

# **Guidebook to the MTSU Mineral, Gem, and Fossil Museum**

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## **Introduction to the Museum**

The MTSU Mineral, Gem, and Fossil Museum was established in 2005. It serves as both a teaching lab for our Earth Science classes and a learning experience for the general public. Most of our visitors outside of the university are school groups from the 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> grades that can reserve a tour during the work week. We also help scout groups obtain their Merit Badge in Geology. There are “scavenger hunts” available for children, so please ask for one if interested. The Museum is open to the public on Saturdays from 1pm to 5pm, and admission is free.

The Museum has two main exhibit rooms and a smaller room that displays minerals that beautifully fluoresce under a black light. There are some truly world class minerals and fossils in the Museum. There are samples from every state in our country and from over 50 countries. The first room of the Museum is largely minerals that have been displayed in Family Groups. Most of the fossils are in the second room, as well as, a display of birthstones, jewelry made from semi-precious stones, and figurines carved from various minerals. A Geologic Time Scale is provided on the last page of the guidebook to help you visualize the long periods of time associated with the different geologic ages. Please enjoy your visit and tell your friends about our “Hidden Jewel” here at MTSU.

## **Introduction to Minerals**

There are well over 4000 different minerals but only about 75 are considered common. A mineral is defined as a naturally occurring substance that contains one or more elements, and has a definite crystal structure. Many mineral names end in “ite” or “lite” from the Greek word “lithos”, meaning stone. Some mineral names contain a Greek word for a typical property such as weight, luster, or cleavage. Other minerals are

named from old mining terms such as “spat” or “blende” which are German for minerals lacking valuable metals. During the last 200 years, many minerals have been named for the geographic location where they were discovered. Only a few minerals have been named for people.

Minerals are grouped primarily by similar chemistry, particularly by the elemental components shown at the end of their formula. Sulfides, for example, all end in S, and Oxides all end in O. In addition to similar chemistry, minerals are sub-divided into groups based on similarities in crystal structure. Silicates are the largest group of minerals with all ending in some multiples of the silica-oxygen tetrahedra. The way in which these tetrahedra are “glued” together by other elements defines the subclasses of the silicate family. Phyllosilicates, for example have a layered crystal structure that can best be imagined by “peeling off” the sheets of mica minerals like biotite and muscovite. Minerals are not grouped by crystal form such as the simple cubic shape (isometric) or hexagonal, but are farther classified in this manner. Cabinet 11 shows each of the seven crystal forms and their varieties.

## **Cabinet 1/2—Carbonate Minerals**

All of Cabinet 1 and part of Cabinet 2 display carbonate minerals. All carbonate minerals have the “carbonate radical-CO<sub>3</sub>” at the end of their mineral formula. One of the most common minerals on the earth is **Calcite** and its near equivalents, **Dolomite** and **Aragonite**. Calcite is deposited in shallow, warm seas with coral reefs, such as in the Bahamas today. It is also the mineral that forms most stalactites and stalagmites in caves. Calcite is the primary mineral in limestone which is used to make lime, cement, and roadbed material. **Malachite** and **Azurite** are two beautiful carbonate minerals that are the main sources for copper throughout the world. Malachite is also used to make jewelry. **Rhodachrosite** is a beautiful pinkish-red carbonate that is used in jewelry. **Smithsonite** is occasionally polished to make cabochons in jewelry, but it can locally be an important source for zinc. **Cerussite** is locally important as a source for lead which is used in batteries, fishing weights, and ammunition. **Siderite** occasionally occurs in sufficient quantities to be mined for iron.

## **Cabinet 2—Sulfate Minerals**

Sulfate minerals all hold the “sulfate radical—SO<sub>4</sub>” in common in their mineral formula. **Gypsum** is a very common mineral found in sedimentary rocks that forms in shallow, warm seas as they evaporate and/or eventually dried up. It is used to make wallboard found in most of our homes and workplaces. It is also used as a soil conditioner, for cement, and as filler in paper and paints. **Barite** has an important use in the oil and gas industry. Its heavy weight enables it to prevent dangerous “blowouts” of explosive gases during the drilling process. It is also used as filler in paper, a pigment, in floor materials, and some medical procedures. **Celestite** crystals are loved for their extraordinary light blue color. Where there is a rich deposit, **Celestite** is mined for its strontium content which is used to make coloring in fireworks and as a general coloring agent.

## **Cabinet 3—Sulfides**

Sulfide minerals are a large group and all have “sulfur—S” as a common denominator in their mineral formula. They also include most of the economically important ore minerals that supply use with such elements as zinc, bismuth, tin, arsenic, selenium, and tellurium. **Sphalerite** is a very common mineral and the most important source of zinc. Zinc is used in batteries, in the galvanizing process, in many alloys, paints, and in medicines. Tennessee is the nation's 4<sup>th</sup> largest producer of zinc, processed from **Sphalerite**. Most of the mines occur in East Tennessee, but one, over 300 miles long, occurs under Al Gore's property and the greater Carthage area. **Iron Pyrite**, commonly known as “**Fool's Gold**” is a very common mineral and unfortunately found in the shales around coal and the igneous rocks mined for gold and silver. When **Pyrite** is exposed to the weathering agents of rain and oxygen, its sulfur component forms sulfuric acid. The result is what we all know as “acid mine drainage”. Many of the streams of the Cumberland Plateau of Tennessee and Kentucky have been unofficially declared “dead” because the acid waters leaving old coal mines have killed nearly all life in them. **Arsenopyrite** is the most common source of arsenic. Although toxic to humans, arsenic has many uses in industrial products. **Realgar** and **Orpiment** are two other arsenic sulfides. They use to be mined for yellow and red pigments but this

practice has stopped due to their poisonous nature. **Galena** is our world's most important source of lead and is relatively common. Unfortunately, it too has led to acid mine drainage in some locations and dangerous lead levels in the water and stream sediments. In many old US lead mine sites, the mining tailings and smoke from the smelters have also laden the soils and water with lead. In some locations, many illnesses and death have been attributed to the lead content. **Chalcopyrite, Bornite, Covellite, Chalcocite, Tetrahedrite, Tennantite, and Enargite** are all sulfides mined for their copper content. **Chalcopyrite** is the world's most important sources of copper other than Malachite and Azurite. **Cinnabar** is a relatively rare sulfide, but is the principal ore for mercury. Mercury can be toxic to humans, but it has many important uses. These include thermometers and barometers, electrical apparatus, batteries, dental fillings, paints, and as a preservative in some aspects of agriculture. **Stibnite** is the principal ore for antimony which is used in various alloys, ball bearings, and pigments. **Jamesonite** and **Zinkenite** also contain antimony, but rarely are there sufficient deposits to be mined. **Cobaltite** is one of the most important mineral sources for cobalt which is used primarily for making various steel alloys. **Linnaeite** is a rare cobalt mineral. **Skutterudite** is another sulfide mined for its cobalt content. **Molybdenite** is the principal ore for molybdenum. Molybdenum is also used to make steel alloys, but also used for electrical components and lubricants. **Sylvanite** and **Argenite** are relatively rare silver-bearing sulfides, but occasionally they are of sufficient abundance to be mined. **Nicolite** is the most important mineral source for nickel. **Ullmanite** also contains nickel but is very rare.

