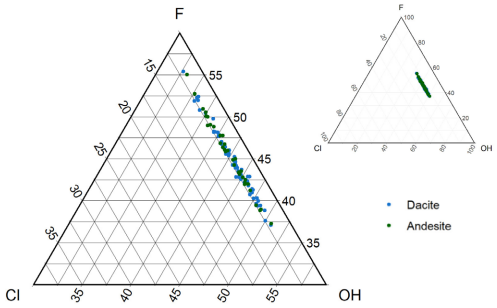
Goldschmidt 2026 Abstract
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Apatite as an Indicator for Volatile Behavior in Intermediate-to-Silicic Zoned Eruptions at Cosigüina Volcano, Nicaragua

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Cosigüina is an active stratovolcano in northwestern Nicaragua capable of volcanic explosivity index (VEI) ≥ 5 eruptions. Field observations from Cosigüina identified plinian deposits from a series of large andesite-to-dacite, compositionally zoned eruptions, the largest of which we denote as Tephra F. Repeated zonation in Cosigüina eruptions supports a single stratified magma chamber triggered by a common eruptive mechanism. Previous research suggests overpressurization driven by volatile exsolution as the trigger for the most recent Cosigüina eruption in 1835. Thus, the goal of this study is to investigate volatile behavior in Cosigüina's Tephra F zoned eruption using apatite, a phosphate mineral that accepts magmatic volatiles (OH, F, Cl) up to wt.% levels in its structure. Apatite readily re-equilibrates its halogen content with changes to melt composition. Therefore, the volatile contents of phenocryst-hosted apatite inclusions and apatite zonation during crystal growth are useful indicators of volatile behavior during magmatic evolution. We collected volatile data by Electron Microprobe Analysis (EMPA) on apatite microphenocrysts and phenocryst-hosted apatite inclusions along with matrix glasses from Tephra F. Results indicate indistinguishable Cl content between dacite and andesite apatites with identical means of 0.854 wt.% over a range of 0.815-0.897 wt.%. By contrast, the range of F content in apatite is almost an order of magnitude larger (1.403-2.09 wt.%) and mean F content varies slightly between dacite (1.68 wt.%) and andesite (1.71 wt.%) horizons. A homogeneous Cl signature means that apatite's ternary OH-F-Cl substitution is dominated by a proportional XF vs XOH relationship (Attached Figure). Further analysis shows that the volatile contents of apatite microphenocrysts overlap with those of phenocryst-hosted apatite inclusions, suggesting limited volatile differentiation during crystallization. Constraining volatile behavior, along with the addition of apatite-based melt modelling, will allow us to better understand and explain the magmatic behavior of Cosigüina volcano.