OLIVINE

$Fe,MgSiO_4$

CLASS: SILCATES

NOTES: Olivine is named for its color! It forms at high temperatures and has a simple, individual tetrahedron x-talline structure. Olivine breaks down quickly when exposed at the surface of the earth. Olivine forms a conspicuous layer of the Palisades (across the Hudson from N.Y.C.) that geologists call the rotten layer. Weathering of the rotten layer undermines the rocks above. These rocks fall, keeping the cliff face sharp.

AUGITE

(Ca,Mg,Fe,Al Silicate)

CLASS: SILICATES FAMILY: PYROXENE (Single chain tetrahedral structure)

NOTES: Augite, like hornblende, is an iron rich, heavy mineral that forms at high temperatures in the earth. It is a common rock forming mineral.

HORNBLENDE

(Na,Ca,Mg,Fe,Al Silicate)

CLASS: SILICATES FAMILY: AMPHIBOLES (double chain tetrahedral structure)

NOTES: Hornblende, like augite, is an iron rich, heavy mineral that forms at high temperatures in the earth. It is a common rock forming mineral.

BIOTITE

$K(Mg,Fe)_3AlSi_3O_{10}(OH)$

CLASS: SILCATES FAMILY: MICA

NOTES: Like all micas, biotite is know for its 'basal cleavage' in one direction. Biotite contains more iron than most micas, hence its dark color.

ORTHOCLASE

$KAlSi_3O_8$

CLASS: SILICATES FAMILY: K-FELDSPARS

NOTES: Orthoclase gets its name from the Latin words *ORTHO*, meaning 'right angle', and *CLASE*, meaning 'fracture'. Notice the 2 cleavages at right angles to each other, as well as the distinctive 'salmon' color. Note the fine pale lines running throught the sample. They are the result of a 'kink' in the lattice called ***twinning***. Excellent samples of orthoclase can be found in the quarries in and around Bedford.

MICROCLINE

$KAlSi_3O_8$

CLASS: SILICATES FAMILY: K-FELDSPARS

NOTES: This mineral has the same chemical formula as orthoclase, but a slightly different x-tal structure. Each mineral is ***polymorphic*** with the other. Note the fine white lines running throught the sample. They are the result of a 'kink' in the lattice called ***twinning***.

MUSCOVITE

$KAl_3AlSi_3O_{10}(OH)$

NOTES: Like all micas, muscovite is know for its 'basal cleavage' in one direction. Muscovite has been used for many years as an insulator, and as window material for ovens. It is extremely stable even at high temperature, expanding and contracting very little with temperature changes. Eisenglass windows on carriages of the past were actually muscovite sheets. Large books of muscovite can be found in the quarries around Bedford.

ALBITE

$NaAlSi_3O_8$

CLASS: SILICATES FAMILY: FELDSPARS

NOTES: Albite is named for its white color. (*Alb* is Latin for white). It is a Na (sodium) rich feldspar. Note the fine white lines running throught the sample. They are the result of a 'kink' in the lattice called ***twinning***.

LABRADORITE

Na,Ca Al Silicate

CLASS: SILICATES FAMILY: FELDSPARS

NOTES: Labradorite is Na/Ca (sodium/calcium) rich feldspar noted for the fabulous blue play of color (called *LABRADORESCENSE*) it gives in sunlight. The high peaks of the Adirondacks contain lots of labradorite, and along Feldspar Brook and Opalescent Creek, you often see rocks along the trail glowing blue and gold.

ANORTHITE

$CaAl_2Si_2O_8$ *Al Silicate*

CLASS: SILICATES FAMILY: FELDSPARS

NOTES: Anorthite is a Ca (calcium) rich feldspar that forms at very high temperatures. The high peaks of the Adirondack Mts. are made of *metanorthosite* (a metamorphic rock containing anorthite). The highlands of the moon are also formed from anorthite!

QUARTZ X-TALS

SiO_2

CLASS: SILICATES

NOTES: Quartz x-tals are typically hexagonal in cross section, and terminated (come to a point) on one end. Often striae are observed running across the sides of the x-tal. Quartz does not cleave - the x-tals must have stopped growing before they ran out of room. You are looking at growth faces

AGATE

SiO_2

CLASS: SILICATES FAMILY: QUARTZ *(AGATE)*

NOTES: Agate is a *'crypto x-talline'* (*crypto* = hidden) form of silica. The silica in agate is precipitated, not cooled from a melt. forms of agate include flint, chert, jasper, chalcedony, and onyx.

