Correction of fractionation in LA-ICP-MS elemental and U-Pb analysis

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Reduced precision and accuracy can occur in LA-ICP-MS analysis when critical element pairs (*e.g.*, analyte and internal standard, radiogenic parent and daughter) have substantially different volatility and, thus exhibit fractionation during ablation, transport and vaporisation in the ICP. The response to these matrix-dependent, non-stoichiometric processes has largely been to attempt hardware 'fixes' that minimise fractionation. None of these approaches has been widely adopted.

This work investigates post-analytical correction of fractionation-related biases, both for trace element analysis and U-Pb dating. A procedure has been developed that employs the signal ratios of two (or more) mutually fractionating major elements, with known concentration ratio, to effect a fractionation correction for the analytes [1]. This approach is here applied to LA-ICP-MS analysis of sulphide minerals, which has been restricted, to date, by the lack of sulphide standards. Accurate analyses are achieved using non-matrix-matched (glass) standards.

The same correction approach is extended to LA-ICP-MS U-Pb zircon dating, which is currently beset by minor biases and degraded precision due to variable fractionation of U and Pb during ablation sampling. It is shown that the intensity ratio for a major element pair, Si and Zr(+Hf), which also fractionate during ablation, can be used to correct the Pb-U fractionation effect. This procedure substantially reduces biases related to matrix differences, crystal orientation and ablation conditions, and provides near counting statistics-limited precision on Pb-U ratios.

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Aerosols over the United States: Space observation, source characterization, and climate interactions

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We present a new method for retrieving aerosol optical depth (AOD) over land from MODIS satellite measurements of backscattered radiances. The method uses improved constraints on surface reflectances together with local information on aerosol optical properties from aircraft observations and a chemical transport model (GEOS-Chem CTM). We apply the method to an integrated analysis of aerosols over the eastern U.S. in summer 2004 using MODIS together with data from aircraft (ICARTT campaign), surface networks (IMPROVE, AERONET) and model simulations. We find that our MODIS retrieval improves significantly on the standard operational products and enables a better inference of surface aerosol concentrations from the satellite AOD data. A consistent feature from the ensemble of U.S. data is that standard models overestimate sulfate aerosol and underestimate organic aerosol, and we discuss possible explanations. In particular, we examine the possible role of incloud reactions of dicarbonyls as a source of secondary organic aerosol. Anthropogenic sources of aerosols in the U.S. have increased over the past decades but are now decreasing, and we use simulations with a general circulation model (GCM) to examine the implications for regional climate. Finally, we show through correlations of U.S. aerosol concentrations with meteorological variables that climate change could have a significant effect on particulate matter (PM_{2.5}) air quality.