

= Vanadinite =

Vanadinite is a mineral belonging to the apatite group of phosphates, with the chemical formula  $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$ . It is one of the main industrial ores of the metal vanadium and a minor source of lead. A dense, brittle mineral, it is usually found in the form of red hexagonal crystals. It is an uncommon mineral, formed by the oxidation of lead ore deposits such as galena. First discovered in 1801 in Mexico, vanadinite deposits have since been unearthed in South America, Europe, Africa, and in other parts of North America.

= = Origins = =

Vanadinite is an uncommon mineral, only occurring as the result of chemical alterations to a pre-existing material. It is therefore known as a secondary mineral. It is found in arid climates and forms by oxidation of primary lead minerals. Vanadinite is especially found in association with the lead sulfide, galena. Other associated minerals include wulfenite, limonite, and barite.

It was originally discovered in Mexico by the Spanish mineralogist Andrés Manuel del Río in 1801. He called the mineral "brown lead" and asserted that it contained a new element, which he first named panchromium and later, erythronium. However, he was later led to believe that this was not a new element but merely an impure form of chromium. In 1830, Nils Gabriel Sefström discovered a new element, which he named vanadium. It was later revealed that this was identical to the metal discovered earlier by Andrés Manuel del Río. Del Río's "brown lead" was also rediscovered, in 1838 in Zimapán, Hidalgo, Mexico, and was named vanadinite because of its high vanadium content. Other names that have since been given to vanadinite are johnstonite and lead vanadate.

= = Occurrence = =

Vanadinite occurs as a secondary mineral in the oxidized zone of lead-bearing deposits, the vanadium is leached from wall-rock silicates. Associated minerals include mimetite, pyromorphite, descloizite, mottramite, wulfenite, cerussite, anglesite, calcite, barite, and various iron oxide minerals.

Deposits of vanadinite are found worldwide including Austria, Spain, Scotland, the Ural Mountains, South Africa, Namibia, Morocco, Argentina, Mexico, and 4 states of the United States: Arizona, Colorado, New Mexico, and South Dakota.

Vanadinite deposits are found in over 400 mines across the world. Notable vanadinite mines include those at Mibladen and Touisset in Morocco; Tsumeb, Namibia; Córdoba, Argentina; and Sierra County, New Mexico, and Gila County, Arizona, in the United States.

= = Structure = =

Vanadinite is a lead chlorovanadate with the chemical formula  $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$ . It is composed (by weight) of 73.15% lead, 10.79% vanadium, 13.56% oxygen, and 2.50% chlorine. Each structural unit of vanadinite contains a chlorine ion surrounded by six divalent lead ions at the corners of a regular octahedron, with one of the lead ions provided by an adjoining vanadinite molecule. The distance between each lead and chlorine ion is 317 picometres. The shortest distance between each lead ion is 448 Å. The octahedron shares two of its opposite faces with that of neighbouring vanadinite units, forming a continuous chain of octahedrons. Each vanadium atom is surrounded by four oxygen atoms at the corners of an irregular tetrahedron. The distance between each oxygen and vanadium atom is either 172 or 176 Å. Three oxygen tetrahedrons adjoin each of the lead octahedrons along the chain.