Crystal Diving for Fluid Inclusions

Recently I received a number of fluorites from Rosiclaire, Ill. They were clear enough for me to indulge in a favorite activity- crystal diving. Crystal diving is using a hand lens to focus down on different levels within a crystal. You can see various bizarre flaws, fracture patterns, mineral inclusions and even the backsides of crystal faces come into focus like exotic fish emerging from serene blue, purple or yellow depths. My favorite finds (present in abundance in the Rosiclaire fluorites) are fluid inclusions. These are small liquid filled cavities of various shapes, often with small, perhaps movable, gas bubbles. Rockhounds are familiar with the large fluid inclusions (enhydros) in agates. Most minerals contain a myriad of microscopic fluid inclusions, most too small to see even with a hand lens. Milky quartz, for example, is milky because of thousands of tiny fluid inclusions. The same is true of ice, whether found in lakes or ice cubes in your freezer. Fluid inclusions (or "flinks") have been studied by geologist and reveal much about mineral histories. The fluorites of Rosiclaire are good examples.

There are several kinds of flinks. Primary flinks, found randomly scattered through a crystal, form at the same time as the mineral and are samples of the mineral-forming solutions. Secondary flinks line up along later fractures and form from fluids seeping through the mineral long after it has crystallized. These are less useful to geologist. Pseudosecondary flinks form at the same time as the mineral, but are aligned along fractures that form during mineral growth. They also sample the mineral- forming fluids.

There are two kinds of primary and pseudosecondary flinks in the Rosiclaire fluorites. One type is dark to golden brown and is composed of petroleum with little bubbles of methane gas. The chemicals in the petroleum are thought to have catalyzed the deposition of the fluorite. The second type are clear and contain a salt water solution enriched with sodium, calcium and fluorine, usually with a small gas bubble of CO_2 . Analysis of such small amounts of fluids requires special equipment. The salinity of the fluids is most easily measured by cooling the mineral grains until the liquid in the flinks freezes. As we know from our car radiators, the freezing of water depends on the amount of stuff dissolved in it. Water in the fluorites has a salinity ranging from 1 to 3 %, similar to sea water and to groundwater associated with petroleum. The only unusual element present in these fluids is fluorine, which could have come from a deeply buried magma sending off fluids that mixed with the water in the oil field's brines. The fluorite was deposited where these two fluids mixed.

The temperature of fluorite deposition can also be estimated from flinks. The samples are heated until the little gas bubbles dissolves back into the liquid, which fills up a flink. This gives the minimum temperature of mineral formation. Geologists have found that the Rosiclaire fluorites formed at temperatures of 90-140 degrees C, similar to temperatures seen in oil field waters.

More sophisticated instruments can even get more data out of flinks. For example, some recent tests of amber flinks have suggested that the air the dinosaurs breathed may have been richer in oxygen than our air. So as we "dive" into crystals, we may be astonished anew at the information locked in their pellucid depths.

-Dr. Bill Cordua, University of Wisconsin-River Falls