THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
LUNAR & PLANETARY LABORATORY

Meteorite or Meteorwrong? ...the Path to Identification

Have you ever wondered if your "interesting rock" is a meteorite?

Here are some clues to help distinguish real meteorites from terrestrial rocks and manmade materials. Official classification of meteorite type and name requires analysis by a meteorite laboratory. Check out this helpful website for more examples: http://meteorites.wustl.edu/realities.htm

POSSIBLE GOOD INDICATORS

- **Does the rock have a fusion crust?**
  This is a thin, black coating formed as a meteorite passes through Earth's atmosphere. Fusion crust weathers to a rusty-brown color the longer it is exposed to oxygen and water. Don't be fooled by black desert varnish that is very common in desert regions or slags that have a "melted" appearance.

- **Does the "fusion crust" look different than the interior of the rock?**
  It should be smooth and not too rough or frothy. It won't necessarily *look* melted.

- **Is the sample magnetic?**
  Most meteorites attract a magnet and are easily found with metal detectors. But so are many meteorwrongs such as iron-bearing rocks and metal debris. If the sample does not attract a magnet, does it have a fusion crust? Some rare meteorites are not noticeably magnetic.

- **If the sample is dense (heavy for its size), is it metallic?**
  The densest meteorites are the iron-nickel and stony-iron type. Stony meteorites may or may not seem heavier than common rocks. Some rocks and slag are very dense.

- **Iron-nickel meteorites will exhibit a diagnostic criss-cross "Widmanstätten" pattern when etched with a special acid mixture.** This is best done in a laboratory.

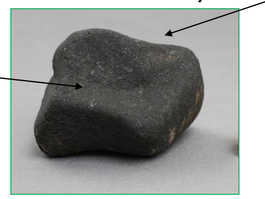
- **Do you see small flecks of metal inside the sample?**
  This is a very important feature of ordinary chondrites. These are sometimes confused with glints of light reflected from crystal faces. Use a magnifier or microscope to check.

- **Are there chondrules (tiny, 1mm diameter, spheres) visible in the interior?**
  These may or may not be easily discernable depending on the meteorite type. (Iron-nickel meteorites and some rare stony meteorites don't have chondrules).

Typical Meteorites

Fresh, black fusion crust

Weathered brownish fusion crust



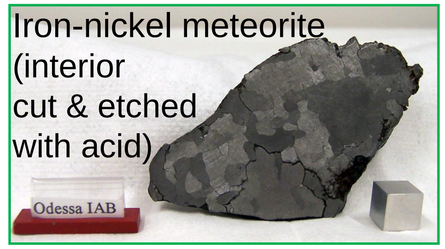
Outer surface

Broken interior

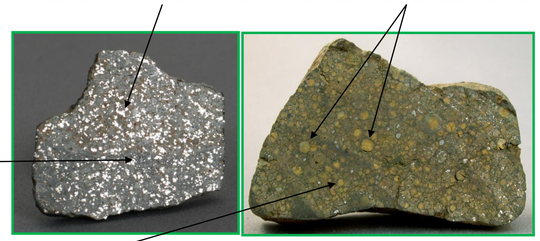
Outside of old stony meteorite

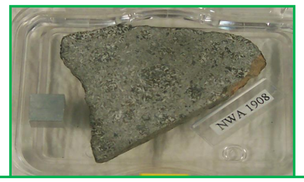
Iron-nickel meteorite (outside)

Iron-nickel meteorite (interior cut & etched with acid)



Metal flecks & round chondrules





Rare stony meteorite: no chondrules, not very magnetic.

BAD SIGNS (USUALLY)

- **Does the rock have vesicles or gas bubbles?**
  Very few meteorites have vesicles large enough to see.