GEODE

SiO_2

CLASS: SILICATES FAMILY: QUARTZ*(AGATE)*

NOTES: These rocks form as dissolved silica (SiO_4) come together in *vugs*, or pockets, in sedimentary rocks. The geode is the the state rock of Iowa, where some of these come from. This form of quartz is called *agate*.

JASPER

SiO_2

CLASS: SILICATES FAMILY: QUARTZ*(AGATE)*

NOTES: Jasper is a *'crypto x-talline'* (*crypto* = hidden) form of silica. The silica in agate is precipitated, not cooled from a melt. Jasper is used, cut and polished, for jewelry.

AMETHYST

SiO_2

CLASS: SILICATES FAMILY: QUARTZ

NOTES: Amethyst is a variety of quartz noted for its deep purple color, caused by the presence of Fe (iron) atoms in the lattice. The best samples come from the *Minas Gerais* district of Brazil, as this one did. Amethyst is used extensively in moderately priced jewelry.

ROSE QUARTZ

SiO_2

CLASS: SILICATES FAMILY: QUARTZ

NOTES: This variety of quartz is colored by a small amount of the element *titanium* in the lattice. Some of the finest rose quartz in the world was mined in Bedford, sent to China where it was carved into birds and animals, and sold back in the U. S. Excellent samples can still be found in old quarries around Bedford, as these were.

SMOKY QUARTZ

SiO_2

CLASS: SILICATES FAMILY: QUARTZ

NOTES: Smoky quartz gets its dark color from free Si (silicon) atoms blasted from the lattice by radiation deep in the earth. The samples here are from Bedford, with the exception of the very dark crystal, which was irradiated in a laboratory.

MILKY QUARTZ

SiO_2

CLASS: SILICATES FAMILY: QUARTZ

NOTES: The milky appearance is caused by fluid inclusions, in tiny spaces within the lattice. This is probably the most common form of quartz.

HERKIMER DIAMONDS

SiO_2

CLASS: SILICATES FAMILY: QUARTZ

NOTES: These x-tals are really only very pure x-tals of quartz. They form in pockets, or *vugs*, in a sedimentary rock called *dolostone* found in Herkimer County, N. Y. They are more resistant than the dolostone, and often 'weather out' at the edge of a dolostone cliff. For a few dollars, you can dig for diamonds at the Herkimer diamond mine in Little Falls, N. Y.

The fact that these x-tals show well defined growth faces indicates that they had plenty of room to grow, though several samples jammed up against the side of the vug. Unlike most quartz x-tals, Herkimer diamonds are 'doubly terminated'.

KAOLINITE

$Al_2Si_2O_5(OH)_4$

CLASS: SILICATES FAMILY: CLAY MINERALS

NOTES: Kaolinite is the product of the hydration of feldspars, a process that is part of the natural weathering of many minerals. Kaolin clay, when heated, can fuse into a hard, silicate ceramic (like porcelin). It is prized by potters.

GARNET

$A_3B_2(SiO_4)_3$

WHERE A=Ca,Mg,Fe B=Al,Fe,Mn,V,Cr

CLASS: SILICATES FAMILY: GARNET

NOTES: There are many varieties of garnet, some of which are exhibited here. Garnet is used for jewelry, and also as an abrasive (its hardness is 8). The sample in the black matrix (*var. Almandine*) is from Gore Mt., N. Y., where garnet is mined to make sandpaper.

STAUROLITE

$Fe_2Al_9Si_4O_{22}(OH)_2$

CLASS: SILICATES

NOTES: Staurolite typically forms cruciform twins, cross shaped x-tals, like these. As a result, staurolite is valued as a religeous symbol in some parts of the world. To the geologist, the presence of staurolite is the indicator of a past high temperature and pressure metamorphic environment.

TOURMALINE

$Na(Fe,Mg)_3Al_6(BO_3)(Si_6O_{18})(OH,F)_4$

CLASS: SILICATES

NOTES: Tourmaline is mineral that comes in many colors. Typical crysals are black, hexagonal, and have lines, or *striae* running along the sides of the x-tal. Other varieties, like *watermelon tourmaline* here are valued as gems.

GALENA

PbS

CLASS: SULFIDES

NOTES: This mineral is typical of the sulfides, metallic, shiny, and dense. Galena is Pb (lead) sulfide (PbS), mined as the major ore of lead. Note the perfect cubic cleavage, and great *heft*, or density.

