Woodruffite

\[(\text{Zn, Mn}^{2+})\text{Mn}_3^{4+}\text{O}_7\cdot 1-2\text{H}_2\text{O}\]

**Crystal Data:** Tetragonal. *Point Group:* \(4/m \ 2/m \ 2/m, \overline{4}2m, 4mm, 422, 4/m, \overline{4}, \text{or} \ 4.

In very fine-grained, concentrically-layered, botryoidal crusts and masses.

**Physical Properties:** *Fracture:* Conchoidal. *Hardness* = 4.5  \(D\text{(meas.)} = 3.71-4.01\)

\(D\text{(calc.)} = [3.75]\)


**Optical Class:** Uniaxial. *Anisotropism:* Strong. *Birefringence:* Weak.

**Cell Data:** *Space Group:* \(P4/mmm, P\overline{4}2m, P\overline{4}m2, P4mm, P422, P4/m, P\overline{4}, \text{or} \ P4. \ \ \ a = 8.42 \ \ c = 9.28 \ \ Z = [4]\)

**X-ray Powder Pattern:** Sandur, India.

4.66 (10), 2.66 (6), 2.48 (6), 9.34 (5), 1.48 (5), 1.86 (4), 1.69 (4)

**Chemistry:**

| SiO₂ | 0.86 | 1.28 | BaO | 0.12 | 0.62 |
| MnO₂ | 64.27 | 68.29 | Na₂O | 0.06 | 0.04 |
| Al₂O₃ | 0.14 | 0.96 | K₂O | 0.55 | 0.08 |
| Fe₂O₃ | 0.26 | 0.89 | H₂O⁺ | 8.48 |
| MnO | 7.88 | 8.46 | H₂O⁻ | 0.83 |
| ZnO | 13.89 | 9.42 | H₂O | 10.48 |
| MgO | 0.62 | 0.48 | Total | 99.13 | [99.83] |

(1) Sterling Hill, New Jersey, USA; Mn²⁺:Mn⁴⁺ calculated from stoichiometry. (2) Sandur, India; original total given as 99.84%.

**Occurrence:** In the oxidized portion of a metamorphosed stratiform zinc orebody (Sterling Hill, New Jersey, USA); in massive manganese ores (Sandur, India); in the oxidized zone of a Ag–Pb–Zn ore deposit (Lardeau, Canada); a component of ocean-floor Fe–Mn nodules.

**Association:** Franklinite, chalcophanite (Sterling Hill, New Jersey, USA); pyrolusite, cryptomelane (Sandur, India); smithsonite, gunningite, hydrozincite, aurichalcite (Lardeau, Canada).

**Distribution:** From Sterling Hill, Ogdensburg, Sussex Co., New Jersey, USA. At the Willett mine, Lardeau, British Columbia, Canada. From the Lecht mine, near Tomintoul, Aberdeenshire, Scotland. On Mont Chemin, Valais, Switzerland. From Maria Weitscach, near Hüttenberg, Carinthia, Austria. In Germany, at Juliushütte, Astfeld, Harz Mountains, in slag. From Sandur, Mysore, India.

**Name:** To honor Samuel Woodruff, American miner for the New Jersey Zinc Company, and prolific mineral collector of Franklin-Sterling Hill minerals.

**Type Material:** Harvard University, Cambridge, Massachusetts, USA, 112987.