

BORATES

Borate minerals are minerals that contain a borate anion group. Simple borate anion is BO_3 and has a -3 charge. This means each borate anion requires a +3 cation to generate a non-charged stable compound or mineral. But there are also more complex boron-oxygen combinations like B_2O_5 and B_3O_6 .

59. Ulexite - $\text{NaCaB}_5\text{O}_6(\text{OH})_6 \cdot 5\text{H}_2\text{O}$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



Ulexite is also known as [TV](#) rock due to its unusual optical characteristics. The fibers of ulexite act as [optical fibers](#), transmitting light along their lengths by internal reflection. When a piece of ulexite is cut with flat polished faces perpendicular to the orientation of the fibers, a good-quality specimen will display an image of whatever surface is adjacent to its other side



CARBONATES

Carbonate minerals are minerals that contain a carbonate anion group. Simple borate anion is CO_3 and has a -2 charge. This means each borate anion requires a +2 cation to generate a non-charged stable compound or mineral. There are many very common carbonate minerals. You are responsible for knowing 5 of them, two of which, aragonite and calcite, have the same chemical composition

5. Aragonite - CaCO_3

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



Near surface,
low temperature phase

13. Calcite - CaCO_3

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



Dogtooth
crystals



Reactive to acid

CARBONATES - continued

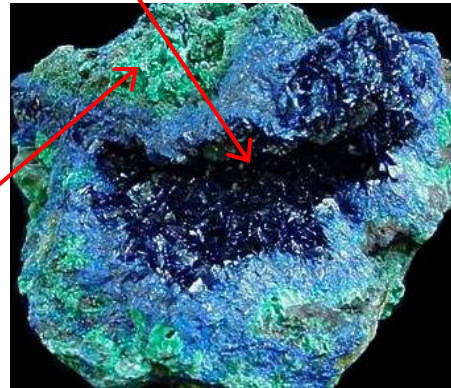
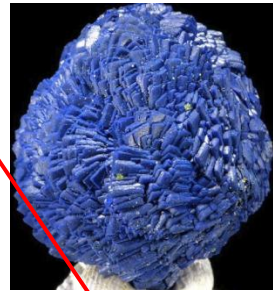
19. Dolomite $\text{CaMg}(\text{CO}_3)_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



7. Azurite $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



36. Malachite $\text{Cu}_2\text{CO}_3(\text{OH})_2$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



HALIDES

The **halide mineral** class include those **minerals** with a dominant **halide** anion (F^- , Cl^- , Br^- and I^-). Each carries a -1 charge that must be balanced. You are only responsible for two.

22. Fluorite – CaF_2

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - octahedral
Hardness - _____
Luster/Streak /
Use (if any) - _____
Other _____

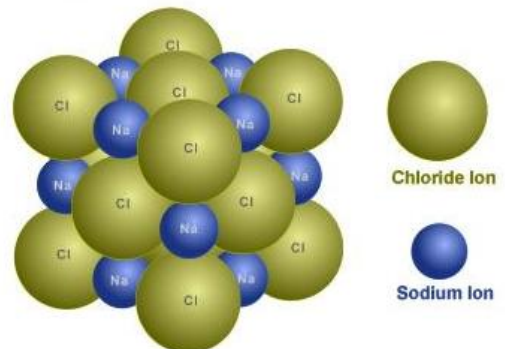


30. Halite – $NaCl$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak /
Use (if any) - _____
Other _____



Arrangement of Sodium and Chloride Ions in Halite



Evaporite mineral

HYDROXIDES

A group of minerals combining metallic elements with either water (H_2O) or a hydroxyl group (OH) or both.

8. Bauxite – $\text{Al}(\text{OH})_3$ or $\text{AlO}(\text{OH})$

Gibbsite, Diaspore

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____

Almost all aluminum produced has come from bauxite, which is actually a combination of minerals.



OXIDES

An **oxide** is a chemical compound that contains at least one oxygen atom and one other element in its chemical formula.

17. Corundum - Al_2O_3

Color - _____

Crystal Habit - _____

Crystal System - _____

Cleavage - _____

Hardness - _____

Luster/Streak _____/_____

Use (if any) - _____

Other _____



Rubies and sapphires are gem corundum.

OXIDES – continued -- Iron OXIDES

24. Goethite/Limonite ($\text{FeO}(\text{OH})$)

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



31. Hematite Fe_2O_3

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



35. Magnetite Fe_3O_4

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - _____
Luster/Streak _____/_____
Use (if any) - _____
Other _____



PHOSPHATES

Phosphate minerals are those minerals that contain the tetrahedrally coordinated phosphate (PO_4^{3-}) anion along with the freely substituting **arsenate** (AsO_4^{3-}) and **vanadate** (VO_4^{3-}). **Chlorine** (Cl^-), **fluorine** (F^-), and **hydroxide** (OH^-) anions also fit into the crystal structure.



4. Apatite $\text{Ca}_5(\text{PO}_4)_3(\text{F}, \text{Cl}, \text{OH})$

Color - _____
Crystal Habit - _____
Crystal System - _____
Cleavage - _____
Hardness - 5 on Mohs scale
Luster/Streak _____/_____
Use (if any) - _____
Other _____

