Zvyaginite

\[ \text{NaZnNb}_2\text{Ti}[\text{Si}_2\text{O}_7]_2\text{O(OH,F)}_3(\text{H}_2\text{O})_{4+x} \quad (x < 1) \]

**Crystal Data:** Triclinic.  \( \text{Point Group: } \overline{1} \). As rectangular platy crystals to 2 cm, flattened on {001}, probably pseudomorphs after vuonnemite.

**Physical Properties:** \( \text{Cleavage: Perfect on } \{001\}, \) two other distinct sets are nearly perpendicular to each other and to {001} under a microscope. \( \text{Fracture: Stepped. Tenacity: Brittle.} \)

**Hardness = 2.5-3 \quad \text{D(meas.) = 2.88}(3) \quad \text{D(calc.) = 2.94} \)

**Optical Properties:**
- \( \text{Color: Colorless, pearly-white, creamy, yellowish brown, pale pink or lilac-pink.}\)
- \( \text{Luster: Pearly on crystal faces, greasy on breaks.} \)
- \( \text{Optical Class: Biaxial (-).} \)
- \( \alpha = 1.626(5) \quad \beta = 1.714(3) \quad \gamma = 1.740(5) \quad 2\nu(\text{meas.) = 45}(15)^\circ) \)
- \( \nu(\text{calc.) = 55}^\circ \quad \text{Dispersion: Weak, } r < v. \)
- \( \text{Orientation: } Y \text{ and } Z \text{ in the } \{001\} \text{ plane.} \)

**Cell Data:**
- \( \text{Space Group: } \text{P1-} \)
- \( a = 8.975(3) \quad b = 8.979(3) \quad c = 12.135(4) \quad a = 74.328(9)^\circ \)
- \( \beta = 80.651(8)^\circ \quad \gamma = 73.959(8)^\circ \quad Z = 2 \)

**Chemistry:**
- \( \text{Na}_2\text{O} \quad 4.74 \quad 3.89 \quad \text{SiO}_2 \quad 29.42 \quad 30.13 \)
- \( \text{K}_2\text{O} \quad 0.22 \quad \text{TiO}_2 \quad 12.33 \quad 10.02 \)
- \( \text{CaO} \quad 0.77 \quad \text{Nb}_2\text{O}_5 \quad 27.22 \quad 33.33 \)
- \( \text{MnO} \quad 1.36 \quad \text{F} \quad 1.94 \)
- \( \text{FeO} \quad 0.24 \quad \text{H}_2\text{O} \quad 12.65 \quad 12.43 \)
- \( \text{ZnO} \quad 9.61 \quad 10.20 \quad -\text{O}=\text{F}_2 \quad 0.82 \)
- \( \text{Al}_2\text{O}_3 \quad 0.19 \quad \text{Total} \quad 99.87 \quad 100.00 \)

(1) Mt. Malyi Punkaruaiv, Kola Peninsula, Russia; average of 5 electron microprobe analyses, \( \text{H}_2\text{O} \) by modified Penfield method; corresponding to \( \text{Na}_{1.24}\text{K}_{0.04}\text{Ca}_{0.11}\text{Mn}_{0.16}\text{Fe}_{0.03}\text{Zn}_{0.96}\text{Nb}_{1.66}\text{Ti}_{1.25} \) \( (\text{Si}_{3.97}\text{Al}_{0.03})_2\text{O}_{15.07} \) \( (\text{OH})_{2.16}\text{F}_{0.83}(\text{H}_2\text{O})_{4.64} \)  (2) \( \text{NaZnNb}_2\text{Ti}[\text{Si}_2\text{O}_7]_2\text{O(OH,F)}_3(\text{H}_2\text{O})_{4.64} \)

**Mineral Group:** Epistolite group.

**Occurrence:** In a hydrothermally-altered peralkaline pegmatite lens in a peripheral part of the ussingite core near its contact with the aegirine-eudialite zone; the pegmatite is part of a larger complex alkaline igneous intrusion. Possibly the product of a cation exchange reaction between epistolite and low-alkali aqueous (late hydrothermal) solutions enriched in \( \text{Zn}^{2+} \).

**Association:** Microcline, sodalite, arvedsonite, sphalerite, pectolite-sérandite, mangan-neptunite, murmanite, vigrishinite, epistolite, belovite-(Ce), steenstrupine, chkalovite, tugtupite, polylithionite, galenite.

**Distribution:** From pegmatite #71, Mt. Malyi Punkaruaiv, Lovozero alkaline complex, Kola Peninsula, Russia.

**Name:** Honors Russian crystallographer, crystal chemist and physicist Boris Borisovich Zvyagin (1921-2002), who was a pioneer and expert in electron diffraction studies of materials.

**Type Material:** A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (#94140).

**References:**