

# OPERATION CHEMISTRY: MORE THAN CALCITE AND GYPSUM

BETH PRICE

4-2009

## INTRODUCTION

Although calcite, calcium carbonate, and gypsum, calcium sulfate, are the most common and most widely used carbonate and sulfate minerals, respectively, there are many more examples of useful carbonates and sulfates.

## OBJECTIVES

Students will locate on the periodic table the metals or cations associated with various carbonates and sulfates, as well as propose uses for the minerals.

## MATERIALS

- Periodic table
- Sample minerals, carbonates and sulfates
- Properties of the minerals such as chemical formula, hardness, solubility
- Information about the uses of the carbonate or sulfate minerals

## PROCEDURE

- 1) Using the “Creating a Universe Periodic Chart” from the Minerals Information Institute, look to find reference to carbonate or sulfate minerals.
  - a) List such minerals and the related elements.
  - b) Look up formulas for the minerals in a list of minerals such as <http://www.minerals.net/mineral/index.htm> .
  - c) Try to find some system to the minerals, such as noting what metals seem to occur in carbonate and sulfate minerals and their locations on the periodic table.
- 2) If possible, look at samples of the minerals to discover hardness and solubility.
  - a) Try to predict solubility in water.
  - b) Try to predict solubility in a weak acid such as vinegar.
  - c) List the hardness and solubilities for the minerals if possible.
- 3) Discuss and list uses of the various minerals.
  - a) What property of the mineral is reflected in its use?

## EVALUATION

- 1) List minerals, chemical formulas, and uses.
- 2) What minerals are commonly encountered in everyday life?

## REFERENCES

Minerals <http://www.minerals.net/mineral/index.htm>

Mineral data <http://webmineral.com/>

Solubility products <http://www.csudh.edu/oliver/chemdata/data-ksp.htm>

Minerals Information Institute periodic table <http://www.mii.org/PosterPeriodic.htm>

## TEACHER NOTES

Here are some common carbonate and sulfate minerals. The solubility constants are for chemicals with similar compositions, if not the same composition, so the values are useful qualitatively rather than quantitatively.

### Carbonates

Mineral name	Chemical formula	Hardness	Solubility constant
Calcite	$\text{CaCO}_3$	2-3	$3.8 \times 10^{-9}$
Dolomite	$\text{CaMg}(\text{CO}_3)_2$	3.5-4	
Magnesite	$\text{MgCO}_3$	3.5-4	$3.5 \times 10^{-8}$
Azurite	$\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$	3.5-4	$1.4 \times 10^{-10}$
Malachite	$\text{Cu}_2\text{CO}_3(\text{OH})_2$	3.5-4	$1.4 \times 10^{-10}$
Siderite	$\text{FeCO}_3$	3.5-4	$3.2 \times 10^{-11}$

### Sulfates

Mineral name	Chemical formula	Hardness	Solubility constant
Gypsum	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	1.5-2	$9.1 \times 10^{-6}$
Anhydrite	$\text{CaSO}_4$	3-3.5	$9.1 \times 10^{-6}$
Barite	$\text{BaSO}_4$	3-3.5	$1.1 \times 10^{-10}$
Epsomite	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	2-2.5	soluble
Siderotil	$\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$	2.5	soluble