#### **Cabinet 4—Halides and Native Elements**

The Halide Group of minerals are simple compounds in which a halogen element such as fluorine, chlorine, bromine, and iodine are bonded to an alkali metal such as sodium, potassium, and calcium. **Halite** or "rock salt" is perhaps the most abundant of the halides. It formed in ancient shallow seas that slowly dried up. It is used for domestic purposes and winter road salting. **Sylvite** is a similar evaporite deposit, but contains potassium. It is used in the chemical industry for compounds requiring potassium such as some fertilizers. **Chlorargyrite** is a silver bearing halide that was once mined by the South American Incas. No deposit is known today that is rich enough

to be mined. **Fluorite** is usually a beautiful purple mineral prized by collectors. Some of the finest specimens come from the zinc mine under Carthage, Tennessee. Fluorite is the primary mineral source of fluorine used to prevent tooth decay. Fluorite is also an important flux in the smelting of aluminum and in steel production. It is also used for many fluorine chemicals such as Freon. **Cryolite** also contains fluorine and once was used as a flux. Now, synthetic cryolite is produced from fluorite.

Only a few minerals occur as native elements, but nearly all have an important economic use. **Gold and Silver** are well known for their use in jewelry, but also have important applications in electronics and medicine. Native **copper** commonly forms unusual shapes such as exhibited here. Large pieces the size of small cars have been found in the Upper Peninsula of Michigan where it was mined for over a hundred years. Today, copper-bearing sulfides and carbonates are a more important source of copper. In addition to wires and plumbing, copper is used to make brass when combined with zinc and bronze when it is joined with tin. Native **Sulfur** deposits occur throughout the world. The largest deposits form in evaporate environments similar to halite and gypsum. It is also common in volcanic regions. Sulfur is a main component of gunpowder, a raw material for sulfuric acid, has medical uses, used for vulcanizing rubber, and in the production of insecticides, and fertilizers. **Graphite** is composed of just carbon. It is an abundant native element that is best known as the “lead” in pencils. Its chemical resistance and high melting point make it ideal in metal casting and melting processes. It is also a common lubricant and used for some paints. Another native element made of just carbon is **Diamond**. Although coal is largely composed of carbon, diamonds do not form from coal deposits as depicted in many Superman cartoons and comic books. Diamonds form deep below the earth’s surface where there is great heat and pressure. Since graphite and diamonds are both made of pure carbon, they can completely burn leaving no residue behind. **Antimony** is rare so is not mined as a native element. Sulfides containing antimony are more abundant and mined for the element (see Cabinet 3—Sulfides). **Arsenic** and **Bismuth** also occur as native elements, but are too rare to be mined. Similar to Antimony, these elements are obtained by mining the sulfides that contain them in their chemical makeup.

## Cabinet 5—Phyllosilicates and Nesosilicates

The SiO<sub>4</sub> tetrahedra are linked in **Phyllosilicates** to form infinite layers. The Si/O ratio in the silicate layers is 2:5 with all the formulas ending in (OH). The largest group of phyllosilicates are the clay minerals, most of which are of economic importance. **Kaolinite** is used to make porcelain and is a filler material for making bricks, tile, and paper. **Montmorillonite** and **Vermiculite** are both very expansive and capable of absorbing large volumes of liquid. Montmorillonite has been used to absorb oil spills and as an absorbent in kitty litter. Another important group of phyllosilicates is the Talc Group. **Talc** is used as a lubricant, for talcum powder, and as a filler in paint, rubber, and paper. Perhaps the second largest phyllosilicate group is the Mica Group. These include **Muscovite**, **Fuchsite**, **Biotite**, **Phlogopite**, **Lepidolite**, **Margarite**, and **Zinnwaldite**. Micas are very important economically because of their low thermal capacity, non-inflammability and good dielectric properties. In addition to their use in the electrical industry, some micas are used as a filler in rubber and asphalt products. Before the invention of tempered glass, muscovite was used in wood burning stoves with thin, transparent sheets acting as a means to check on the fire. In Russia, some “books” of mica are so large, that the thin sheets were once used as window glass. **Lepidolite** is mined for its lithium content. The last group of phyllosilicates is the Chlorite Group. Although few minerals in this group are of economic use, many are prized by collectors because of their beautifully-colored crystals. These include **Cavansite**, **Apophyllite**, **Chrysocolla**, and **Prehnite**. **Sepiolite** is a very dull mineral but worldwide has been used in ornamental carvings and decorative tobacco pipes.

In the **Nesosilicates** the SiO<sub>4</sub> are isolated and are linked together by other cations. Most of the formulae for this group end with SiO<sub>4</sub> or a multiple of SiO<sub>4</sub>. There are several popular gemstone minerals in the nesosilicate group. **Peridot** is gemstone quality **Olivine**. **Garnet** is a somewhat generic term for several minerals. The most commonly used garnet gemstones are of the reddish-brown variety, and these include **Pyrope**, **Almandine**, **Spessartine**, and **Andradite**. **Grossular** and **Unvarovite** are prized when they have an emerald-green color. **Topaz**, like garnet is a birthstone and comes in blue, green, pink, yellow, and brown colors. **Staurolite** is occasionally used as a gemstone,

but it is prized by collectors because it is the only mineral that develops crystals naturally shaped as crosses. **Zircons** are used in gemstones, but they are usually heat treated to give them color. Zircon is the principal source of zirconium. Pure zirconium is used in the construction of nuclear reactors and crucibles because of its extraordinary high melting point. **Willemite** has been mined for zinc, and in a few areas, **Titanite** has been mined for titanium. Titanium is used to make high strength, light-weight steel. **Kyanite** is used in the production of porcelain and for spark plugs.

## **Cabinet 6—Sorosilicates, Inosilicates, and Tectosilicates**

The  $\text{SiO}_4$  tetrahedra in **Sorosilicates** are linked together in pairs. Most of the mineral formulae have  $\text{Si}_2\text{O}_7$  in them. Four of the Sorosilicate minerals are occasionally used as gemstones. **Tanzanite** is the mineral **Clinzoisite** and is very rare. It is an alternative birthstone, blue in color, and only comes from Tanzania. **Epidote** and **Vesuvianite** are green gemstones. **Danburite** is colorless or light yellow. **Hemimorphite** is not used as a gemstone, but it is valued by collectors due to its rich-blue color.

