



## COLUMBITE GROUP MINERAL EVOLUTION ACROSS ZONATION IN THE EMMONS PEGMATITE, GREENWOOD, ME.

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Columbite Group Minerals (CGM) encompass the columbite-tantalite solid solution series  $[(\text{Fe}^{2+}, \text{Mn}^{2+})(\text{Nb}, \text{Ta})_2\text{O}_6]$  where Mn and Fe occupy the A-site and Nb and Ta occupy the B-site. Mn/Fe and Ta/Nb ratios in CGM vary depending on their degree of geochemical evolution. As the degree of evolution increases, CGM fractionate towards higher Mn/Fe and Ta/Nb, with both pairs showing an inverse linear correlation. As CGM are a relatively common accessory mineral in pegmatites, they are a useful indicator of the geochemical evolution of the pegmatite melt during formation.

The Emmons pegmatite in Greenwood, Oxford County, Maine is a highly evolved, complexly zoned, boron-lithium-cesium-tantalum-enriched (LCT/DPA Group 1) pegmatite believed to have formed through anatectic remelting. Emmons is known for being incredibly species-rich with 243 currently identified species, including those in the columbite group. The represented ideal zonation (Figure 1) of the Emmons constitutes a wallzone, intermediate zone and core margin in the hangingwall and footwall mirrored across a core zone. CGM were obtained from 60 drill core samples extracted across all zones of the pegmatite. CGM chemistries were quantified through heavy mineral separation and energy dispersive spectral (EDS) analysis.

Columbite-(Fe), Columbite-(Mn), and Tantalite-(Mn) were found, with no Tantalite-(Fe) or Tapiolite-(Fe) identified. No CGM were found in the hangingwall wallzone. Analyses show that the Emmons pegmatite displays elevated Fe and Nb in the outer zones of both the hangingwall and footwall with lower Mn and Ta, and inversely the inner zones contain elevated Mn and Ta with lower Fe and Nb (Figure 2). Both pairs of Mn, Fe and Ta, Nb are inversely linearly correlated. These results correspond to the increasing evolution of the bulk melt as the pegmatite crystallized from the outside inwards.

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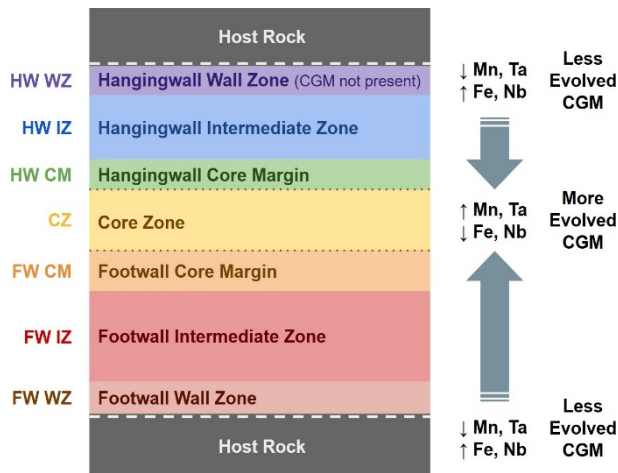


Figure 1. Idealized zonal structure of the Emmons pegmatite with Mn-Fe evolution of CGM.

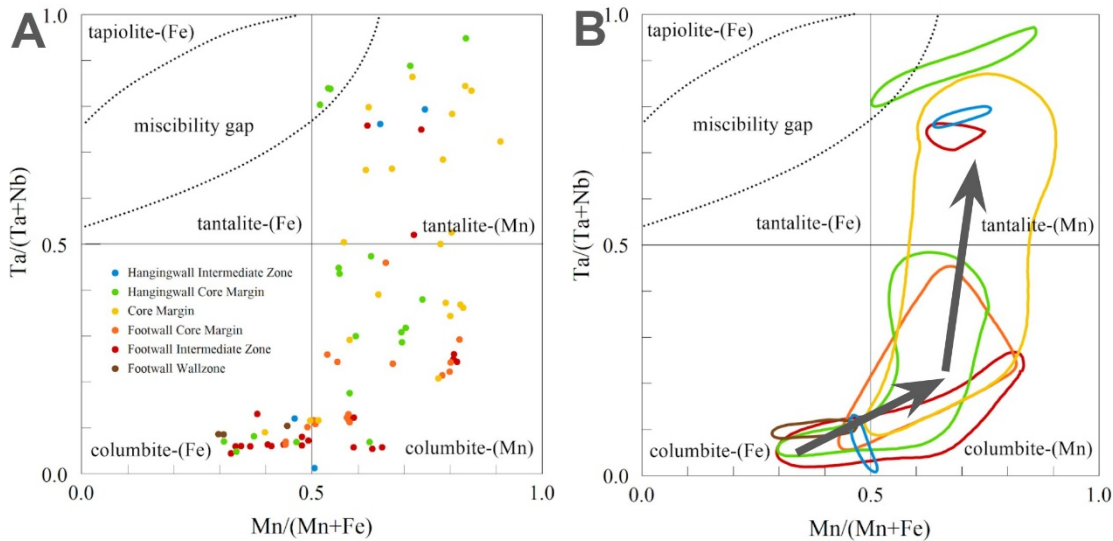


Figure 2.

(A) Plotted data of CGM composition in all zones. (B) Representative regions of data spread in each zone with the suggested evolutionary pathway.