What the heck is limonite?

One of my first great rockhound finds was a mass of botryoidal yellow-brown limonite that I picked up when I was about 12. I was hunting for rocks around a housing development near my home in College Park, Maryland. I came home with both the rock and me covered with sticky mud. My mother was appalled at the rock's appearance, even after it and I were cleaned up. She told me it looked like fossil dog poop. I think I loved it for that very reason. It was also the first time I found something that was botryoidal -or bubbly- in habit, and one of the first times I was able to use my mineral books to identify something I had found. I still proudly display the piece.

If you research the name "limonite" you will find it a non-approved mineral name. It is usually listed under "goethite", but that isn't quite correct either. So what is this stuff?

Limonite is always fine-grained and usually quite earthy. It may be crudely fibrous, oolitic, botryoidal or stalactitic. Its hardness is usually around 4, but can be soft enough to scratch with a fingernail. It is yellow, orange or brown and has a yellow to brown streak. Some of it is described as "ocher", some as "bog iron ore" some as "gossan" and some as "minette". This is clearly interesting stuff to have so many odd names.

Limonite is a mixture of fine-grained hydrated iron oxides. It is chemically similar to goethite (HFeO2), but varies from ideal goethite by having more water. Although goethite is a very common component, limonite can also contain many other minerals. Some are polymorphs of goethite: lepidochrocite, akaganeite and feroxyhyte. Polymorphs are minerals that have the same chemical composition but different crystalline structures. Ferroxyhte is the rarest, found in deep sea nodules, and alters to goethite upon exposure to the air. Akaganeite has chlorine with the water. Lepidochrocite can form scaley crystals and has a dull red to orange streak. All of these are found intergrown in limonite. Hematite, siderite, jarosite and clay minerals can also be mixed in. Without access to X-Ray diffractometry or other sophisticated devices, one cannot tell exactly what is in a particular limonite specimen. As an example of how misleading hand-sample I.D. can be, the "type" material for goethite from Eiserfeld, Siegen Germany, described in 1806, turns out to be lepidochrocite. Hence "limonite" is a very handy field name for such mixtures of variable composition without specifying which particular minerals are present. Limonite is really a rock name, not a true mineral name.

Limonite is an important material. It is in soils, especially tropical soils called laterites. It is part of the oxidized cap (called gossan) over sulfide ore

deposits. Such gossans have lead many prospectors to important deposits of gold, silver and copper through the years. Ocher is the softer limonite used as a pigment. Some limonite is used as iron ore. "Minette" refers to an oolitic form of limonite that is the major iron ore in Lorraine and Luxembourg. "Bog iron ore" refers to masses of limonite deposited in swampy conditions. In fact, the name "limonite" comes from the Greek meaning "meadow". Bacteria likely had a major roll in precipitating the iron oxides under these relatively stagnant conditions. Limonite forms from the alteration of other iron minerals such as siderite (iron carbonate), pyrite and marcasite (both iron sulfides.) Specimens of limonite after these minerals are relatively common.

It was limonite from a Cretaceous-age bog iron ore I was collecting in my younger days. The east coast has many small iron ore bodies, found in a band from New Jersey to Georgia and dominated by limonite. These were deposited in swamps about 120 million years ago and are associated with finds of plant and dinosaur fossils. (Yes not all D.C. area dinosaurs are in Congress). The limonite is associated with a very sticky clay, the Arundel Clay. That was one reason my Mom never liked me to go collect in that stuff. These deposits have been known since colonial time. In fact, their presence was a reasons the U.S. could declare its independence from Britain. With domestic sources of iron and coal being discovered, we were not dependent on these imports, and could make our own musket and cannon balls. These deposits were eventually made uneconomic by the finds of the large iron ranges in Minnesota, Michigan, and Wisconsin.

I embrace the term limonite as a useful rock name. What else to call the matrix on which sometimes perch dandy crystals of adamite, wulfenite and other fine minerals?

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

Reference:

Gaines, R.V., Skinner, C.W., Foord, E.E., Mason, B, and Rosenzweig, A., with sections by V.T. King, 1997. Dana’s new mineralogy - The system of mineralogy of James Dwight Dana and Edward Salisbury Dana: Eighth edition, John Wiley & Sons, New York, 1819 p.