# Vivianite $Fe_3^{2+}(PO_4)_2 \cdot 8H_2O$



**Crystal Data:** Monoclinic. *Point Group:* $2/m$. Prismatic crystals, to 1.3 m; flattened on [100] or [010], somewhat elongated along [100], many modifying forms, dominated by {100}, [010}, may be rounded or corroded; stellate groups, incrustations, concretionary, earthy, powdery. *Twinning:* Translation gliding T(010), t[001].

**Physical Properties:** *Cleavage:* Perfect on {010}. *Fracture:* Fibrous. *Tenacity:* Flexible, sectile. Hardness = 1.5–2 D(meas.) = 2.68(1) D(calc.) = 2.69

**Optical Properties:** Transparent to translucent. *Color:* Colorless, very pale green, with oxidation becoming dark blue, dark greenish blue, Indigo-blue, then black; colorless to blue in transmitted light. *Streak:* White, altering to dark blue, brown. *Luster:* Vitreous, pearly on the cleavage, dull when earthy.
*Optical Class:* Biaxial (+). *Pleochroism:* $X$ = blue, deep blue, Indigo-blue; $Y$ = pale yellowish green, pale bluish green, yellow-green; $Z$ = pale yellowish green, olive-yellow. *Orientation:* $X = b$; $Z \wedge c = 28.5°$. *Dispersion:* $r < v$, weak. $\alpha = 1.579$–$1.616$ $\beta = 1.602$–$1.656$ $\gamma = 1.629$–$1.675$ 2V(meas.) = 63.5°-83.5°

**Cell Data:** *Space Group:* $C2/m$. $a = 10.034$–$10.086$ $b = 13.434$–$13.441$ $c = 4.687$–$4.714$ $\beta = 102.65°-104.27°$ Z = 2

**X-ray Powder Pattern:** Synthetic.
6.73 (100), 3.210 (16), 7.93 (13), 4.90 (12), 4.081 (12), 2.985 (10), 2.728 (9)

**Chemistry:**

| | (1) | (2) |
|---|---|---|
| $P_2O_5$ | 27.17 | 28.30 |
| $SiO_2$ | 0.10 | |
| FeO | 44.10 | 42.97 |
| $H_2O$ | 27.95 | 28.73 |
| Total | 99.32 | 100.00 |

(1) Cantwell's Bridge, New Castle Co., Delaware, USA. (2) $Fe_3(PO_4)_2 \cdot 8H_2O$.

**Mineral Group:** Vivianite group.

**Occurrence:** A secondary mineral in the oxidized zone of metallic ore deposits and complex granite pegmatites; replacing organic material in fossil bones, lake sediments, and in bog-iron ores and peat bogs; rarely in caves.

**Association:** Metavivianite, ludlamite, pyrite, pyrrhotite.

**Distribution:** Numerous localities, even for well-crystallized material. In England, from [Wheal Kind,] St. Agnes, and other mines in St. Just and Kea, Cornwall. At Hagendorf, Bavaria, Germany. From the Stari Trg mine, Trepča, Serbia. On the Taman Peninsula, Russia. Around Kerch, Crimean Peninsula, Ukraine. Huge crystals from Anloua, near Ngaoundéré, Cameroon. In the USA, from the Blackbird Mine, Lemhi Co., Idaho; in the Treece and Ibex mines, Leadville, Lake Co., Colorado; at the Bingham Canyon mine, Salt Lake Co., Utah; from Richmond, Henrico Co., Virginia; at the Foote mine, Kings Mountain, Cleveland Co., North Carolina. In Mexico, from Santa Eulalia, Chihuahua. In Brazil, from the Énio pegmatite mine, northeast of Galiléia, Minas Gerais. Exceptional examples from Bolivia, as at Poopo, Llallagua, Avicaya, Tazna, Monserrat, Morococala, Tatasi, and elsewhere. In the Ashio mine, Tochigi Prefecture, Japan.

**Name:** Honoring John Henry Vivian (1785–1855), Welsh-Cornish mineralogist, of Truro, Cornwall, England, who discovered the species.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 742–746. (2) Fejdi, P., J.-F. Poullen, and M. Gasperin (1980) Affinement de la structure de la vivianite $Fe_3(PO_4)_2 \cdot 8H_2O$. Bull. Minéral., 103, 135–138 (in French with English abs.). (3) Rodgers, K.A., H.W. Kobe, and C.W. Childs (1993) Characterization of vivianite from Catavi, Llallagua, Bolivia. Mineral. Petrol., 47, 193–208. (4) (1979) NBS Mono. 25, 16, 38.