Introduction to Fluorite

By Bob Jones for *"Rock & Gem"* magazine, reprinted by permission.

Fluorite, Annabel Lee Mine, Hardin County, Illinois
B. Britt collection

Fluorite was the theme mineral for the 1998 Tucson Gem and Mineral Society Show, often called The Main Show, during Tucson's February mineral extravaganza. It was selected for a variety of reasons It is colorful, it seems to be ubiquitous, it is found in large groups of lovely crystals, it has played a significant role in the science of mineralogy, and specimens are within the reach of most collectors. Fluorite is certainly the most attractive mineral to be found in the Swiss and French Alps, explaining why alpine minerals were chosen as a companion locality theme at the TG & MS show.

Since color is one of fluorite's most appealing traits, it might be wise to discuss that property of this calcium fluoride. It occurs in a whole range of colors. Its color never seems intense; rather, it displays delicate tints and hues in most cases. It can be violet to purple, pale blue, a soft to strong yellow, verdant to emerald green, even brown or black. Pure fluorite is colorless, so something is going on in the structure of the fluorite molecules to cause this range of color.

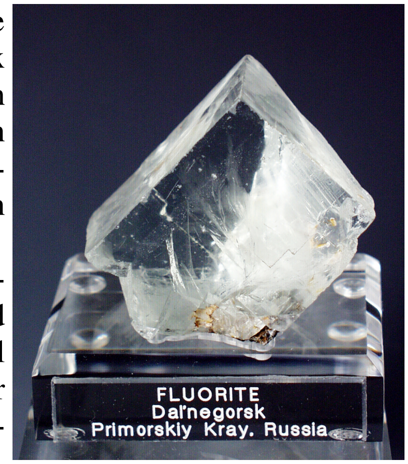
Fluorite, New Mexico
B. Britt collection

From the limestone quarries of Ohio, fluorite is often a lovely tan or brown. It can even be iridescent. The cause is organic petroleum compounds caught up in the fluorite's structure. Often the fluorite from here responds to ultraviolet light, showing a lively bluish cream color due to the petroleum.

Fluorite, Rogerley Mine, England
B. Britt collection

From the great iron and lead mines of Cumberland, England, fluorite was abundant during mining days. It was more often found in simple, more or less square cubes, in either a rich violet to purple color or a strong green. Under a long-wave ultra violet lamp, the violet/purple varieties almost always flash a brilliant blue response. You probably have already concluded that because fluorite fluoresces it is responsible for the scientific word which describes the giving off of light under ultraviolet excitation. You are right. But which came first, fluorescence or fluorite in naming? Actually neither. Fluorite has been known as a mineral for probably thousands of years. Just what it was initially called is not known, but by the time the Romans were extracting metals from their ores they knew this mineral would serve as a flux for it would drop to the temperature needed to make the metals flow easily. So they gave it the Latin name fluere, meaning "to flow."

When the German silver mines came on line, helping to bring the Dark Ages to a close, this gangue mineral was common in the hydrothermal veins of metal ore and supplied the necessary flux in their smelters. It was usually found as yellow crystals, which were, rather rarely, very complex in crystal form. Goldshmidt, in his classic 1918 volume, offers no fewer than 160 crystal drawings of the mineral, some extremely complex with several dozen faces.



Fluorite, Primorskiy Kray, Russia
B. Britt Collection

The significance of this fluxing property for the mineral collector lies in the fact that huge tonnage's of mineral were needed for the making of steel, so what was a gangue or useless mineral suddenly became an ore. In our country, the great fluorspar mines of Kentucky, southern Illinois and elsewhere in the Midwest fed flux to the greedy steel furnaces along the Great Lakes and beyond.

In the mid- 1700's, fluorine as an element was not yet known in pure form, though fluorine compounds, including fluorite, had been used for centuries. The problem is that fluorine is the most active of all elements, reacting with almost anything it comes in contact with. Consequently, it was nearly impossible to isolate. Many scientists were killed or maimed for life trying to release this active gas from fluorite. Ferdinand Moissan, a French scientist, using fluorite, finally accomplished this difficult feat in 1886. His reward was seriously poisoned lungs from the gas he liberated.