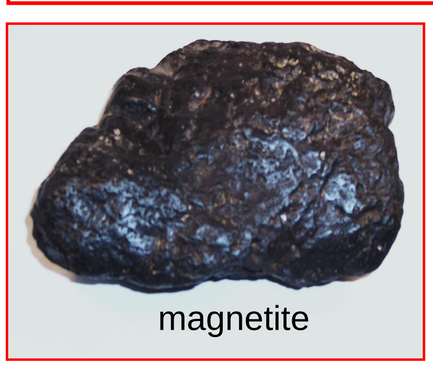
- **Does the sample have large, colorful crystals?**
  Meteorites generally lack large, colored crystals like those seen in geodes.

- **Does the sample have sedimentary texture?**
  Meteorites do not exhibit layers or cemented grains or pebbles.

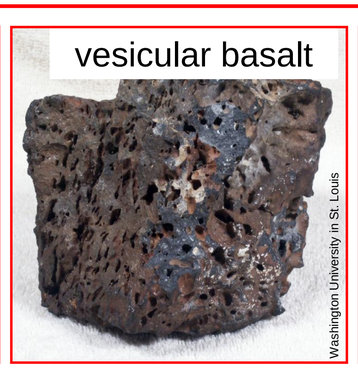
- **Is the rock colored (red, purple, blue)?**
  Meteorites are not very colorful. Colors in terrestrial rocks are often formed from mineral rich fluids (water).

- **Are there other rocks like this one in the area?**
  If so, this is a clue there might be a reasonable geological explanation as in magnetite and concretions.

Typical Meteorwrongs: Iron tools, mill balls, slag, magnetite, hematite, iron-rich rocks, basalt, volcanic rocks, clinkers, river rocks, concretions.



magnetite



Iron debris

concretions

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The Many Meteorite Types

Three main types with many subgroups that depend on their composition, minerals, structure, and relationships: irons, stony-irons, and stony.

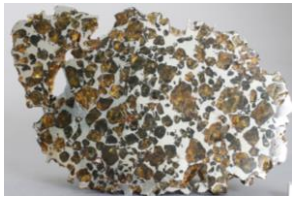
Irons

Iron meteorites are thought to be the cores of large asteroids that were broken apart by impacts. They are made of iron-nickel and other minerals such as troilite (iron sulfide) or schreibersite (iron nickel phosphide).

When cut, polished, and etched, many iron meteorites show a distinct pattern called a "Widmanstätten Pattern" that gives clues as to how slowly the meteorite cooled in the interior of the asteroid. It is formed by the intergrowth of two iron-nickel minerals.

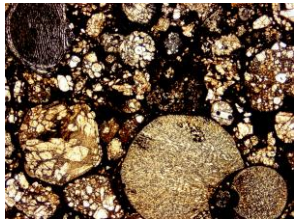
Inside the ordinary-looking stones above, we find a wondrous variety of material and a wealth of information about our solar system..

Stony-Irons



Stony-iron meteorites are a mixture of iron-nickel metal and stony materials similar to those found in Earth's mantle rocks. There are two types of stony-iron meteorites: Pallasites and Mesosiderites. Pallasites are thought to be samples of the boundary layer between the metal core and overlying rock of large asteroids. Mesosiderites are more complex. How they formed and what they represen‧ is a mystery yet to be solved.

Stony



Stony meteorites are the largest group of meteorites. They are composed of minerals commonly found on Earth (with important differences) and can be divided into two categories based on the presence of small rocky spheres or "chondrules" ~1mm across. Chondrites contain chondrules. Achondrites do not.

Chondrites

Chondrites are the most primitive of the meteorites and come in a number of different types.

Carbonaceous Chondrites contain "Calcium-Aluminum-rich Inclusions" (CAIs) identified as the oldest material in the solar system and represent the first solid material to condense out of the solar nebula gas from which our solar system formed.

The chondrite class also includes "Ordinary" Chondrites and others.

Achondrites

Achondrites do not have chondrules and contain features that lead us to believe they were formed on large bodies in the solar system. They are evidence for processing of original solar system material; similar in many ways to igneous rocks on Earth. Achondrites come from different parent asteroids and experienced different histories.

Falls

Another way to classify meteorites is how they come into our possession. We either witness the fall or find them long after they collided with Earth.

Finds