Inclusions in Flourite from the Quebradas, Socorro County, and the Sandia Mounatins, Bernalillo County, New Mexico

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41st Annual New Mexico Mineral Symposium
November 12-14, 2021,Socorro, NM
pp.26-27

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Interesting inclusions in fluorite have been recently observed from three different locations in New Mexico. This paper describes inclusions in fluorite from two locations in the Quebradas ("ravines" in Spanish); the Gonzales and the Bonita prospects, plus one stray 4 foot boulder found in the Sandia Mountains.

There is no shortage of published information about inclusions. Here are some basics—Inclusions in fluorite are common worldwide. Inclusions can occur as a gas, a liquid or a solid, or any combination of the three. Combinations of gas and liquid in bubbles, are common. They can be large enough to have visually movable bubbles. Most inclusions are microscopic, however they can be large enough to spot without visual aids. The more magnification one has, the more inclusions one can spot. Looking at a specimen under a microscope one can easily understand how there could be literally thousands of unseen inclusions in the field of view, but they are so small as to render them invisible to the eye. No three phase inclusions have been observed in fluorite from the Quebradas or the Sandias.

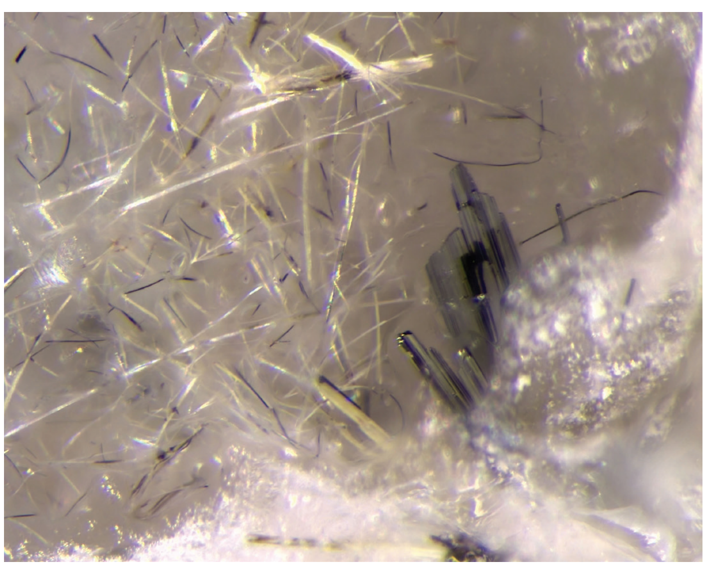
Fractures are considered to be inclusions. Fractures can occur as a material cools off after its initial crystallization or anytime later from a number of causes.

Primary inclusions formed before or during the precipitation of the fluorite. Primary inclusions can crystallize on the surface of a mineral or rock and then be covered over or enveloped by later fluorite. "Phantom" layers of fluorite represent stages of growth, with changes in the material being precipitated. Some layers appear to be clean unblemished fluorite, while other layers can have a plethora of various minerals, bubbles, etc.

Secondary inclusions are items that develop after a crystal's formation. A good example are manganese dendrites on a fracture.

Unfortunately taking images of inclusions in fluorite can be similar to taking images of something in a fog or a sandstorm. You may often think that something is "down there," but getting an image of it, a decent image, might be impossible. One can cleave the fluorite and hope for a clear, better shot of the intended inclusion. Good luck with that. It can work well with the Quebradas material. Grinding and polishing works well for fluorite from all locations, especially if one develops a feel for where the inclusions might be hiding. Note that fluorite will generally not take a nice polish on a cleavage face, and unfortunately, fluorite has some of those.

Minerals found at the Gonzales and the Bonita prospects include anglesite, baryte, cerussite, chalcopyrite, fluorite, galena, goethite, hematite, malachite, and sphalerite. All of the Quebradas minerals were visually identified. Minerals that were found only at the Bonita prospect, but not at the Gonzales, include covellite, marcasite (1 or 2 specimens), mimetite



Pyrite and baryte (upper left) in fluorite from the Bonita Prospect, Quebradas area, Socorro County, New Mexico. 3 mm field of view.

(?, 2 specimens with tiny yellow prisms), and pyrite. Brochantite was found only at the Gonzales prospect. It was distinguished from malachite by not effervescing in HCl. The Quebradas material has common distorted galena crystals. This is where the fluorite and the galena are crystallizing at the same time, being in "competitive" growth with each other. If the galena is crystallizing faster than the adjacent fluorite, then the galena crystal can widen. If the adjacent fluorite is crystallizing faster than the galena, then the fluorite takes away available space for the galena, causing the galena to lessen its girth. Some very random-looking shapes can develop.

