An unusual perhamite-pollucite-lepidolite-fluorapatite-quartz assemblage in the Emmons pegmatite, Greenwood, Oxford Co., Maine, USA: implications for the origin of this unusual paragenesis

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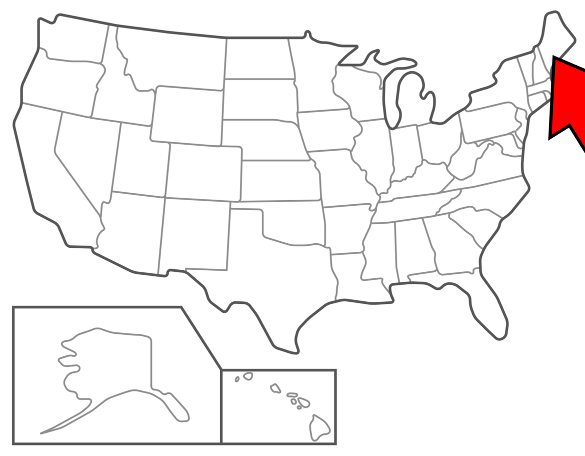

Figure 1: US map with state of Maine indicated.

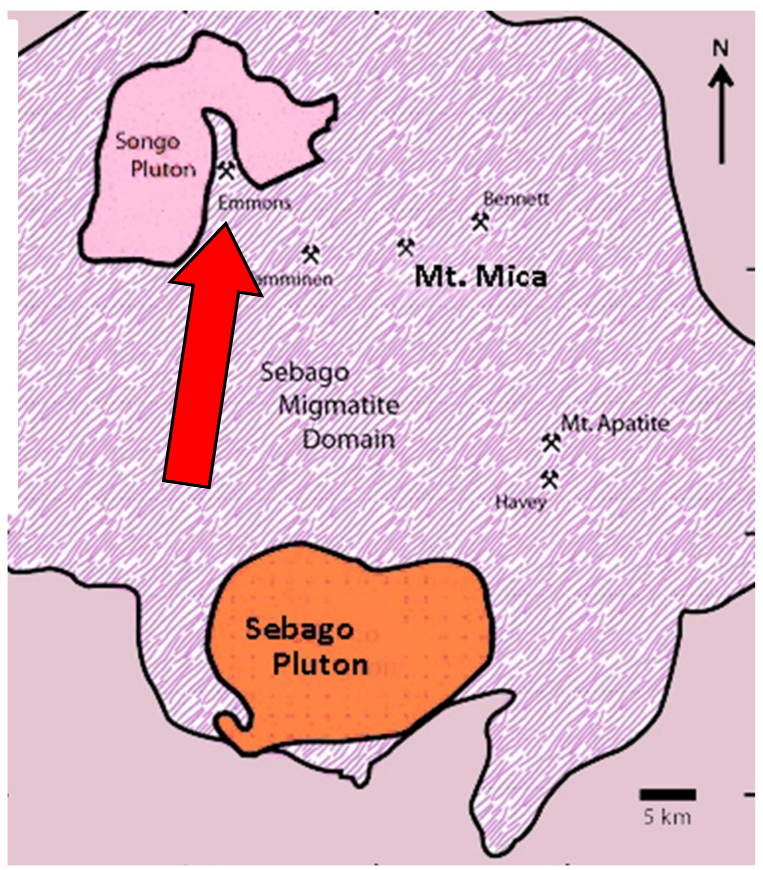

Figure 2: Regional geological map showing the Emmons pegmatite within the Sebago Migmatite Domain.

Figure 3: The Emmons pegmatite cutting across the metamorphic country rock.

Figure 4: Pollucite mass in situ at the Emmons pegmatite. 1.5 m across.

