NOTES ON MINERALS ASSOCIATED WITH HILGARDITE

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A general discussion of the water-insoluble residues from the rock salt of Louisiana salt plugs has been given by Taylor (1937). A new mineral, hilgardite, described by Hurlbut and Taylor (1937), and an associated mineral, parahilgardite, described by Hurlbut (1938), were found in the Choctaw salt dome. In addition to these minerals, the insoluble residues from the Choctaw salt dome yielded several others worthy of note because of their unusual occurrence and association.

The insoluble residue which separates from the brine comes from well within the salt dome and is composed largely of anhydrite grains mixed with fragments of argillaceous sandstone and black calcareous shale. The other minerals form but a small percentage of the total residue. The minerals identified from the residue are briefly described below in order of abundance.

Anhydrite. A bluish gray color is given to the residue by the large percentage of anhydrite present. It is found chiefly as cleavage fragments somewhat etched and worn by solution, some of which include carbonaceous matter. Occasional partially developed tabular crystals are found elongated parallel to either the a[100] or c[010] axis. The grains average from 0.1 to 0.8 mm. in length, with an occasional one as long as 15 mm.

Dolomite. Crystals of dolomite, unusually well developed, make up nearly five per cent of the total residue. Cleavage fragments and irregular grains are present but are much less common than the crystals. The base {0001} dominates the crystals, but its modification by the positive rhombohedron $\{10\bar{1}1\}$ and the negative rhombohedron $\{01\bar{1}2\}$ gives the crystals a star-shaped appearance as shown in Fig. 1. When transparent, or nearly so, the crystals show definite nuclei of a finely divided white substance. Such crystals are slowly soluble in cold 1:1 HCl, leaving the finely divided white substance of the nucleus as a residue.

On the basis of refractive indices some of the dolomite can be separated into the varieties magnesiodolomite and ankerite. The ankerite differs from the magnesiodolomite in containing a higher percentage of iron, which gives it a yellow to orange color and higher refractive indices.

Magnesite. One of the interesting features of the residue is the presence of well-developed magnesite crystals, for crystals of this mineral have been described from only a few places in the world. The crystals are clear and colorless and range from 0.1 to 3.0 mm. in length. The sec-

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ond order prism $a\{11\bar{2}0\}$ is the dominant form and is frequently the only one, for many of the terminations are either deeply etched or broken. A few crystals show a positive rhombohedron, probably $r\{10\bar{1}1\}$, and the base, $c\{0001\}$, but too deeply etched to permit measurement. The cleavage angle $rr'(10\bar{1}1):(\bar{1}101) = 72°36'$ and $cr(0001):(10\bar{1}1) = 43°8'$ check exactly the angles of Kokshorov given by Dana (1892). The refractive indices determined with sodium light are: $\omega = 1.701 \pm 0.002$ and $\epsilon = 1.508 \pm 0.003$, which check within the limits of error the refractive indices given by Larsen and Berman (1933) for pure $MgCO_3$.

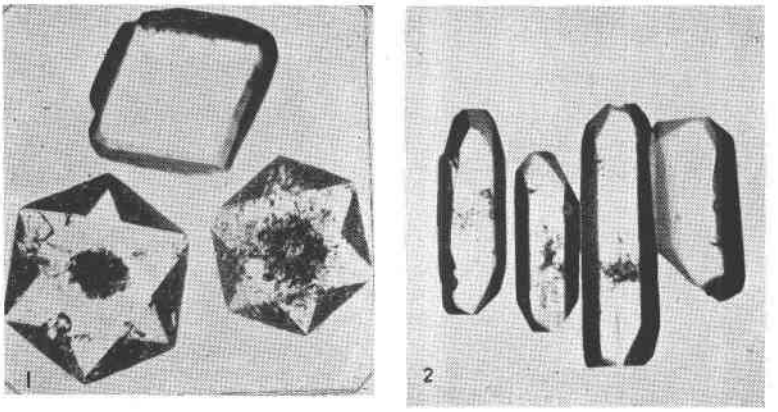


FIG. 1. Dolomite crystals showing nuclei. ×21.
FIG. 2. Magnesite crystals, ×25.

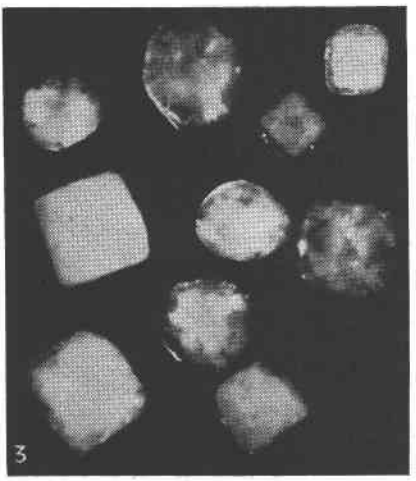
Hilgardite and Parahilgardite. The new hydrous calcium borates, hilgardite and parahilgardite, have been described by Hurlbut and Taylor (1937) and Hurlbut (1938).

