Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38102

Development of a Portable X-ray fluorescence(pXRF) Method for Rapid Geochemical Analysis of Coarse-Grained Rocks: A Case Study from the Mt. Lowe Intrusion, San Gabriel Mountains, California

JI-IN SOPHIA REE[1], CLAIRE E BUCHOLZ[1], PAUL D. ASIMOW[1] AND JASON B PRICE[2,3]

[1]California Institute of Technology
[2]Oregon State University
[3]Ibex Exploration LLC

Portable X-ray fluorescence (pXRF) is a powerful tool for rapid, in situ geochemical characterization in the field. However, its application to coarse-grained plutonic rocks is challenging because the small (~1 cm^2) analytical spot size does not integrate over a sufficiently large area to yield representative bulk compositions. Large grain sizes, mineral-scale heterogeneity, and matrix-dependent effects can bias measurements away from true bulk-rock chemistry.

Here, we develop and validate a reproducible pXRF workflow optimized for coarse-grained granitoids, using the Mount Lowe Intrusion (MLI), San Gabriel Mountains, California, as a case study. The MLI displays strong mineralogical zonation and systematic compositional gradients, making it well-suited for evaluating pXRF performance across evolving magmatic assemblages. Petrologically, the intrusion ranges from monzodioritic to granodioritic in composition, records relatively deep crystallization conditions (~0.7 GPa), and locally contains Ca-rich garnets, which is unusual for felsic arc plutons. Despite its geological significance, the MLI has not been studied in detail since the 1980s, and its location within a national monument designated in 2014 limits destructive sampling, further motivating the development of a robust non-destructive geochemical approach. We have a reference suite collected before the designation and plan to revisit each of the sampling sites for pXRF analysis.

Our protocol integrates (1) multi-spot averaging strategies to reduce grain size effects and mineral scale heterogeneity, (2) standardized surface preparation to minimize roughness effects, (3) correction of matrix effects by using secondary reference materials with similar compositions, and (4) precision assessment through comparing pXRF acquired in the field with laboratory measurements. Major elements (Si, Al, Mg, Fe, Ca, K, Ti, Mn) and key trace elements (Sr, Ba, Rb, Zr) are evaluated for accuracy, precision, and reproducibility relative to conventional XRF analyses.

This workflow enables the application of pXRF to plutonic rocks where sampling is restricted or high spatial-density geochemical mapping is required. By establishing methodological constraints and best-practice calibration strategies, this study provides a transferable framework for rapid, non-destructive geochemical characterization of coarse-grained intrusive rocks.