In **Inosilicates**, the  $\text{SiO}_4$  tetrahedra form infinite chains. Simple chains occur in the **Pyroxene** Group which have a SiO ratio of 1:3. Double chains occur in the **Amphibole** Group and have a  $\text{SiO}_4$  ratio of 4:11. **Jadeite (Jade)** is the most well known mineral in the Pyroxene group because it has been used for carvings for over a 1000 years. **Nephrite** is an amphibole, but has all the same properties as jadeite and is similarly used for carvings. The pyroxenes, **Diopside** and **Spodumene**, are occasionally used to make gemstones. Spodumene is more important as an economic source of lithium. The amphiboles, **Tremolite** and **Actinolite** are used for asbestos when in the fibrous form. They are also used for carvings and in early times, tremolite was used to make axes and other tools. **Hornblende** is one of the common minerals found in igneous and metamorphic rock, but unfortunately is of no economic value. **Astrophyllite**, **Babingtonite**, **Okenite**, and **Anthophyllite** are other amphiboles that have no economic use. **Wollastonite** is widely used in the ceramic industry and as a substitute for

traditional asbestos minerals. Finally, **Rhodonite** has a beautiful pinkish-red color and is commonly used for jewelry and carvings.

The **Tectosilicates** are perhaps the most abundant of the silicate minerals. In tectosilicates all four oxygen atoms of the  $\text{SiO}_4$  tetrahedra are shared with other  $\text{SiO}_4$  tetrahedra. The most simple of the tectosilicates are the various varieties of quartz where the formula is just  $\text{SiO}_2$ . The rest of the tectosilicates are aluminum silicates with calcium, magnesium, and/or potassium in the formulae, as well. The **Zeolite Group** also contain water ( $\text{H}_2\text{O}$ ) in the formulae. Zeolite minerals were considered rare until huge deposits were discovered relatively recently in former gas pockets within lava beds of the Deccan Plateau, India (see Cabinet 10). The zeolites commonly have colorful and unusual shaped crystal so are highly collectable. Examples displayed are **Analcime**, **Natrolite**, **Scolecite**, **Mesolite**, **Thomsonite**, **Mordenite**, **Heulandite**, **Stilbite**, and **Chabazite**. Some zeolites have economic use due to their absorbent properties. The **Feldspar Group** of minerals are very common, but unfortunately few have any economic use. Three are considered semi-precious stones for jewelry. These include **Moonstone** (iridescent **Sanidine**), **Amazonite** (green **Microcline**), and **Labradorite** (iridescent **Plagioclase**). **Microcline** from pegmatites is extensively mined to be used in porcelain production, enamel, and glass. Other feldspars include: **Albite**, **Anorthite**, **Anorthoclase**, **Orthoclase**, **Oligoclase**, and **Perthite**. Minerals of the **Feldspathoid Group** of tectosilicates are not as abundant as those in the Feldspar Group, but a couple are blue and commonly used for jewelry. These are **Lazurite** and **Sodalite**. **Nepheline** has been used to make glass and in the production of ceramics, leather, and textiles. **Leucite** also has some economic importance.

### **Cabinet 7—Varieties of Quartz (Tectosilicates)**

Quartz has a hardness of 7 and comes in many varieties representing every color in the spectrum. Most common is clear quartz, called **rock crystal**. Most of the great quartz specimens in America come from Mt. Ida, Arkansas. Herkimer, New York produces a unique form of rock crystal referred to as **Herkimer Diamonds**. **Amethyst** is purple quartz, and **Citrine** is yellow quartz. Brazil produces the best specimens with

both occurring in huge vugs that look like eggs similar to the one displayed. When sliced in half, they are referred to as “cathedrals. There is an amethyst cathedral in Cabinet 20. Imitation citrine can be made by “baking” amethyst. Imitation **Smoky quartz** can be produced by irradiating clear quartz. **Rose quartz** is relatively common in the western United States, but good quality blue quartz is relatively rare. **Tigers Eye** is a variety of quartz with a small component of asbestos minerals to give it the shimmer. **Agate** is a banded form of the chalcedony variety of quartz and is usually slightly blue. **Onyx** is also a banded variety of quartz, but is most often various shades of yellow. **Jasper** is brown to blood red quartz, and **Adventurine** is a green variety. **Chrysoprase** is also green but is quite rare. **Opal** is a prized variety of quartz with mystical iridescence. Very seldom is it clear or faceted. Finally, **chert** and **flint** are forms of quartz. Although never used for jewelry, they are the material used by early humans and native Americans to make most arrowheads and stone tools. Chert is most commonly found in layers or nodules within limestone beds so it is very abundant in Tennessee.

### **Cabinet 8—Cyclosilicates, Borates, Phosphates, Arsenates, Chromates, Molybdates, and Vanadates**

The  $\text{SiO}_4$  tetrahedra in **Cyclosilicates** are linked together to form rings. The Si/O ratio is 1:3 or multiple of that like 3:9. **Beryl** is likely the most known cyclosilicate as it is the gemstone called **Emerald** when green, and **Aquamarine** when blue. **Morganite** is the rose beryl used for gemstones and **Heliodor** is the golden-yellow gemstone variety. **Dravite** and **Elbaite** are other beryl minerals. Beryl of non-gemstone quality is useful for various alloys, particularly copper, and it is used for neutron reflectors in nuclear power facilities. The most famous emerald mines occur in Columbia and Brazil. **Tourmaline** is another important gemstone. **Rubellite** is the pink to red variety and **Verdelite** is the green form of the mineral. Also prized is “**watermelon**” **tourmaline** which is usually green on the outside and purplish-red in the middle. Incredible tourmalines are being uncovered in North Carolina and California, as well as, Brazil, Sri Lanka, and Madagascar.

**Borates** are a small group of minerals that all have some form of the BO radical in their formulae. **Borax** is the most common. Most of the borates are associated with borax deposits which form from evaporating salt lakes. Numerous deposits occur in arid areas of the United States. **Ulexite** has fibre optic properties and is commonly sold in gift shops as “**TV Stone**”. **Colemanite** is another important source of boron which has many uses. It is used for medical products, soaps and detergents, enamels in textiles, non-flammable products, rocket fuel, and has a hardness comparable with diamond when combined with nitride.

**Phosphates** are a small group of minerals that all have PO<sub>4</sub> in their formula. **Apatite** is the most common and is the primary ore for phosphate used for fertilizers. It is also a minor gemstone. **Turquoise** is a well known phosphate because it is a birthstone. **Wavellite** is a rare phosphate mineral, but is prized by collectors because of its wonderful green color and crystal form. **Variscite** is very rare and also is highly desired by mineral collectors. It is green and usually displayed in polished slabs. **Pyromorphite** and **Amblygonite** are the only other phosphates in the Museum. Pyromorphite is of minor importance as a lead ore.