The Emmons pegmatite is a large, peraluminous, LCT-type pegmatite exposed on Uncle Tom Mountain, Greenwood, Oxford County, ME. This gently dipping, 300 Ma dike intrudes Paleozoic metapelite and metacarbonate rocks. The pegmatite is complexly zoned with a wall zone comprised of K-feldspar, quartz, almandine and schorl, which locally exhibit a comb structure. Small pockets containing goyazite occur sporadically in the wall zone near the country rock contact. The intermediate zones are comprised of K-feldspar, quartz, muscovite, and spodumene. A quartz-rich core is present but is poorly exposed. Replacement units along the core - intermediate zone boundary have undergone extensive alteration and replacement. Nb-Ta oxide minerals are widespread and include columbite-(Fe), columbite-(Mn), tantalite-(Mn) and wodginite group species. Secondary minerals include vuggy albite, cleavelandite, and a dense and fibrous grayish-green muscovite which occurs as a fracture filling and as a secondary mineral replacing schorl and garnet. Additionally, pollucite pods several meters in size, large phosphate nodules (up to 15 cm in diameter), löllingite with minor arsenopyrite, and beryl up to 35 cm in size are present.

Pollucite from the Emmons pegmatite occurs in masses up to approximately 1 m. These pollucite masses are cut by numerous thin veins in the central and upper portion of the pollucite masses which consist of pale pink lepidolite and feldspars (Figures 1A, B). The thicker veins that are 2 mm and above in thickness and show distinct zoning and possess a core of very low Cs analcime (Figure 1C). The veins in the bottom portion of the pollucite masses are distinctly different in their mineralogy: the veins are generally thinner, rarely exceeding 1 mm in thickness. They consist of lepidolite and feldspars but lack an analcime core. The outside of the veins is coated with fluorapatite of simple morphology and tiny crude quartz crystals (Figures 2A, B). There are also abundant small sprays (up to 2 mm in diameter) and single crystals of perhamite.

The distinctively different mineralogy of the veins near the bottom edge of the pollucite masses may be related to late-stage fluids emanating from a very large miarolitic cavity system that has been named by the miners as the 'Gross pocket,' from which very little valuable specimen material was taken. The contents of this cavity were dominated by muscovite, albite, quartz and fluorapatite. Fractures formed in the pollucite masses and fluids from the nearby miarolitic cavity entered and supplied Ca, P, Al, Li and F to form the described vein minerals.

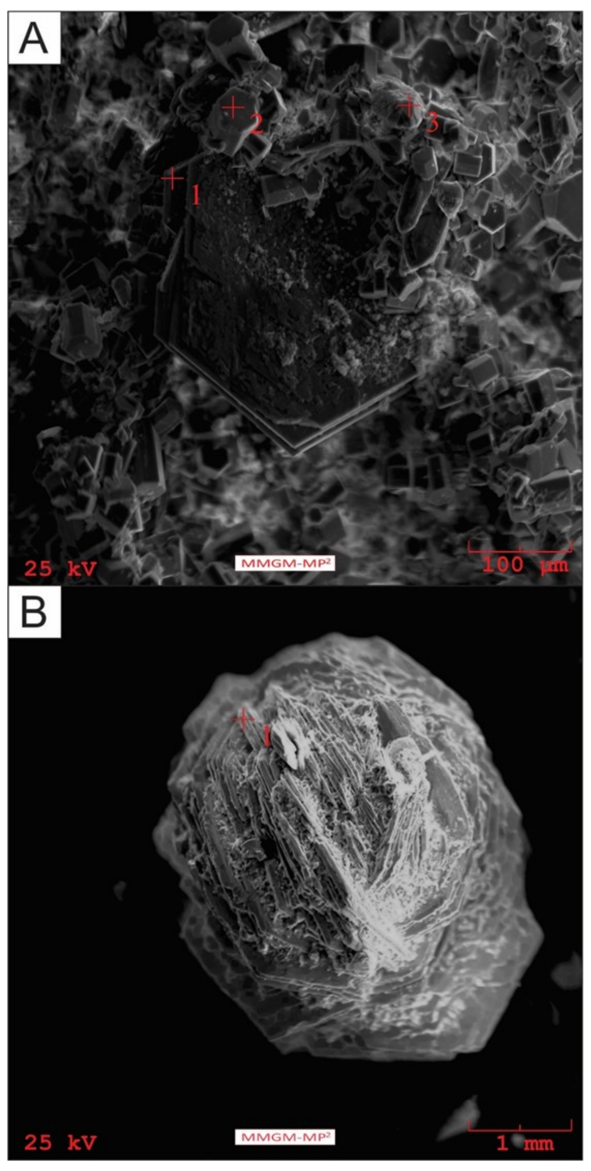

Figure 6. *A - Surface of a vein from the bottom of the pollucite mass showing perhamite (1), fluorapatite (2), and quartz (3). B - Secondary electron image of a perhamite cluster from the massive pollucite just adjacent to the veins.*

