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High Throughput, High-Resolution Major- and Trace-Element Mapping via Laser-Ablation Time-of-Flight Mass Spectrometry

ANDREW KYLANDER-CLARK[1], MORGAN ADAMSON[1] AND JOHN M. COTTLE[2]

[1]University of California, Santa Barbara
[2]Department of Earth Sciences, University of California, Santa Barbara, CA, USA

High-resolution elemental mapping is a cornerstone of petrology, allowing researchers to decode a rock's evolution by tracking elemental exchange between minerals and their surroundings. However, traditional mapping via electron probe microanalyzer (EPMA) is often a bottleneck; it requires hours of analytical time, is limited to major and minor elements, and can only detect a few elements simultaneously. The emergence of time-of-flight inductively coupled plasma mass spectrometry (TOF-ICPMS) paired with ultrafast-washout laser cells represents a paradigm shift, promising faster throughput, lower detection limits, and the ability to map almost the entire periodic table at once with minimal sample consumption. In this study, we utilize an ESL ImageGeo Laser (~1 ms washout; 1000 Hz) and a Nu Instruments Vitesse TOF-ICPMS to define and optimize the parameters necessary for high-quality, accurate mapping. By comparing our data against both theoretical models and traditional EPMA results, we provide practical methodology recommendations for researchers looking to integrate these high-speed analytical tools into their own geochemical ventures.