**Arsenates** have AsO<sub>4</sub> in their formulae and **Vanadates** have VO<sub>4</sub> in theirs. They are both very small groups of minerals. **Mimetite** and **Erythrite** are the only two arsenates at the Museum. Mimetite is valued by collectors due to its beautiful yellow crystals. **Vanadinite** is our only vanadate mineral. It is prized for its beautiful red crystals, but is too rare to be a source of vanadium or lead. **Wulfenite** is the Museum's only **Molybdate** (MoO<sub>4</sub>), and **Crocoite** is our only **Chromate** (CrO<sub>4</sub>). Wulfenite forms exceptional yellow crystals and crocoite forms deep red crystals. Both are rare and highly valued by collectors.

## **Cabinet 9—Oxides, Hydroxides, and Meteorites**

**Oxides** are a large group of minerals that all have O at the end of their formulae. Many of the oxides are our most important source of metals. Others are used as valuable gemstones. **Hematite** and **Magnetite** are two important iron ores. **Ilmenite** is the primary ore for titanium. **Rutile** is another source of titanium, and it is used as a coating

for welding rods. **Pyrolusite** is the principal ore for manganese which is used in steel production, electric batteries, and as an oxidizing medium in the production of chemicals. **Cassiterite** is the primary mineral for tin which is used for roofing materials, tinplating, bronze, and solders. **Uraninite** is the principal source for uranium which is used for nuclear fuel and unfortunately, bombs. **Chromite** is the only ore for chromium which is used for chrome plating, stainless steel, pigments, and in the tanning of leather. Chromium is very deadly to humans when in the plus 6 ionic state. Waste products from the above industrial processes have contaminated many areas in the United States and throughout the world. **Zincite** and **Franklinite** were once important zinc ores mined in the Franklin, New Jersey area. The source has been depleted, but these two minerals and the calcite associated with them produce some of the most incredible fluorescent rocks in the world. This can be seen in our “**Blacklight Room**”.

**Rubies** and **Sapphires** are the oxide mineral called **Corundum**. The most famous locations for the finest examples of these gemstones are in some of the world's most politically troubled spots. These include Myanmar (formerly Burma), Sri Lanka, Cambodia, Kashmir, India, and Thailand. When not of gemstone quality, corundum is one of the most important sources for abrasives. It is referred to as “emery”. **Chrysoberyl** is another oxide and is prized as the gemstone called **Alexandrite**.

**Hydroxides** all have OH at the end of their formulae. **Geothite** is an important iron ore. **Brucite** is a source of magnesium and used in refractories. **Manganite** has never been found in sufficient quantities to be mined for manganese.

The Museum only has a few small examples of “**Extraterrestrial Rocks**”. **Meteorites** are of three common types: **Iron, Stony, and Stony-Irons**. Iron meteorites are composed of nearly all iron as the name suggests with 5 to 20% nickel. Stony meteorites are largely silicate minerals with inclusions of other minerals. Stony-irons are a mixture. **Tektites** are small natural glass rocks that most geologists believe formed by the impact of large meteorites. They are usually black or greenish-black and were first described by Darwin. We have examples from Thailand and Vietnam, but Australia is one of the most important sources of tektites and meteorites.

## **Cabinet 10—Minerals Mined for Iron, Minerals Mined for Copper, and Minerals of India**

Humans left the Stone Age when they learn to fashion tools, dishware, and many other items from iron and copper. As a result, the minerals rich in these elements have been mined for thousands of years. Iron is usually mined from the minerals **Hematite**, **Goethite**, **Magnetite**, and **Limonite**. Native copper deposits were once mined, but they are essentially all depleted. Today, **Malachite**, **Azurite**, **Bornite**, and **Chalcopyrite** are the primary ores for copper. Other iron and copper minerals are mined where they are locally abundant. These have been mentioned previously.

This cabinet also presents a display of some top quality minerals from the Deccan Plateau of India. At the end of the Cretaceous Period (about 65 million years ago), there was a three million year period of massive outpourings of basaltic lava that formed what we now call the Deccan Plateau. Many geologists believe that the gases emanating from this long period of volcanism are actually what led to the gradual extinction of the dinosaurs, not a meteor impact (which did happen at the very end of the Cretaceous). Large vugs and cavities formed in the lava flows as gases escaped during the solidification process. Later, hot hydrothermal waters moved through the lava flows and former gas pockets. As the waters cooled, minerals were deposited along the linings of the pockets. The **amethyst** “eggs” of Brazil formed in a similar manner, and the same time in geologic history. Although common quartz minerals formed in the Brazilian lava flows, much more exotic and rare minerals formed in the Indian flows. Examples of these are **Scolecite**, **Apophyllite**, **Stilbite**, and **Gyrolite**.

## **Cabinet 11—Crystal Forms**

The beauty of crystal form is what allures many people to become mineral collectors. The study of Crystal Forms falls under a branch of Mineralogy called Crystallography. A majority of geology students find it the most difficult field to understand during their academic career. Basically, crystallography deals with the symmetry of crystals, their internal structure, and the chemical and physical properties that are determined by their structure. To better classify crystals based on the geometry

and symmetry of the crystal faces, mineralogists have developed seven groups of crystal forms. A large number of crystals are in the **Isometric** or **Cubic** group which has five crystal classes. The simple cube shape is very common, but versions of this, such as octahedron and dodecahedron, often exist. Galena, halite, pyrite, and fluorite often show the cubic shape. Garnets commonly have a dodecahedron shape as do pyrite crystals. The **Trigonal** group also has five classes with calcite and quartz being the most common minerals in this system. Calcite can have a large variety of crystal shapes but the rhombohedron and “dogtooth spar” shapes are the most frequently seen. Rubies, sapphires, and tourmalines also have crystal shapes in the Trigonal group. Emerald and aquamarine crystals fall under the **Hexagonal** Group. Many platy minerals like the Mica Group are **Monoclinic** as are many fibrous ones like the group of minerals we referred to as asbestos. There are a number of minerals that are called clay minerals, and these are all in the **Triclinic** Group. Finally, the **Tetragonal** Group has varieties of the prism shape and the pyramid form. Apophyllite, cassiterite, and rutile are example minerals in this class.

### **Cabinet 12—Mineral Miniatures**

Some “rockhounds” prefer to collect small mineral specimens showing a perfect crystal form. These are referred to as Miniatures. This fine collection was donated by Dr. Aaron Todd, a former chemistry professor at MTSU.

### **Cabinet 13—Sedimentary, Igneous, and Metamorphic Rocks**

Rocks are classified based on the environment in which they formed. Sedimentary rocks formed as deposits, usually on sea bottoms. These also form at the bottom of lakes and occasionally accumulate in large inland areas that are undergoing large-scale crustal sinking. This is occurring today in areas of our Basin and Range Province which primarily occurs in Nevada. Sandstone and shale usually form in large delta areas while the various types of limestone form in warm, shallow seas with coral reefs like in the Bahamas today. Igneous rocks formed from the cooling of molten rock called “magma”. There are two types of igneous rocks: those that solidified on the earth’s surface (extrusive) and those that formed deep in the earth’s crust (intrusive).