Fluorite, Smith County, Tennessee
B. Britt Collection

The role of fluorite in researching fluorescence, phosphorescence and thermoluminescence is important. It was noted that some specimens of fluorite, when gently heated, would glow for a brief period in darkness, obviously responding to the heat. It was said to thermoluminesce. It was further noted that when some fluorites were taken out in direct sunlight, then returned to a darkened room, they continued to glow. This helped us gain an understanding of phosphorescence. Finally, some fluorites seemed to take on a bright, more intense blue color when exposed in sunlight, only to lose that effect in the absence of sunlight.

By using a variety of instruments that emitted various energy rays, it was shown that fluorite responds to such excitation, hence they were said to fluoresce, or phosphoresce if the glow persisted after the energy source was removed. Today, this response of fluorite has been translated into a branch of our hobby wherein collectors seek out all specimens that respond like fluorite. We use inexpensive and portable short- and long-wave ultraviolet lamps to enjoy this phenomenon.

But organics and fluorescence do not account for the lovely delicate colors seen in most fluorites. One important factor that plays a role in the color of fluorite is called a color center in its atomic structure. This is not a small dot of color which diffuses color in an entire crystal. A color center is, in fact, nothing! It is an empty space in the electron structure of a fluorite molecule. Where an electron is supposed to be in an atom's orbit, the electron has been disturbed by some outside energy, leaving a vacant spot which should be filled. Multiply that vacancy or color center by billions upon billions and the stage is set for the fluorite to have a color. This is accomplished when light enters the crystal and is partially absorbed by the myriad electrons loose from their color centers in the crystal. Wavelengths of energy not absorbed in this way are emitted from the crystal as visible light, the color being determined by the wavelengths of that residual or remaining light energy.

Fluorite, Okarusu, Namibia
B. Britt Collection

There is yet another factor involved in some fluorite colors. The fluorites from England have shown to contain one or more trace elements of the rare earth family: yttrium, europeum, and so on. These have been shown to significantly affect the intensity of the color response seen when an ultraviolet lamp is employed.

Like any mineral which develops in nature from solutions, fluorite is almost never quite pure and impurities affect colors, yet another factor in fluorite's color chart. Lovely as these colors are, they can be ethereal. Since the loss of electrons in the atomic structure can cause a color center and hence a real color in a crystal, replacing those electrons will fill the color centers, and there will be no energy absorption and so the color of the fluorite crystal will fade. Fluorite, under intense light for a long period of time, will lose its color. This is true of the lovely pinks from Peru, The violet fluorites from Spain, the greens from Mexico, and most other fluorites. Brief exposure to a strong light as in a display case at a mineral show is not sufficient to wipe out the color, but fluorites should be suspect and never displayed in bright light for long periods of time.

Fluorite, Swiss Alps
J. Scovil photo

Fluorite has added yet another accomplishment to its repertoire. When Friedrich Mohs realized that there was a need to standardize the testing of the hardness of minerals, he determined to develop a readily available group of 10 minerals starting with the softest talc, and ending with the hardest, diamond. This allowed scientists to use his reference minerals for comparison. Since fluorite has a hardness that is quite consistent, he chose it as 4 on his 1-to-10 scale Remember, minerals on the Mohs hardness scale do not increase in hardness by a factor of 1 each time. Fluorite, for example, is many times harder than mineral No. 3, calcite, just as mineral No. 5, apatite, is many times harder than fluorite.

Fluorite, China
B. Britt collection

As we said earlier, fluorite is virtually ubiquitous. It is found in many different environments It can be an important mineral in limestone deposits like in Southern Illinois. In such a relatively low temperature of formation deposit, the mineral is generally found in just simple cubes. It can be a major gangue mineral in hydrothermal deposits as in Niaca, Mexico. Metalliferous veins are the most prolific producers of more complex crystallized fluorites. In such deposits where the temperature of crystallization is high, fluorite does it's best to display a great variety of crystal forms, from octahedron to dodecahedron. The variety of modifications seems almost endless.