Microscopic purple"fluorite spots" have been observed in colorless fluorite from all 3 locations. These are rounded purple-colored areas that have undefined boundaries. They have a purple rounded "core" that disseminates into the relatively colorless adjacent fluorite. Some theories exist regarding their formation, which I will avoid at this time.

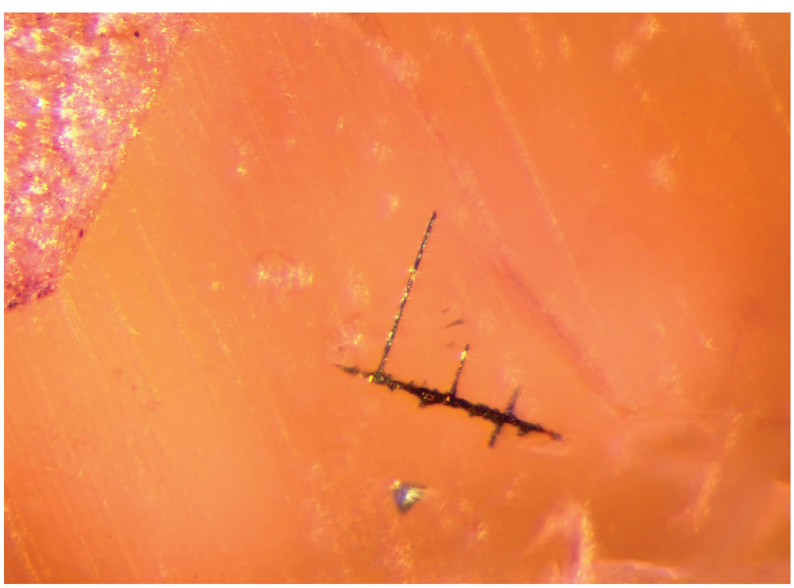
Minerals found in a 4-foot-wide Sandia mountains boulder include aurichalcite, baryte, bismutite, calcite, cerussite, chalcopyrite, chrysocolla, friedrichite, galena, hemimorphite, malachite. quartz, rosasite, sphalerite, and 5 specimens of wulfenite. All were visually identified except cerussite, chalcopyrite, galena and friedrichite. These 4 were identified by Dr. Inna Lykova with PXRD and EDS, however, the identification of cerussite is not 100%.

The most interesting mineral found in the Sandia boulder was friedrichite, which was originally found in Austria and published in 1977. It was named for a noted Austrian mineralogist, Dr. Othmar Friedrich (1902–1991). Friedrichite is an orthorhombic member of the aikinite group. Its formula is $Pb_5Cu_5Bi_7S_{18}$. Long black or gray metallic laths/tendrils were observed in polished Sandia fluorite. The length to width ratio can be quite high, requiring magnification to spot the crystals. Dr. Inna Lykova was able to identify the friedrichite via EDS and PXRD using a tiny amount of material. Due to the tedious sample preparation, more testing of the sulfosalt tendrils may not be forthcoming.

The friedrichite crystals can abruptly change chemistry, turning into white or colorless cerussite. This would be caused by a change in the amount of oxygen in the solution. Cerussite can also coat friedrichite. Perhaps cerussite can pseudomorph friedrichite as well?

Sandia friedrichite may be mineralogically unique in some of its behavior, exhibiting habits not observed in other minerals by this author. The crystals have the luxury of having been formed in a liquid and then having their delicate characteristics preserved within the host fluorite. Such delicate features would have been obliterated had the crystals been formed in open cavities. The crystals can bend, twist, rotate, bisect, change chemistry (to cerussite) and seemingly do whatever they want. Chalcopyrite crystals may be catalysts for friedrichite growth. Certainly they are close associates.

I wish to thank Inna Lykova for testing specimens. Also, Virgil Lueth, Peter Richards and John Rakovan for their comments and explanations. Plus Paulina Iñigo and Nancy Attaway for their field help, and Nancy Attaway and Alan Perryman for the use of their lapidary shops. I want to thank Nancy Attaway for editing this abstract.



Friedrichite and cerussite in fluorite from the Sandia Mountains, Bernalillo County, New Mexico, 4mm field of view.