Extrusive rocks cooled so quickly that the crystals had little time to grow and are thus very small. Basalt and rhyolite are two of the most common extrusive igneous rocks. Intrusive rocks cooled slowly inside of the earth and, as a result, have larger crystals. Granite is the most common intrusive igneous rock. Metamorphic rocks form by great heat and/or pressure, but not melting. These metamorphic processes change pre-existing rocks into a new rock type. Limestone is metamorphosed to marble, shale to slate, granite to gneiss, etc. The metamorphic processes have produced some of our most treasured gems like rubies, emeralds, and diamonds.

### **Cabinet 14—Fossil Leaves**

This cabinet displays a variety of fossil leaves. Some are as old as Pennsylvania Age (286 to 320 million years ago). This is the age of the rocks of the Cumberland Plateau. There are also leaves of Eocene Epoch which spanned the time from 37 to 58 million years ago. The sand, silt, and clay deposits of much of West Tennessee are Eocene in age. Most fossil leaves are the result of trees falling and being buried in ancient swamps associated with river deltas. The petrified wood of Tennessee formed in similar environments. The leaves displayed from Colorado, though, are believed to have been buried at the bottom of large lakes that once covered parts of Colorado and Wyoming.

### **Cabinet 15—Land and Sea Fossils**

This cabinet displays some of the more rare fossils such as the sea scorpion from New York, crabs from Washington State, and insects from Italy, Wyoming, and Colorado. The fossil insects shown from the United States came from the Green River Formation which is the same lake deposit described for some of the leaves above and the fossil fish in this cabinet and described in Cabinet 16. There are also Tertiary-aged sharks' teeth and a Woolly Mammoth vertebra from South Carolina.

## **Cabinet 16—Fossil Fish**

Fossil fish are relatively rare, but they are very abundant in Lincoln County, Wyoming. These fish once lived in large, shallow lakes during the Eocene Epoch. It is believed that the series of subsiding lakes began to dry up as earth's temperature warmed and oxygen levels dropped leading to a massive die-off of fish. This occurred over a six million year period. The fish were buried in deposits of thin, shaly, lake sediments now referred to as the Green River Formation. Most of the fish-bearing beds crop out in the Badlands National Park and are thus preserved. There are areas outside the park where you can pay and dig for the fossil fish. One of the displayed fish (upper left) is the State Fossil of Wyoming. The fish in this display were donated by Antares Fossils and Minerals.

## **Cabinet 17—Mixture of Minerals and Fossils**

Madagascar has become famous for its Cretaceous-aged ammonites that they cut in half and polish. Most are only a few inches in diameter, but we were able to obtain a spectacularly large specimen. Morocco has also become famous for its cephalopods and ammonite fossils, and they too, often polish them. The country has also become well known for its trilobites. It is not common to find both the cast and mold of a trilobite as is displayed in this cabinet. Minerals displayed in the cabinet include a beautiful specimen of blue fluorite from New Mexico, a splendid combination of pyrite and sphalerite from China, and an exceptionally large specimen of aragonite clusters from Morocco.

## **Cabinet 18—Mixture of Minerals and Fossils**

The Museum was fortunate in obtaining an actual Mesosaurus skull from Morocco. This reptile once lived in Cretaceous-age seas 65 to 145 million years ago. Such a sea once existed in west Tennessee during that geologic age, and certainly many Mesosaurus's swam about. Also, on display in this cabinet are a real Woolly Mammoth and Mastadon tooth found right here in Rutherford County. They were found recently by Marbry Hardin, a former geology student at MTSU. The exact location of the discovery

is being kept a secret from the public until a means of preserving the site can be found. As mentioned earlier, Morocco is famous for its cephalopods, and this cabinet has some spectacular specimens displayed. Mineral specimens on display include a large pyrite cluster from Peru and a beautiful array of Sphalerite, pyrite, and quartz from China.

### **Cabinet 19—Minerals of Tennessee**

Tennessee is home to many more mineral varieties than displayed in this cabinet, but these are from the world famous Elmwood Mine locality. The Elmwood Mine is now part of a much larger zinc mine that has over 300 miles of tunnel in the Carthage area. Parts of the mine go under Al Gore's farm. Most of the tunnels are 1000-1400 feet below the surface. Beautiful amber-colored calcites, purple fluorite, barite, and sphalerite crystals are found in vugs and small cavities in an Ordovician-aged (505 to 438 million years ago) dolomite. The zinc (sphalerite) and other minerals are believed to have formed as hot, hydrothermal waters rich in zinc, barium, fluorine, and exotic elements moved through the formerly deposited, karstified rock. The calcite and fluorite specimens are of such exceptional quality that they are featured in most mineral description guidebooks. The displayed minerals were donated by Dr. Albert Ogden, Professor of Geology at MTSU and Museum Curator.

### **Cabinet 20—Selected Large Mineral Specimens**

This cabinet displays some fine examples of selected mineral specimens. This include a stalactitic version of malachite from Zaire, smoky quartz from Arkansas, an amethyst "cathedral" and "egg" from Brazil, fluorite and barite from Tennessee, and a mixture of apophyllite and stilbite from India. The cabinet also displays an exquisite fern fossil from the anthracite coal region around St. Clair, Pennsylvania. During the Pennsylvanian age from 286 to 320 million years ago, much of the earth's surface was covered by warm swamp whose decaying deposits would some day become coal. As a result, most of the world's coal deposits such as those of Tennessee, Kentucky, West Virginia, and Pennsylvania are of Pennsylvanian age.

## **Cabinet 21—Fossils of Morocco**

As mentioned previously, Morocco has recently become one of the most prolific locations for fossils that they often polish. Extraordinary examples of polished, round cephalods and straight ammonites can be viewed in this cabinet. In addition, there are two exceptionally large trilobites and a mold and cast of another trilobite. Also, there is the jaw plate and teeth of an actual Cretaceous-aged Mososaur.

