

Robust trace element analysis of rutile by LA-ICP-MS

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Several recent studies reporting trace element results for rutile by LA-ICP-MS using spot sizes as large as 40 μm . However, even Q-ICP-MS are sensitive enough to have a suitable signal-to-background ratio for a number of important trace elements in most natural rutiles (*e.g.*, V, Cr, Fe, Zr, Nb, Sn, Hf, Ta, W and U) at spot sizes of only 10 μm . Here, counting statistics give errors better than 5% for Zr concentrations on the 100 ppm level (translating to analytical errors in metamorphic temperatures of only a few $^{\circ}\text{C}$). Still, the level of accuracy is so far unknown at such small spot sizes mostly due to a lack of suitable rutile standards.

Recently, we have proposed to use three natural (R10, R19, Diss) and one synthetic (Sy) rutiles as secondary mineral standards [1]. These minerals are sufficiently homogeneous and analyzed by several techniques (EMP, SIMS, ID-MC-ICP-MS) for a range of trace elements to test LA-ICP-MS performances. Therefore, we have run several LA-ICP-MS profiles with variable spot sizes (10-40 μm) along the same EMP and SIMS profiles as reported in [1].

Most importantly, it is found that spot size differences can have a severe effect on calculated rutile concentrations for such small spots. For example, calculated Zr concentrations for rutile systematically deviate by 40% between 10 and 40 μm . This makes it an absolute necessity to always use identical spot sizes at such small scales. Furthermore, it can be demonstrated that an accuracy of <10% is reached for most trace elements for the rutile standards R19 and Diss when R10 is used as a matrix matched standard under the exact same analytical conditions.

The demonstration of an accuracy of <10% for 10 μm spot analysis for rutile by LA-ICP-MS significantly opens up the field of rutile geochemistry. In Mainz, with the help of a fast-washout large format cell and automatization, we routinely use such small spot sizes for rutile trace element analysis with a sample throughput of >60 samples/hour. Applications are found *e.g.*, in pre-scanning for high-U detrital rutiles suitable for U/Pb dating [2] and fine-scale Nb diffusion profiles [3].

[1] Luvizotti *et al* (2009) *Chem Geol* **261**, 346-369, [2] Zack *et al* (in press) *Contr Min Petrol*, [3] Cruz-Uribe *et al*, *MinMag*, this volume

Effect of plant-microbial associations on weathering of basalt, granite, schist, and rhyolite

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The goal of this study was to measure how plant-microbe interactions affect the initial weathering of four distinct rock types (basalt, granite, schist, and rhyolite) and the extent to which this weathering results in chemical denudation versus biomass accumulation or re-precipitation of dissolution products. This initial phase of experiment focused on denudation. We hypothesised that the presence of plants will increase weathering but decrease denudation (*i.e.*, we will see more mineral transformation but less element loss from system in the presence versus absence of plants). To achieve research objectives, we conducted a series of environmentally-controlled, greenhouse experiments that involved measuring plant uptake, mineral transformation and chemical denudation in basalt (35.9% An64 plagioclase, 6.5% diopside, 11.9% forsterite, and 45.7% basaltic glass), granite (28.8% quartz, 31.1% K-feldspar, 32.8% albite, and 7.2% muscovite), rhyolite (32.6% quartz, 15.9% albite, and 51.5% K-feldspar in crystalline form, plus yet unquantified glass fraction), and schist (23.8% quartz, 22.8% K-feldspar, 14.2% albite, 7.6% amphibole, and 31.7% biotite), as affected by presence and growth of microbiota and vascular plants. The experiments also included plant-free (but microbially-colonized) and abiotic (sterile) controls. Buffalo Grass (*Buchloe dactyloides*) and Ponderosa Pine (*Pinus ponderosa*) were employed as model plant species. Plants were grown in 4 cm (diameter) by 30 cm (length) Plexiglas columns filled with granular study materials. Columns were equipped with micro-suction cup solution samplers to collect soil solution. Solution was analysed to determine pH, cations and metals, anions, and aqueous phase organic matter chemistry. Concentrations of low molecular weight organic acids in soil solution and drainage water were also determined.