Biotite trace element fingerprints (V-Co-Nb) identify magma batches and correlate volcano sequences at Las Cañadas Volcano, Tenerife

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Accurate identification of single volcanic events in the field is crucial for constraining eruption volumes and calculating recurrence intervals between eruptive episodes. Due to intra-unit textural variability as well as the complexities of pyroclastic transport and deposition, such identification can be challenging. We present a novel method for fingerprinting ignimbrites via trace element chemistry (V, Co, Nb) in biotite by laser-ablation inductively-coupled-plasma mass spectrometry (LA-ICP-MS). Using samples from the alkaline ocean island of Tenerife, we are able to demonstrate: (1) clustering of previously-characterized units into distinct, homogeneous groups in biotite-V/Co/Nb space; (2) preservation of homogeneous biotite-V/Co/Nb even in the presence of extreme variation and zonation in other trace elements (Ba, Sr, Rb); (3) the magnitude of difference in biotite-V/Co/Nb space exceeds the magnitude of variability in major elements (e.g. Al_2O_3), meaning that the latter can be estimated from stoichiometry for LA-ICP-MS internal calibration, thus making microprobe analysis optional and underscoring the efficiency of LA-ICP-MS fingerprinting as a reconnaissance tool; (4) biotite compositions are homogeneous throughout a deposit and not changed by stratigraphic height or juvenile clast texture (crystal-rich vs crystal-poor). We propose that biotite trace element archives allow us to (1) fingerprint eruptions at least as large as the ones on Tenerife (VEI ~4) and correlate turbidite records/geographically-separated deposits and (2) biotite serves as a faithful marker of the magmatic melt environment throughout much of the evolved magmatic history.