

Novel Applications of Time of Flight (TOF) Mass Spectrometry to Compositional Mapping

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Laser ablation inductively coupled mass spectrometry (LA-ICP-MS) is increasingly becoming an integral tool for mineral exploration. Popular applications include using mineral chemistry to assess fertility and as a tool for vectoring to mineral deposits; along with compositional maps, where the spatial distributions of elements can provide constraints on mineral growth histories and metal deportment. Although widespread, quadrupole instruments have many limitations, particularly for compositional mapping where analytical times can be lengthy and measured isotope choice is limited. Coupling a laser ablation system with ultra-fast washout to a time of flight (TOF) mass spectrometer makes it possible to measure most of the periodic table (Na – U) quasi-simultaneously from a single laser pulse allowing for high resolution maps of large areas to be produced substantially faster than with a quadrupole mass spectrometer. Here, we showcase some applications of compositional maps obtained with LA-ICP-TOF-MS, including a new method to map and quantify groundmass compositions, applicable to a range of sample types. These groundmass compositions can be used as proxies for melt composition, providing constraints on magma sources and processes. Results from preliminary testing of this method, comparison groundmass compositions obtained by LA-ICP-TOF-MS mapping to bulk rock compositions obtained by XRF of unaltered volcanic rocks from New Zealand and Iceland will be presented. Our approach highlights the strength of using LA-ICP-TOF-MS to rapidly collect high-resolution compositional data and indicates where improvements to quantifying these data can be made.