	$\gamma = 1.705 \pm .001$
$\gamma - \alpha = .071$	$\gamma - \alpha = .064$
$2V(\text{calc}) = 66^\circ$	$2V(\text{calc}) = 56^\circ$

The blue-green crystals give a faint microchemical reaction for zinc whereas the zinc content of the sky-blue crystals is below the limits of detection. The devillite gives a strong zinc test and the serpierite is virtually zinc-free.

Identification of the langite was confirmed by an *x*-ray powder pattern



twin on (110)

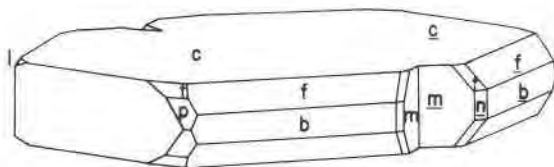


FIG. 1. Langite crystals.

which have good agreement with data published by Pierrot and Sainfeld. Devillite and serpierite were identified on the basis of morphology, optics, and microchemical tests. X-ray powder data on authenticated, type locality specimens of these species are unavailable.

REFERENCE

PIERROTT, R. AND P. SAINFELD (1958) Sur la langite des Vosges. *Bull. Soc. Franc. Mineral.* **81**, 257-260.