GLY 4200C
LAB EXERCISE 8

CARBONATES and BICARBONATES

Carbonates

Carbonates are minerals consisting of metallic elements bonded to the carbonate group, CO_3^{2-}. Carbonate anionic groups do not break apart in most chemical reactions so they may be treated as a group. One exception to this rule is the reaction of a carbonate with an acid.

$$2\ HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2\ (g, \uparrow)$$

The carbon dioxide is a gas and bubbles (or "fizzes") off. This provides a good qualitative test for the presence of carbonate minerals in most samples. Most carbonate minerals will fizz when a small (!) drop of acid is placed on the mineral. However, it may be necessary to listen for the fizz and a few minerals react so slowly that the reaction is not detectable. Always wash the mineral off after testing.

Hydrous carbonates are often soluble in water, and are frequently weathering products. Some, like azurite and malachite, are indicator minerals for possible ore deposits.

Carbonates occur in three structure types. The **calcite** group consists of divalent cations bonded to the carbonate anionic group. The structure is a distorted NaCl type, compressed along a three-fold axis, and CN = VI. All members of the calcite group belong to class $\bar{3}$ 2/m. The cations and carbonate anionic groups form alternate layers. Another group, the **dolomite** group, is similar to calcite except that two distinct divalent cations are present in the structure. These cations occupy separate layers. For example in dolomite itself there is a layer of Mg^{2+} ions, a layer of carbonate ions, a layer of Ca^{2+} ions, a layer of carbonate ions, a layer of Mg^{2+} ions, a layer of carbonate ions, etc. The ordering of the cations results in dolomite group minerals belonging to class $\bar{3}$. The final group is the **aragonite** group. Minerals in this group have large divalent cations and each cation is coordinated to nine oxygens. Calcium is borderline between the ratio required for CN = VI or IX so occurs in both the calcite and aragonite structures. Aragonite is denser and is stable at higher pressures. The aragonite group minerals are orthorhombic, 2/m 2/m 2/m.

Two other carbonates are common. These are the hydrous copper carbonates azurite and malachite. Both of these are monoclinic and are easily recognized by their color.

Bicarbonates

Bicarbonates are minerals with the bicarbonate anion, HCO_3^-. Trona is a typical saline lake deposit.

Examine the following specimens:

Calcite Group

CALCITE $CaCO_3$
varieties Iceland Spar, chalk, tufa, and travertine
MAGNESITE $MgCO_3$
SIDERITE $FeCO_3$
RHODOCROSITE $MnCO_3$
SMITHSONITE $ZnCO_3$

Dolomite Group

DOLOMITE $CaMgCO_3$
ANKERITE $CaFeCO_3$

Aragonite Group

ARAGONITE $CaCO_3$
STRONTIANITE $SrCO_3$
CERUSSITE $PbCO_3$

Hydrous Carbonates

MALACHITE $Cu_2CO_3(OH)_2$
AZURITE $Cu_3(CO_3)_2(OH)_2$

Bicarbonate

Trona $Na_3H(CO_3)_2 \cdot 2\ H_2O$

Reference material in text

Klein and Dutrow, Chapter 17, pp. 399-403 and 407-416 has information concerning carbonate minerals. No specific information about bicarbonates is available, although trona is mentioned on page 416. These pages should be consulted while doing this laboratory exercise.

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