## **Cabinet 22—Birthstones**

In the 1930's, the British and U.S. jewelry industries assigned stones to the months of the year as a ploy to increase sales. The public embraced the scheme, and there have been only minor modifications to the "birthstone" assignments since then. Birthstones are a variety of precious and semi-precious minerals that as a group are often referred to as "gemstones". Most gemstones have been chosen based on their hardness, brilliance when faceted, and/or rarity. **Diamond** is the hardest mineral (hardness 10 on the Moh's Hardness Scale), but is actually less rare than equal quality and sized emeralds and sapphires. The high cost of diamonds is a result of a single company controlling nearly all of the world's supply and distribution. **Sapphires** and **Rubies** are both the mineral corundum which has a hardness of 9. **Emeralds** and **Aquamarines** are two varieties of beryl which has a hardness of 8. Diamonds, rubies, emeralds, and sapphires can be laboratory created and in recent years tiny impurities have been purposely placed in the "grown" stones to fool even the most trained eye. **Alexandrite** is a gemstone variety of chrysoberyl and has a hardness between 8 and 9. **Tanzanite** is a member of the **Epidote** group and is very rare being found only in Tanzania. It has a hardness of 7. **Turquoise** rarely forms crystals and generally is not faceted. It has a hardness of only 5 to 6. It is of igneous in origin with some of the best deposits being found in Australia, New Mexico, and Iran. Turquoise and tanzanite are both considered birthstones for the month of December. **Topaz** is most commonly blue, but several others colors, such as pink and green, occur. It has a hardness of 8 and is of igneous origin. Some exceptionally large topaz crystals have been found in Brazil and Russia, but deposits also occur in Colorado and Utah. **Citrine**, which is yellow quartz, is also an accepted birthstone for the same month as topaz. **Garnets** actually are a group of five different

minerals all having a hardness of 7. They are usually a dark, reddish color and very common. A beautiful green variety called **Uvarovite** is found in Russia. **Peridot** is the gemstone variety of **Olivine**. It is relatively common and can be of either igneous or metamorphic in origin. It has a hardness of around 7. **Amethyst** is the purple variety of quartz and is very common. It has a hardness of 7. Some of the world's largest deposits occur in "pockets" in the ancient lava flows of Brazil. Finally, the last birthstone, **Pearl**, is actually not a mineral. Since an oyster or muscle is involved in the formation of a pearl, it does not fit the strict mineral definition of being "naturally" occurring. Muscles from the Tennessee River are famous for their pearls. White and black Tennessee pearls are displayed in the cabinet.

### **Cabinet 23—Jewelry Made from Semi-Precious Stones**

Semi-precious stones come in many colors and can be used to make beautiful and affordable jewelry. This display shows necklaces, bracelets, and carved stone hearts made from a variety of semi-precious stones. Many are varieties of quartz such as Tiger Eye, Amethyst, Goldstone, Adventurine, and Onyx. There is no gold in Goldstone. It is shiny due to all of the tiny, incorporated flakes of muscovite mica. Snowflake obsidian is actually volcanic glass with impurities. Malachite is also a favorite stone for jewelry because of its beautiful green color and banded nature. Malachite is too soft to facet and is rarely clear. The necklaces were made and donated by Ethel Ogden. The bracelets and stone hearts were manufactured commercially in China.

### **Cabinet 24—Dishes, Bowls, and Serving Platters made from Moroccan Polished Fossil-Bearing Rocks**

In recent years, the Moroccans have begun to mine their huge deposits of fossil-laden Devonian-aged (360 to 408 million years ago), limestone rocks. World class trilobites have been unearthed, as well as, giant ammonites and cephalopods. Two large polished straight ammonites from Morocco are displayed on the wall as are three large trilobites. The Moroccans soon learned that there could be a market for these same rocks when polished and formed into various types of dishware. Each piece is handmade so no two are alike. They also have used these same rock beds to make coffee tables, counter

tops, and floor tile. The material is relatively soft and easily scratched so usually is given a protective coating.

### **Cabinet 25—Figurines Made from Minerals**

Figurines have been carved from minerals for thousands of years. The Chinese have particularly prized jade and once believed that it has medicinal powers when worn or ingested. Jade can be either the mineral Jadeite or Nephrite. There are three grades of jade. Grade A is natural jadeite. Grade B is bleached, and then treated with plastic or waxes. Grade C has been dyed and/or impregnated with plastic or wax. Grades B and C are much softer and less expensive. Onyx is another common mineral used for carving figurines. True onyx is a banded variety of quartz/agate, and thus, too hard to carve. The name is incorrectly applied to banded calcite, called travertine, which is soft and easily carved. Most onyx figurines sold in U.S gift shops have been mined from old hot spring deposits of travertine and carved in Mexico. Soapstone is the mineral talc and is soft and easily carved. Fluorite is usually purple. In recent years, Chinese figurines carved from fluorite have been imported into the United States. One of the displays depicts a grapevine bush made of jade leaves with carved fluorite grapes.

### **Cabinet 26—Replicas of Dinosaur Skulls, Teeth, and Claws**

Every fossil in the Museum is real except for those displayed in this cabinet and the **Raptor** and **Ichthyosaur** on the walls. The Raptor and Ichthyosaur replicas are actually antiques that are life size casts of the real specimens on display at the American Museum of Natural History in New York City. These casts were made over 50 years ago and then taken to an artisan in Florida to paint them to appear the same as the originals. On the top shelf of the cabinet, we have a one-quarter size replica of a **T-Rex** and **Triceratop** skull. Also on display are actual size replicas of a baby **Pterdactylus** of Jurassic age (208 to 144 million years ago) and a **Pachypleurosauros** of Triassic age (245 to 208 million years ago). Both of these replicas are casts of the originals that are housed in European museums. Other replicas on display are the actual size specimens of an **Albertosaurus** claw, a **T-Rex** tooth, and a **Saber Tooth Tiger** tooth. The saber tooth tiger lived during our Ice Age (Pleistocene) which started slightly less than two million

years ago. We presently are in an inter-glacial period of earth warming and will return to an ice-age in about 45,000 years or so.

### **Cabinet 27—Jewelry and Jewelry Material**

This cabinet displays the beautiful silver-smithing and cabochon making of Bill Buckner and some wonderful sliced and polished Tennessee Paint Rock Agate on loan from Kenneth Swann. Agate is our state mineral. Kenneth Swann and Bill Buckner have been long time members of the Mid-Tennessee Gem and Mineral Society that holds its monthly meetings right here in Murfreesboro the 3<sup>rd</sup> Thursday of every month at 7:30pm in the lower floor of the Farm Bureau Building at 818 S. Church Street. The Society has generously provided our best geology student(s) with a small scholarship for many years. Since the Museum was founded, the scholarship has been given to a geology student(s) who has performed outstanding work at the Museum. Plaques dedicated to these students and the Society can be found on a Museum wall.

### **Cabinet 28—Crush Ore Samples, Cabochons, and Other Cool Stuff**

Many minerals are mined for a particular element such as iron to make the things we use in our daily life. This cabinet displays some of them that have been crushed, refined, and ready to produce useful products. Examples include halite used as table salt, asbestos for fire fighting gear and brake linings, hubuerite for tungsten light bulbs, and nickel for steel production and coins. Also displayed are beautiful amber calcite filled clams shells from the Ft. Drum Crystal Mine in Florida. There are also a number of cabochons made by Onsby Hammons, wife of Ernest Hammons. Ernest Hammons donated a large collection of invertebrate fossils, the best of which are displayed in cabinets 14, 31, 32, 43, and 44. A big specimen of quartz and pyrite from Morocco can be viewed in the case, as well as, a pyrite specimen on shale found in a coal mine in Illinois. The pyrite is quite unusual as it looks like a pyritized sand dollar, which it is not.