PYRITE

FeS

CLASS: SULFIDES

NOTES: This mineral is typical of the sulfides, metallic, shiny, and dense. Pyrite, FeS, is commonly known as *Fool's Gold*, and is often found in x-talline form.

CHALCOPYRITE

$CuFeS_2$

CLASS: SULFIDES

NOTES: This mineral is typical of the sulfides, metallic, shiny, and dense. Chalcopyrite is a CuFeS, and is *brassier and bluer* than pyrite.

BORNITE

Cu_5FeS_4

CLASS: SULFIDES

NOTES: Bornite is a Cu,FeS, which tarnishes quickly to show the many colors you see here. Bornite is commonly called *peacock ore*.

SPHALERITE

ZnS

CLASS: SULFIDES

NOTES: This mineral is typical of the sulfides, metallic, shiny, and dense. Sphalerite is ZnS, a major ore of the metal zinc. (You probably have one in your kitchen)

RHODOCHROSITE

$MnCO_3$

CLASS: CARBONATES

NOTES: Rhodochrosite, a manganese carbonate, is recognized by its bright pink color. It is used in jewelry, and good x-tals show the typical rhombohedral cleavage of the carbonates (each face is a parallelogram).

SIDERITE

$FeCO_3$

CLASS: CARBONATES

NOTES: Siderite, the reddish mineral in this sample, is an Fe (iron) carbonate. Note the typical rhombohedral x-tal structure (each face is a parallelogram).

MALACHITE

$Cu_2CO_3(OH)_2$

CLASS: CARBONATES

NOTES: Malachite, a Cu (copper) carbonate, is used extensively in jewelry. Many copper bearing minerals are blue green in color.

CALCITE

$CaCO_3$

CLASS: CARBONATES FAMILY: CALCITE

NOTES: Calcite is easily recognized by its rhombohedral cleavage (each face is a parallelogram). Calcite's formula is $CaCO_3$, and forms the sedimentary rock called *limestone*.

CALCITE
(Var. ICELAND SPAR)

$CaCO_3$

CLASS: CARBONATES FAMILY: CALCITE

NOTES: Calcite is easily recognized by its rhombohedral cleavage (each face is a parallelogram). Place the clear sample over this text to observe another property of calcite, *double refraction*. Light passing through the sample is split in two, giving two clear images!

DOLOMITE

$MgCa(CO_3)_2$

CLASS: CARBONATES

NOTES: Dolomite is similar to calcite, but some of the Ca (calcium) is replaced by Mg (magnesium). Dolomite's formula is $Mg,CaCO_3$, while calcite's is $CaCO_3$. The x-tal structure is the same - dolomite shows rhombohedral cleavage, too.

FLUORITE

CaF_2

CLASS: HALIDES

NOTES: Fluorite comes in a variety of colors and its crystals take several shapes. The purple sample here is an octahedron (8 sided, each side an equilateral triangle). It can be distinguished form quartz by its hardness (only 4) and its cleavage. The green sample here shows cubic x-tals.

APATITE

$Ca_5(PO_4)_3F$

CLASS: PHOSPHATES

NOTES: One of the most common phosphorous-bearing minerals, apatite is used in the manufacture of phosphate fertilizers.

HALITE

NaCl

CLASS: HALIDES

NOTES: This mineral is common table salt, NaCl. Note the cubic cleavage. Halite is mined extensively in Upstate N. Y. by the Diamond Crystal Company.

GYPSUM

$Ca(SO_4)\ 2H_2O$

CLASS: SULFATES

NOTES: Gypsum is a precipitate, generally formed as water evaporates. Gypsum is an important economic mineral - it is used to make dry wall (or 'sheet rock') for the construction industry. There are three varieties displayed here:

ALABASTER

CLASS: A VARIETY OF GYPSUM

NOTES: Alabaster is a massive form of gypsum. It's relatively soft and therefore often carved into decorative sculptures

SATIN SPAR

CLASS: A VARIETY OF GYPSUM

NOTES: Satin spar is the form of gypsum characterized by long, fibrous x-tals.

SELENITE

CLASS: A VARIETY OF GYPSUM

NOTES: Selenite x-tals are relatively clear and 'glasslike'.

GRAPHITE

C

CLASS: NATIVE ELEMENTS

NOTES: Graphite is pure carbon, as is diamond! The difference is the x-tal structure. Graphite is a dull metallic mineral, and soft (2). It is used as pencil 'lead', and ground up for use a lubricant.

DIAMOND

C

CLASS: NATIVE ELEMENTS

NOTES: Diamond is pure carbon, as is graphite! The difference is the x-tal structure. Diamonds are the hardest substance known (hardness 10), and are used as gems and abrasives.