Pyrite. Well-developed pyrite crystals occur in a variety of forms. Pyrite is also found as irregular grains, as inclusions in anhydrite and dolomite, and as crusts on grains of other minerals.

Calcite. For the most part calcite is represented by irregular grains and cleavage fragments with an occasional crystal. The crystals are more elongated and less well developed than those of dolomite, and show faces of a positive scalenohedron, negative rhombohedron, and prism. A few nearly perfect scalenohedrons are also present. All of the calcite grains and crystals are less than 1.0 mm. in greatest dimension.

Boracite. While boracite is found in many of the German salt deposits, its appearance at Choctaw is believed to be the first described for an American locality. The crystals range from 0.1 to 0.5 mm. in diameter

and have the form of cubes truncated by the octahedron. They have the characteristic twinning producing an internal radial structure and pearly luster. Photomicrographs of boracite crystals are shown in Fig. 3.



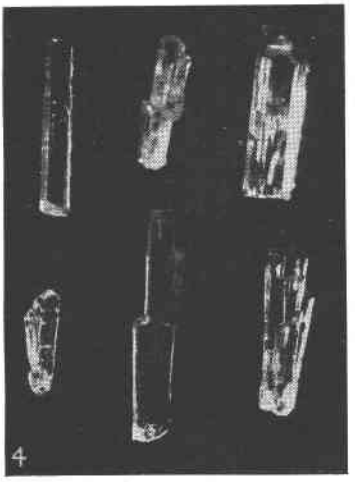


FIG. 3. Boracite crystals, ×23.
FIG. 4. Danburite crystals, ×14.

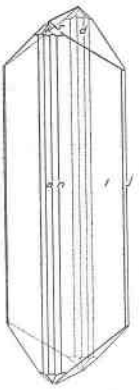


FIG. 5. Doubly terminated crystal of Danburite.

Danburite. One of the most interesting of the minerals present in the residue, because of its unusual occurrence, is danburite. So far as is known, this is the first time danburite has been found in such an association. It occurs as colorless prisms as much as 3.0 mm. in length, and

characteristically intergrown in a subparallel manner. Isolated individuals are doubly terminated as shown in Fig. 5. Photomicrographs of typical crystals are shown in Fig. 4. The following forms were found on the crystals: $a\{100\}$, $h\{210\}$, $l\{110\}$, $j\{120\}$, $d\{011\}$, $w\{201\}$, $r\{111\}$.

Quartz. Sandstone inclusions occur in the residue, but, in addition to these, there are quartz crystals that have developed independently. The crystals are clear or with inclusions of carbonaceous matter, and have the usual prisms terminated by rhombohedrons. They occur as individuals, or in the form of rosettes with nuclei similar to those in the dolomite crystals. The largest rosettes are not greater than 1.0 mm. in diameter.

Sulphur. Yellow to greenish-yellow sulphur grains with diameters up to 0.5 mm. are present; most of them are quite irregular, but a few have partially developed crystal faces.

Limonite. Limonite pseudomorphs after pyrite, rarely larger than 0.1 mm. in diameter, are present.

Hematite. Hexagonal plates and irregular grains of hematite are found, seldom over 0.2 mm. in greatest dimension.

Marcasite. Characteristic coxcomb aggregates of elongated microscopic marcasite crystals are present but rare.

Hauerite. Only a few crystals and irregular grains of hauerite are present. These have a grayish- to reddish-brown color and a maximum dimension of less than 1.0 mm.

Gypsum. Occasional selenite crystals and fibrous masses of gypsum are attached to shale fragments. These have the appearance of being secondary and it seems probable that they are, since the sample had been exposed to the weather before it was collected.

The Zechstein salt deposits of Germany have been studied in much greater detail than those of any other region. Boeke (1910) has summarized the data on the insoluble residues of these deposits, and his list of minerals includes most of those found in the Choctaw salt dome and many that are not. The outstanding feature of the Choctaw residues is the relative abundance of boron minerals—boracite, danburite, hilgardite, and parahilgardite. Boracite is the only one of these boron minerals that has been found in the Zechstein deposits. Taylor (1937), in the study of insoluble residues from twenty Gulf Coast localities found boron minerals in only the Choctaw salt dome. As the salt of the domes has been intruded from sedimentary beds at depth and the minerals of the residues are considered to be syngenetic in the salt, the Choctaw salt dome must represent an area of unusual boron concentration for the Gulf Coast region. A brine sufficiently concentrated for the precipitation of boron minerals might have developed in an isolated basin, or

the boron might be of local volcanic origin, as in the case of the Searles Lake, California, deposits.

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