

Improving Data Precision and Accuracy with Short-Term and Long-Term Elemental Fractionation Corrections for Non-Matrix Matched Silicate Analysis by LA-ICP-MS

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Laser ablation ICP-MS analyses are becoming increasingly common but there remain issues of precision and accuracy related to matrix effects. Even for the more advanced laser technologies, there has been the need of separate determination of an internal standard element and matrix-matched standards due to the elemental fractionation. There are two types of elemental fractionation in LA-ICP-MS analysis: elemental fractionation within the data acquisition of a single spot ablation after laser is fired, and fractionation over the course of a run of many hours. These can be referred to as short-term and long-term elemental fractionation respectively. Long-term fractionation can be dealt with by repeated standard analyses throughout a run. But short-term fractionation is more difficult, and can occur despite normalization to an internal standard element determined by other methods, such as Ca or Ti. We have investigated short-term fractionation for a number of standards, and find that even for two basalts there can be variations of as much as 30% over a sixty second ablation (*e.g.* Cu/Ca or Pb/Ca in BCR-2G divided by Cu/Ca or Pb/Ca in MORB). Using the mean then leads to serious inaccuracies, and it appears that some of these inaccuracies have propagated into preferred standard values by LA-ICP-MS. The short-term fractionation is usually linear within 100 seconds of data acquisition, permitting the possibility of regressing the data acquisition of a single spot ablation back to the initial time steps (Chen in JAAS 1999). This correction applies across a very wide range of compositions, holding the possibility of greatly reducing the problem of exactly matching standards with samples. There is then also the long-term fractionation that takes place during a run, which requires regularly spaced standards throughout the run to determine the change in the slope of calibration curves. Using collision cell technology, it is now also possible to obtain all the major and minor elements on homogeneous silicate glass and mineral compositions. For samples with low or predictable volatile contents, normalizing to a fixed sum leads to excellent agreement with microprobe analyses (<2%), eliminating the need for a separate determination of internal standard elements. Correction for short-term and long-term fractionation combined with complete major and minor element analyses on the same homogeneous silicate samples leads to the possibility of a single, rapid method for determination of a large suite of major, minor and trace element composition of silicates.