# GEOBIT 13

# PYRITE SUNS

*Unique Mineral Treasures of Illinois*

**ILLINOIS STATE GEOLOGICAL SURVEY**

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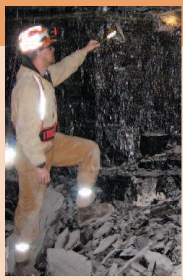
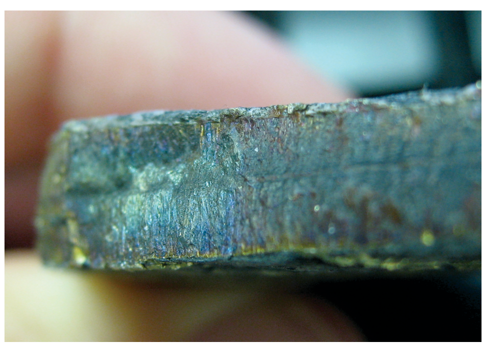


Photograph by W. J. Nelson

Pyrite "suns," also called "miners' dollars," are spectacular disk-shaped mineral concretions of pyrite [iron sulfide ($FeS_2$) arranged in a regular cubic configuration] with minor amounts of marcasite [also iron sulfide ($FeS_2$) but arranged in an orthorhombic configuration, i.e., a rectangular or stretched cube shape].



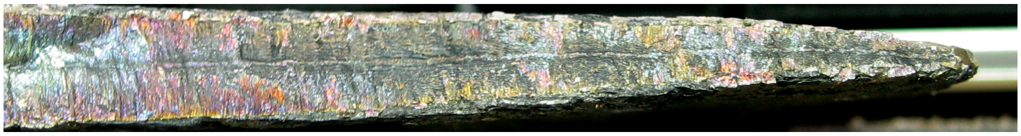
**Above:** A pyrite sun embedded in Anna Shale, 3 inches above the Herrin coal at the Gateway Mine in Sparta, Illinois (hand for scale).
**Right:** Cross-sectional view of a pyrite sun. The faint line running horizontally through the middle of the disk may be the surface where pyrite crystals began growing (nucleating) inside the Anna Shale. A thin pyrite crust is visible, rimming the outside of the specimen.
**Bottom right:** Outside edge of the disk. Notice the cubic pyrite crystal forms rimming the edge, a more common pyrite crystal shape.

The mineral disks range from the size of a small penny up to the size of a dinner plate but are commonly about 3 to 4 inches in diameter. Pyrite has a metallic luster and is generally brassy to yellow in color; thus, it is often called "fool's gold."

The mineral pyrite is commonly found in a variety of geologic settings in nature, often in formerly organic-rich settings. In most cases, pyrite forms as intergrown cubic-shaped masses. A disk-like shape for pyrite, on the other hand, is unique. Very small pyrite disks, fractions of an inch in size, can be found scattered in marine rocks (organic shales) throughout the world, and in rare instances, larger disks can be found, sometimes encrusting fossils. The area near Sparta, Illinois, appears to be unique in the entire world in hosting the largest known deposit of multi-inch disks.

The pyrite suns at Sparta are found in Pennsylvanian-age rocks, approximately 300 million years old, 200 to 250 feet below ground in coal mines that extract the Herrin coal. The flashy pyrite disks are found a few inches above the coal seam in thin, pyrite-rich shale layers in the roof. The roof rock that hosts the pyrite disks is a black, organic-rich marine shale called the Anna Shale, which is widely traceable from Indiana to Kansas. In the mines around Sparta, scraps and thin sheets of roof shale will naturally fall from the roof, or are preemptively pulled down by miners for safety, and can reveal disks of pyrite ranging from clusters of well-formed, show-worthy disks up to 5 inches or more across to misshapen masses of intergrown pyrite blebs unsuitable for attractive display but impressive nonetheless.