## **Cabinet 29—Fossils of Tennessee**

Throughout a significant portion of geologic time, Tennessee was covered by a warm, shallow sea. Throughout the Cambrian (540 to 505 million years ago) through Permian (286 to 245 million years ago) ages, Tennessee was located near the equator and was part of a supercontinent called Pangea. Pangea began to split apart during the next geologic period (Triassic) and the continents continued to drift apart to give us the configuration we see today. At the end of the Pennsylvanian age (320 to 286 million years ago), Tennessee began to rapidly rise out of the ocean and by the Permian, the Appalachian Mountains began to form. As a result, we do not have any sedimentary rocks of Permian, Triassic, or Jurassic age as there were no oceans in Tennessee for deposits to accumulate and later be turned into rock. Since most of Tennessee was under a warm, shallow sea from the Cambrian to the end of the Mississippian age (360 to 320 million years ago), there were many reefs like around the Caribbean islands today. Reefs, and sediments associated with them, form the mineral calcite which is the main component of limestone. Therefore, most of the rocks of these geologic time periods are limestone containing fossils expected to be found in a tropical reef environment. These include **brachiopods, cephalopods, coral, crinoids, blastoids, trilobites, gastropods, starfish,** and **echinoderms**. This cabinet displays some of the finest Tennessean examples of these sea creatures. The cabinet also displays some Tennessee vertebrate fossils of much more recent age. We have Pleistocene-aged (Ice ages) **bison teeth** and either a **mastodon** or **woolly mammoth vertebrate** found right here in Rutherford County. There is also a **horse tooth** found in Cannon County that is likely Pliocene in age. Horses in the United States were once very small like the size of big dogs and became extinct by the Ice Ages. Horses did not come back to American until they were brought from Europe by our early settlers.

## **Cabinet 30--Dinosaur Material, Woolly Mammoth and Cave Bear Teeth**

The crocodile may be the closest animal alive today that could be considered a dinosaur. Crocodiles existed throughout the dinosaur era, and on display is a **Pelagosaurus** skull from Morocco. Pelagosaurus was a sea crocodile that thrived largely on a fish diet and became a common species throughout the Cretaceous period (144 to 66 million years ago). Also on display is a **Hadrosaurus** egg from China. Hadrosaurus was a large duck-billed dinosaur as the picture in the cabinet shows. It was a very common herbivore during the Cretaceous period. The cabinet also contains a Cretaceous-aged **Carcharodontosaurus** vertebrae found in north Africa. Carcharodontosaurus was a gigantic carnivore the size of a T-Rex as the picture shows. The name actually means “shark lizard” which refers to its large, jagged teeth. We also have a several dinosaur and amphibian footprints in the cabinet. Rarely do you find the mold and cast of a footprint, but we have one of a **Grallator** that once roamed throughout Maine during the Jurassic period. Grallator was a fierce bipedal theropod dinosaur the size of the better known raptor. The cabinet also has a footprint of the Pennsylvania-aged amphibian called **Attenosaurus** and the footprints and tail drag print of a similar aged amphibian called **Xiphosaurus**. There are also several small prints of a small amphibian called **Cincosaurus**. The Attenosaurus was a common alligator-sized amphibian of the period. Xiphosaurus and Cincosaurus were the size of a large salamander. Both of these fine amphibian footprint examples come from the Union Chapel Fossil Site near Jasper, Alabama, and where donated by Milo Washington of the Alabama Paleontological Society. The site was considered so important to be preserved that the land was purchased by the Alabama State Lands Division in 2004. The cabinet also displays some really good examples of **coprolites**. Coprolites are dinosaur “pooh”. Also on display are two **woolly mammoth** teeth donated by the author and a large necklace made from big chunks of amber that are filled with insect fossils like seen in the movie, Jurassic Park. Perhaps the rarest pieces in this cabinet are **the fossilized turtle, turtle egg,** and **Hyrachodon** jawbone. Finally, there are some Romanian **cave bear teeth** from the Pleistocene (1.8 million to 10,000 years ago—The Ice Ages).

### **Cabinet 31—Trilobites from the Hammons Fossil Collection**

**Trilobites** were hard-shelled, segmented arthropods that existed from the Cambrian through the Permian. They are considered to be the first animals to have developed eyes. Most were small and believed to be free floating animals while the mid-sized ones likely walked the sea floor filtering mud to obtain food. The largest trilobites are believed to have been swimming predators. Fossil enthusiasts seem to love collecting trilobites more than perhaps any fossil sea creature. This was definitely the case for Ernst Hammons. This cabinet displays some of his best examples.

### **Cabinet 32—Crinoids from the Hammons Fossil Collection**

**Crinoids**, also known as sea lilies, look like plants, but they are actually animals of the echinoderm phylum. The earliest crinoids are of Ordovician age (505 to 438 million years ago), but they still exist today. Crinoids usually have a stem used to attach themselves to a substrate, but many live attached only as juveniles and become free-swimming as adults. Usually, only pieces of the stem are found as fossils. Small individual segments are often referred to as “Indian money”. The top portion of a crinoid is called the **calyx**, and these are rarely found and thus treasured by collectors. Ernst Hammons was able to gather a collection of some of the finest crinoid calyx you will ever see. The Museum is very fortunate to have obtained these incredible specimens.

### **Cabinet 33—Variety of Minerals**

This cabinet displays a variety of minerals specimens. A local quartz geode specimen from Woodbury is on display as well as an exceptionally nice cube of blue fluorite from New Mexico. There are also specimens from Belgium, Finland, and Germany.

### **Cabinet 34—Minerals of Peru**

During the last two decades, Peru has steadily increased the exportation of fantastic specimens that combine combinations of rhodachrosite (pink), pyrite (gold), tetrahedrite (black), quartz, and sphalerite (yellowish-brown). Peru is also known for supplying large cubes of pyrite and clusters of quartz. This cabinet displays some exquisite examples of these mineral assemblages.

### **Cabinet 35—Variety of Minerals**

This cabinet displays a wide variety of minerals from several states and four countries. There is a calcite, an unusual stalactitic version of hematite from Mexico, smithsonite from Spain, nice Brazilian amethyst, lepidolite specimens, and native crystalline sulfur from Bolivia. In addition, there is an iolite specimen from Sweden, a calcite and quartz specimen from China, German specular hematite, and an example of selenite gypsum from Morocco.