The most highly prized fluorites--if rarity and value are any measure--are the pink to red fluorites from the alpine-cleft regions of the Swiss and French Alps. Often found on or with smoky quartz, these simple octahedrons have formed from solutions circulating through the boot rock during metamorphic action. The largest of these may exceed 4 inches on an edge. The best are limpid pink to rose, nearly transparent with slightly rounded faces and sitting individually in clusters on smoky quartz. Perhaps the best is in the F. John Barlow collection, a cluster of 22 crystals on a large quartz crystal. The classic fluorites are those from Germany and England.


Fluorite, Niaca, Mexico
B. Britt collection

The German crystals formed in metalliferous veins can range in color from nearly colorless to green to yellow. They are often quite complex, never huge in size, a 1-inch crystal being average.

Fluorite, Inverness #1 Mine, Illinois
B. Britt collection

The English fluorites are still readily available on the market today, though their sources closed down decades ago. So much of this material came out of the iron and lead mines of Cumberland and Devonshire, as well as the Cornish tin mines from which every important collection has excellent examples. Most are purple in color, though the emerald green penetration twin cubes are more highly prized. The fluorescence of English fluorite has been the subject of much research, as they rank among the most responsive.

Also from England, at Tray Cliff, Castleton, Derbyshire, comes the finest lapidary fluorite. Here in metal veins, the calcium fluoride is found in alternating layers or bands of massive material with alternating purple, blue, and yellow layers. It has been used by lapidary artists to fashion bowls, cups, tazzas, lampshades and more. In recent years, banded fluorite even more varied in color has come from Mexico. It shows blues, violets, greens, and colorless bands that often show the outline of a cube cut at an angle so the bands look like colored shark teeth.

In recent years, superb pale-violet simple cubes of fluorite, usually about an inch across, have been coming from Berbes, Spain. Small clusters of these delicately colored fluorites have engendered great interest among collectors. Unfortunately, the color does fade rapidly, and should therefore be guarded against light.

The same is true of lovely pink to pale-green fluorite octahedrons that came from Peru some years back. These commanded very high prices when found, and rightly so as they are exceedingly attractive. But again, care must be expressed in guarding them against prolonged exposure to light. I suspect high heat would have the same effect.

From China, some great water clear fluorites are emerging. Many are simple cubes of considerable size, to 4 inches on an edge. Others are octahedral on form and just as showy. An abundance of this material is forthcoming these days and every collector can certainly attain a good group easily. Prices are not cheap, but what is these days?

Fluorite with Phantom, Spain

America's classic sedimentary deposit is the Illinois-Kentucky area around Rosiclare and Cave-in-Rock. Here, thick veins of pure fluorite have occurred in limestone, veins so thick as to be easily mined for decades to supply the steel industry with the flux it needed. For collectors, this area was a treasure trove of calcium fluoride. Simple cubic crystals to several inches across in plates as large as a man could carry came from these mines for years. A stop in Cave-in-Rock along the Ohio River was always a treat as front porches and side yards were loaded with specimens for sale.

The color of Illinois fluorite were of full range, from purple to violet to yellow to brown to blue with tints and shadings of all of these. Some crystals are zoned, very often the zoning being included organic material. Not much of the Illinois fluorite fluoresces, except for those crystals with petroleum or organic substances included, and they respond weakly.

More recently, America's most exciting find of fluorite comes from the lead-zinc mines around Elmwood, Tennessee. Here a vast array so spectacular fluorites have been found associated with barite, sphalerite, galena and calcite. The fluorites can be perfect cubes, usually purple or violet. But many are bright yellow. Much of the fluorite from here shows heavy etching, such that only skeletal remains are collected. But the most exciting thing about fluorites from here is that many are gemmy and lend themselves to huge faceted gems weighing many hundreds of carats. Since fluorite has a perfect cleavage, it is no easy task to facet, but our finest cutters can do the job and the results are spectacular.

This by no means completes the list of fluorite sources. There are the soft green octahedrons from Silverton, Colorado; the deep purple octahedrons from New Mexico; the glassy pale-green cubes from Niaca, Mexico; and the rich green cubes from South Africa, to mention a few more. There are more localities than space to describe them. So the next time you are at a mineral show be sure to take notice of all the wonderful fluorites from all around the world!