Woodruffite  \( \text{Zn}_2(\text{Mn}^{4+}, \text{Mn}^{3+})_5\text{O}_{10} \cdot 4\text{H}_2\text{O} \)

**Crystal Data:** Monoclinic. *Point Group:* 2/m. In very fine-grained, concentrically layered, botryoidal crusts and masses; rare acicular crystals to “several hundred” \( \mu \text{m} \) (Mexico).

**Physical Properties:** *Fracture:* Conchoidal. *Hardness:* 4.5 D(meas.) = 3.71 - 4.01 D(calc.) = 3.983


**Cell Data:** *Space Group:* C2/m. \( a = 24.625(1) \quad b = 2.8355(1) \quad c = 9.5381(5) \quad \beta = 94.104(2)^\circ \quad Z = 1 \)

**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:**

\[
\begin{array}{cccc}
\text{SiO}_2 & 0.86 & 1.28 & \\
\text{MnO}_2 & [64.27] & 68.29 & \\
\text{Al}_2\text{O}_3 & 0.14 & 0.96 & \\
\text{Fe}_2\text{O}_3 & 0.26 & 0.89 & \\
\text{MnO} & [7.88] & 8.46 & \\
\text{ZnO} & 13.89 & 9.42 & \\
\text{MgO} & 0.62 & 0.48 & \\
\end{array}
\]

(1) Sterling Hill, New Jersey, USA; \( \text{Mn}^{2+}:\text{Mn}^{4+} \) calculated from stoichiometry. (2) Sandur, India; original total given as 99.84%. (3) Durango, Mexico; electron microprobe analysis (not given), \( \text{H}_2\text{O} \) from Ref. 1; corresponds to \( \text{Zn}_2.8\text{Mn}_{13.8}\text{O}_{28} \cdot 9.7\text{H}_2\text{O} \).

**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 [TL]. At the Willett mine, Lardeau, British Columbia, Canada. From the Lecht mine, near Tomintoul, Aberdeenshire, Scotland. On Mont Chemin, Valais, Switzerland. From Maria Weitschach, near Hüttenberg, Carinthia, Austria. In Germany, at Juliusiitte, Astfeld, Harz Mountains, in slag. From Sandur, Mysore, India. Crystals from near Mapimi, Durango, Mexico.

**Name:** Honors 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.

**References:**