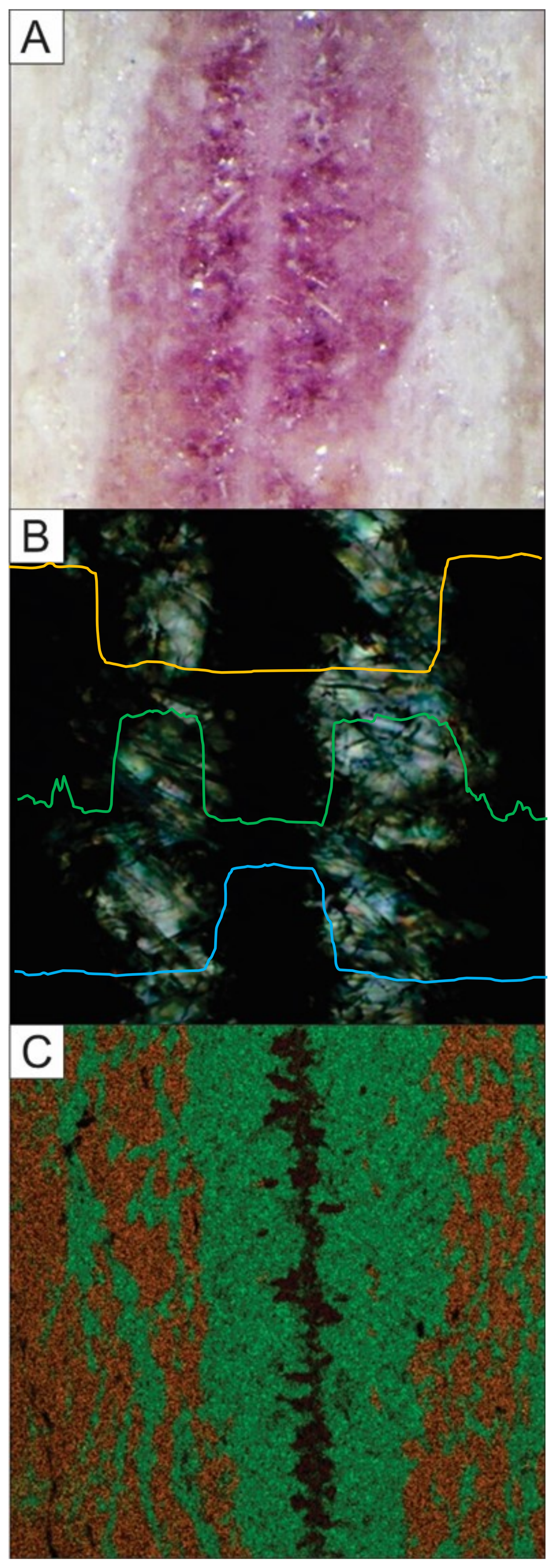

Figure 7. *A - Light photomicrograph of a vein in the interior of the pollucite masses. The lighter central streak is analcime. Around the vein in white is pollucite. B - Petrographic image under crossed Nichols shows analcime in the center and pollucite to the sides of the vein at extinction. Superimposed are energy dispersive line scans for Cs (orange), K (green) and Na (blue). C - X-ray map of a vein in the central portion of the pollucite masses: Na: red, K: green, Cs: orange. Note that the boundary of the vein is not sharp. The dark red center is where the analcime is present. Width of field in Figs 1a -1c is 3 mm.*

Figure 5: Perhamite from the Emmons pegmatite. This specimen is 2 cm wide and was recovered from a small miarolitic cavity. Photo by Ray Sprague.

Perhamite

$$Ca_3Al_7(SiO_4)_3(PO_4)_4(OH)_3 \cdot 16.5(H_2O)$$

References

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