The disk-shaped mineralization pattern of the pyrite suns occurs because the weight of overlying sediment makes it easier for crystals to grow laterally (or radially) as opposed to vertically, thereby resulting in the growth of flat concretions of pyrite. In other words, crystal growth follows the path of least resistance. It is interesting that small cubic-shaped pyrite crystals can sometimes be found on the outside edges of some pyrite disks, capping the disk edges. This change in crystallization



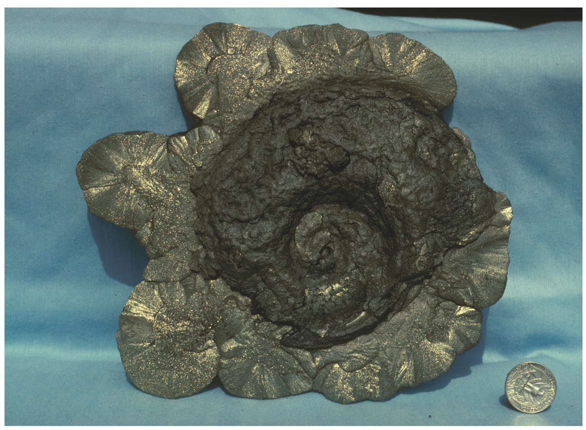
pattern may be the remains of the leading edge of mineralization, or it may reflect a change to overall slower mineralization and therefore more regular crystal growth.

In the modern world as in the ancient, pyrite crystallization takes place in reducing, anoxic (oxygenless) environments, often within shallowly buried, organic-rich sediments. Under these anoxic conditions, sulfate-reducing bacteria thrive, decomposing organic matter for energy and thereby creating the geochemical conditions conducive to precipitation of pyrite crystals.

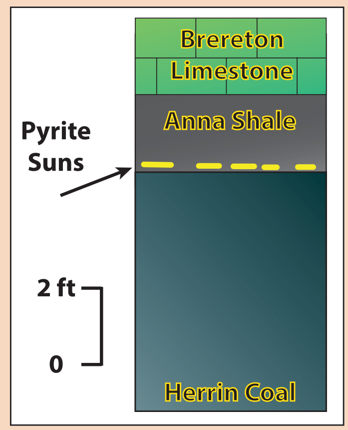
A modern-day example of these conditions would be at the bottom of the Black Sea: poor water circulation, plentiful available organic matter, anoxic conditions . . . and modern-day pyrite precipitation occurring.

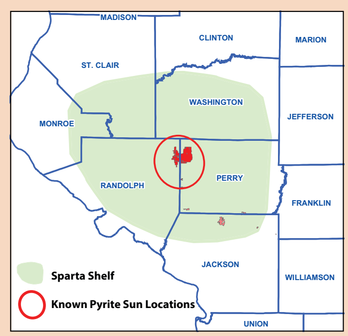
For such large and abundant pyrite suns as found at Sparta to have formed, conditions 300 million years ago must have, for a time, been ideal for pyrite crystallization. During that ideal time, we can imagine there were probably still, quiet, shallow marine waters with very little to almost no circulation to stir up and oxygenate the water column. The black, organic-rich Anna Shale that hosts the pyrite disks shows that organic matter was plentiful—most of it originating from the former Herrin peat swamp just inches below—and that it was anoxic.

The geography of this area 300 million years ago was a broad, low-relief landscape we call the Sparta Shelf. When rising sea level flooded across the Herrin coal swamp, the Sparta area may have been a regional depression, perhaps a large lagoon, in the middle of the ancient Sparta Shelf seaway (see map to the lower right). Combined with abundant decomposing organic material and fluids seeping upward from the flooded and covered peat swamp, the still, anoxic seawaters provided ideal conditions for pyrite crystallization—conditions that persisted long enough to produce Sparta's brilliant pyrite suns.



**Top left:** Cross-sectional view. The horizontal line in the middle of the disk shows where crystallization initiated.
**Center left:** Pyrite suns encrust the perimeter of a rare goniatite (quarter for scale). The goniatite shell provided nucleation sites for pyrite crystallization.
**Bottom left:** View looking up at 5-inch-diameter pyrite suns embedded in Anna Shale (middle and far right of picture) a few inches above the Herrin coal. White limestone rock dust applied after mining indicates the mine roof, or top of the coal seam. A mass of small pyrite disks and pyrite bodies is visible to the left, above the 6-inch-square rust orange roof bolt plate.
**Below:** Stratigraphic column illustrating the position of pyrite suns.

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