

## Rust Minerals

Iron oxides are extremely common minerals. Even people who don't collect minerals own many examples. Collecting trips to the famous iron ranges (the Cuyuna Range near Brainard, MN, the Mesabi Range of Hibbing and Virginia, MN, or the Gogebic Range near Hurley-Ironton WI and MI.) turn up many fine specimens of iron oxides -primarily hematite ( $\text{Fe}_2\text{O}_3$ ) and goethite ( $\text{FeO}(\text{OH})$ ).

Hematite gets its name from the Greek word for "blood" and was described as a mineral as early as 325 B.C. It is often as red earthy masses. Some hematite is steel gray to black and can be very sparkly. Nearly black platey or sparkly material is called "specular hematite". Hematite also forms stalactitic, botryoidal (bubbly) or reniform (kidney-like) masses made of parallel groups of skinny radiating crystals. Some long coarsely fibrous hematite breaks in splintery masses known as "needle ore".

Goethite gets its name from the German philosopher and poet Goethe, who, in addition to writing such monumental works as Faust, made studies in geology and mineralogy. I've heard goethite pronounced many ways. I prefer pronouncing it "Gerthite". Fortunately for written articles such as this, it doesn't matter how you pronounce it -it's always spelled the same. Goethite usually forms yellow, brown or orange earthy masses. It can also form very dark brown coatings of drusy crystals known as "velvet ore". It can be stalactitic, botryoidal to reniform massive with radiating coarsely fibrous crystals. Caution: these crystals can give one nasty splinters!

The best way to tell these two mineral apart is to use a streak plate. Hematite will give a dark to cherry red streak (powder) when rubbed across a piece of unglazed porcellin. Goethite will give a yellow, yellow-brown or orange-yellow streak.

Limonite is a general term given to earthy mixtures of iron oxides, mostly goethite. Limonite's streak depends on the proportion of hematite to goethite present in the mixture.

Despite all the iron in them, neither mineral is magnetic. If your samples are magnetic, it is probably because there is black magnetite ( $\text{Fe}_3\text{O}_4$ ) present. Magnetite gives a black streak. When intermixed with hematite or goethite, it will darken their streak.

Occasionally one will find black crystals, botryoidal masses or earthy material that is not magnetic, but does give a black streak. These are likely

manganese oxides (i.e. pyrolusite, romanechite, manganite) They are particularly common in the Cuyuna and Gogebic Ranges.

Other iron oxides are known, but are rare. Goethite has three relatives that have the same chemical formula but different internal structures. These are lepidochrocite, akaganeite and feroxyhyte. All of these are look similar to goethite, and are easily misidentified. They are probably thus more common than is generally thought.

So which iron oxides are forming on the fenders of your car?

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