



Carbonates: Calcite

(The Mineral with a
Thousand Forms)

A CALCITE SCALENOHEDRON FROM ELMWOOD MINE, TN, USA WITH FLUORITE AND SPHALERITE

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Mineral Classification by Anion Group

Until now, we have studied minerals grouped by their crystal habit, but there are other ways to group minerals. One of the most common is by the anion group which is the negatively charged group on the right of the chemical formula. This is known as the Berzelian system, and there are about 10 major groups. Because anions are negatively charged, they gain electrons leading many to form large complex ion groups. The anion groups tend to be much larger than the metal cation(s) attached to them. This means that the anion groups tend to dictate not only the structure of minerals, but also the chemical properties. The sameness within each group varies. In oxides, where the anion is very small, the chemical properties and structures vary widely. In carbonates, there is general homogeneity throughout the group.

The Carbonate Building Block

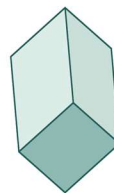
The carbonate group contains one carbon and three oxygen atoms (CO_3) arranged in a flat triangle. The bonding of these 4 atoms is so great that functionally, they act as one unit. This anion group then combines with a metal cation. In calcite, this is calcium which makes calcium carbonate, CaCO_3 . The calcium and carbonate anion repeat over and over, stacking to make the crystal. The comparative large carbonate structure constrains the internal order of the crystal, but it does not require every calcite to have the same outward proportions. In the same way calcium binds, manganese can bind to the same carbonate group to make rhodochrosite or iron can bind to make siderite. The large carbonate group in all three of these (and most other carbonates) makes them generally have structures of rhombohedrons and scalenohedrons (Figure 1.) It also makes them soft and easily cleaved and fractured. Although there are over 70 carbonate species known, practically the Earth's crust is dominated by calcite, dolomite, and siderite. There are about 15-20 other collectible carbonates that are pretty and make nice hand specimens.

Calcite

Calcite belongs to the trigonal crystal system, giving it 6 sides on its prism and terminations with 3 big and 3 little faces (like quartz.) It is soft with a Mohs hardness of 3, a density of about 2.71 g/cm^3 and perfect rhombohedral cleavage. It is brittle, prone to edge wear and damage. Its luster can be resinous and soft to vitreous and quartz-like. Clear pieces can show striking double refraction (many sold as cleavage blocks labeled "Icelandic Spar.") While calcite is clear or white, trace impurities easily incorporate between the big carbonate anions and can create calcites of all colors. In the calcite above, copper colors this Michigan calcite a bright pink. Calcite has 4 major twinning sites.

Calcite is also rock-forming - composing sedimentary limestone and heated metamorphic marble. It occurs in veins, cavities, and many other geological settings. Calcite has the most forms of any mineral with over 1000 crystallographic shapes known. Many are variants of the rhombohedron (diamond shaped parallelograms) and scalenohedrons

RHOMBOHEDRON



6 rhomb-shaped faces

SCALENOHEDRON



12 scalene triangular faces

Figure 1. Idealized schematic of the 6-sided rhombohedron and the 12 sided scalenohedron

Elmwood Mine, Carthage, Tennessee, USA

One of the most prolific mines and calcite specimen localities in the US, Elmwood has produced amazing pieces for decades. Calcite crystals from the Elmwood Mine in Carthage, Tennessee, are world-famous among mineral collectors for their exceptional clarity, deep golden amber-to-cognac colors, and striking scalenohedral crystal form. Some are doubly terminated and jewel-like, while others show twinning – especially along the c-axis (Figure 2.) They are often found with orangy red sphalerite, cream colored rounded barite groups, and classic deep purple cubes of fluorite. You may remember this locality from our studies in fluorite as it is famous for its purple cubes with yellow “Carthage corners.”



Figure 2. Bright yellow Elmwood Mine calcite twin on sphalerite. The arrow shows the reentrant angle of the c axis twin plane. From this horizontal plane across the crystal one scalenohedral twin is going up while the other twin is going down.



Figure 3. Another golden calcite from Elmwood Mine in a wider scalenohedron form. This time it is a fishtail twin with the reentrant angle near the top

• Around 1969, zinc deposits were discovered in the area by the Jersey Minière Zinc Company in Mississippi Valley Type host rock. Planning ensued and in 1975 heavy construction and development culminated in full commercial production

The complex was operated by companies like Savage Zinc and changed a few times before a temporary shut down in 2003-2004. It

reopened in 2010 by Nyrstar Corporation via the Gordonsville #3 shaft—bringing Elmwood specimens back to the global market. In December 2023, mining operations officially ceased, ending nearly five decades of active industrial output.



Figure 4. Mining operations and host rocks of the Elmwood Mine in Carthage Tennessee. Spirit Rock Shop Photos. Unknown date and exact location



Figure 5. A worker holding a map of the underground digging of the Elmwood Mine and associated shafts in the 80s or 90s. The chaotic nature of underground digging can be very dangerous for new projects or shafts Rock Currier photo from Mindat