SULFUR

S

CLASS: NATIVE ELEMENTS

NOTES: Check out that bright color!

COPPER

Cu

CLASS: NATIVE ELEMENT

NOTES: Copper is often found concentrated in veins (small cracks) that were filled with water carrying ions of various metals - the very end of Bowen's reaction series. The metal ores are precipitated from those *hydrothermal* waters.

BAUXITE

Hydrous Aluminum Oxide

CLASS: HYDROXIDES

NOTES: Bauxite, the principal ore of aluminum, is formed during the chemical weathering of many silicate rocks and is insoluable in water. Because of this, it is often 'left behind' as other soluable minerals are leached from tropical soils. Jamaica mines more bauxite from its soil than any other country in the world - 80% of the world's total production, in fact. Hey Mon!

HEMATITE

Fe2O3

CLASS: OXIDES

NOTES: Hematite, Fe_2O_3, it the primary ore of iron. It can be recognized by its red streak. The shiny silver sample is called SPECUALR HEMATITE, and is used in jewelry. Hematite is formed as iron released by the chemical weathering of the ferro-magnesian (Mafic) minerals is oxidized. It is insoluable.

CORUNDUM

Al_2O_3

CLASS: OXIDES (OF Al)

NOTES: Corundum, sometimes called emery, is #9 on Moh's scale of hardness. It is used as an abrasive, particularly in sandpaper. Varieties of corundum include ruby (red)* and sapphire (blue).

*There's no place like home.

MAGNETITE

Fe_3O_4

CLASS: OXIDES

NOTES: Magnetite is an oxide of iron that has the additonal property of being magnetic. It is mined, like hematite, as an ore of iron. Large, though now abandoned, magnetite mines are located throughout the Hudson Highlands, and there’s a good one right in Croton Falls.

GRAPHITE

C

CLASS: NATIVE ELEMENTS

NOTES: graphite is polymorphic with diamond. Graphite's slipperyness makes it an excellent dry lubricant, and its softness and dark grey streak make it and ideal pencil 'lead'.

DIAMOND

C

CLASS: NATIVE ELEMENTS

NOTES: Diamond is pure carbon, as is graphite! The difference is the x-tal structure. Diamonds are the hardest substance known (hardness 10), and are used as gems and abrasives.

OPAL

CLASS: SILICATES

NOTES: Opals are hydrated silicates, valued for their irridescent colors. These are poor quality opals my friend Art brought me from Mexico, where he dug them up. Someone stole the good ones from this room!

SERPENTINE

CLASS: SILICATES

NOTES: Serpentine is closely related to talc and asbestos. The rock formed from serpentine is called *serpentinite*. Serpentinite is formed from the metamorphosis of mafic seafloor, and therefore an indicator of past plate movement.

ARAGONITE

CLASS: CARBONATES

NOTES: This mineral is polymorphic with calcite - same composition, different structure. 'Mother of Pearl' or nacre, the pretty, multicolored inside of some shells is aragonite. Aragonite dissolves into seawater at different pressures than calcite, so its presence can indicate past enviornments

SCHEELITE

CLASS:

NOTES:

ULEXITE

(TV Stone)

NOTES: Ulexite is mined in Death Valley, CA., where mineral rich water from the Sierra Nevada Mts. evaporates on the desert floor.

Ulexite is nature's "fiber optic" material - the crystals of ulexite transmit light perfectly and without distortion, making an image under the sample appear on the top of the sample!

WOLLASTONITE

CLASS: SILICATES

NOTES: Wollastonite is a Ca Silicate, formed by the replacement of CO_3 by SiO_2 in limestones. It happens in the high temperatures and pressures of the metamorphic environment.

VERMICULITE

CLASS: SILCATES FAMILY: MICA

NOTES: Like all micas, vermiculite is know for its 'basal cleavage' in one direction. Vermiculite contains water molecules between the layers. Upon heating, the water flashes to steam, popping the vermiculite. Vermiculite is mined and cooked in huge ovens to make soil filler, cat litter, and oil absorbers. Try a small piece over the burner here.

DOGTOOTH SPAR

$CaCO_3$

CLASS: CARBONATES FAMILY: CALCITE

NOTES: Dog tooth spar is, like all calcite, formed of $CaCO_3$, but has a slightly different x-tal structure than iceland spar calcite. Each mineral is ***polymorphic*** with the other - identical composition, a different x-tal structure.