### **Cabinet 36—Minerals of China and New England**

Like Peru, China only recently opened its door to exporting mineral specimens. Kevin Downey, a dealer of Chinese minerals, donated the beautiful specimens in this cabinet. Green fluorite was considered very rare until a large deposit was discovered in China. We have some excellent examples. Also, China is producing some of the greatest stibnite crystals found anywhere in the world. In addition, the country is exporting fine specimens of quartz, calcite, cinnabar, and realgar crystals. Mr. Downey also donated some great specimens from New England which is where he resides and does personal collecting. These minerals include tourmaline, green beryl, prehnite, and Herkimer “Diamonds”. Herkimer diamonds are actually single quartz crystals. It is very rare to find one as large as displayed in this cabinet.

### **Cabinet 37—Variety of Minerals and some Fossils**

This cabinet is another display of different minerals with a couple exceptional fossils. There is a great example of Eocene (58 to 37 million years ago) **leaves** and Silurian-aged (438 to 408 million years ago) **worm burrows**. In addition, there are two different minerals that are generically called asbestos. There is also a barite and celestite specimen from Nashville.

### **Cabinet 38—Australia, India, and Other Mineral Specimens**

This cabinet displays some wonderful and delicate selenite gypsum specimens from Australia. There are two other crystalline varieties of selenite gypsum from Morocco. There are also some large mineral specimens from India and a great example of malachite and chrysocolla from the Congo.

### **Cabinets 39 and 41—Minerals from the Lewis F. Elrod Collection**

These two cabinets hold truly exquisite mineral specimens on long term loan from Lewis Elrod. Lewis was a co-founder of the Middle Tennessee Gem and Mineral Society (MTGMS). The MTGMS is a club member of the American Federation of Mineralogical Societies of which Lewis was a past president. Lewis, his wife, Anna, and many other club members have provided this Museum with important advice and long-term loan of specimens. For more information about the club, visit their website ([www.mtgms.org](http://www.mtgms.org)).

### **Cabinet 40—Calcites from the Elmwood Mine, Tennessee and Other Minerals**

Large, single crystals of amber-colored calcite are rare. Some of the finest examples in the world are found at the Elmwood Zinc Mine beneath Carthage and the surrounding areas of Tennessee. There are also specimens from six countries in this cabinet including Cuba. These include serpentine from Siberia, quartz from Italy, galena from Hungary, stibnite from China, and smithsonite from Germany. There is also an incredible Wulfenite specimen from Arizona. This is our only example of a molybdate

mineral. Molybdate minerals all have MoO<sub>2</sub> at the end of their chemical formula. There are very few molybdate minerals, and they are quite rare.

### **Cabinet 42—Variety of Minerals**

This cabinet also displays a large variety of mineral specimens. Most were donated by Vanderbilt University. Our only specimens from Ducktown, Tennessee are shown here. Ducktown is located on Tennessee's border with North Carolina in the headwaters of the Ocoee River, which is famous for its white-water rafting. Ducktown was once the center of a major copper-mining district from 1847 into the 1970s. The district also produced iron, sulfur, and zinc as byproducts. When the rich, shallow ore was depleted in 1878, a new company began deep mining and used an "open roasting" technique to extract the copper and iron. As a result, large quantities of sulfur dioxide were released that produced acid rain, killing much of the vegetation in the immediate area and into neighboring North Carolina. At one time, the area was as barren as a desert and a true environmental disaster. This led to the first interstate environmental law suit in the United States that set the precedent for future environmental laws that protect our health today. Also on display, are the only Maryland specimen (orthoclase) and our only Vermont specimen (chalcopyrite).

### **Cabinet 43—Ammonite and Cephalopod Fossils**

**Cephalopods** are a very complex variety of mollusks represented today by chambered nautilus, squids, and cuttlefish. Cephalopods are divided into two subclasses: **Nautiloidea** which have straight or gently undulating sutures and **Ammonoidea** which have more complex sutures. Cephalopods first appeared in the Cambrian period, but became particularly large and abundant during the Cretaceous period. Straight cephalopods are common fossils in the Ordovician rocks of Tennessee. This cabinet displays both straight and coiled cephalopods and a modern day example from the Philippines. On the wall next to the cabinet are two very large, polished ammonites from Morocco. Imagine the size of the squid-like animals that once lived in these shells!

## **Cabinet 44-Blastoids, Starfish, Trilobites, Gastropods and other Fossils**

This cabinet displays more of the fossils from the Ernst Hammons collection. Fossilized **starfish** are really rare, but we have some fine examples. **Sea urchins** are round echinoderms that have been around since the Ordovician period. The spines which can inflict painful wounds are usually not found. The oldest **sand dollars** are found in Jurassic period rocks. They are a flat, round echinoderms related to sea urchins. **Blastoids** are Paleozoic echinoderms that had a stem and attached cup referred to as the calyx. Although not particularly rare, seldom do you find as good as examples as displayed in this cabinet. Several of the displayed blastoids were found in Tennessee. **Stromatolites** are laminated accumulations of calcium carbonate formed by marine algal mats. They are the oldest macro-fossils and found in ancient PreCambrian rocks over a billion years old. Stromatolites are still being formed today by marine algae living in hot, shallow intertidal environments. Shown are an Ordovician example from east Tennessee and a polished example from an unknown location. **Gastropods**, another group of mollusks such as the cephalopods shown in Cabinet 43, are also displayed here. Gastropods first appeared in the Lower Cambrian and evolved into a spiral coiled shell by the Ordovician. They quickly gained shapes similar to the snails living today. There are also some large **peleypods** (clams) and brachiopods on display.

## **Cabinets 45 and 46—Fluorescent Mineral Specimens**

Mineral fluorescence is caused by the molecular absorption of a photon that triggers the emission of a photon with a longer wavelength. In these cabinets, the absorbed photon is in the ultraviolet range, and the emitted colored light is in the visible range. These two cabinets display a variety of relatively ordinary looking rocks that fluoresce beautiful colors under a black light (ultraviolet light). Only a few minerals fluoresce, but some are common such as calcite, fluorite, and amber. Rubies, emeralds, and some diamonds exhibit red fluorescence under short-wave UV light. Cabinet 45 uses a short-wave UV light source. Short-wave UV lights are expensive due to the filter necessary for eye protection. Without this filter, short-wave UV lamps are used to kill fungus in home duct works and bacteria in some water purification systems. Most of the

minerals in Cabinet 45 are somewhat rare as the fluorescent varieties come almost exclusively from old zinc mine spoil piles in Franklin and Ogdensburg, New Jersey. These include Franklinite, willemite, and zincite. Most of the specimens were donated by Kenneth Swann. There are also fluorescent varieties of calcite and fluorite in the cabinet.

Cabinet 46 uses the inexpensive, long-wave UV light source that can be readily purchased to “light up” blacklite posters. The minerals that fluoresce blue in this cabinet are mostly yellow fluorite from Morocco. Most of the yellowish fluorescent minerals are calcite in fossil clams collected at the Ft. Drum Crystal Mine in Florida. The reddish-pink figurines are made of Mexican onyx which is a variety of calcite. The minerals in this cabinet were donated by Albert and Ethel Ogden.