Progress in laser ablation analysis of apatite

T. ZACK

Department of Earth Sciences, University of Gothenburg, Sweden (zack@gvc.gu.se)

Investigation of the chemical compositions of apatite critically hinges on the quality of the analytical analysis. The developments and advancements in methodology at the Gothenburg microgeochemical laboratory are applicable to the apatite analysis. Protocols have been created that remove assuming the concentration of one element in the trace element analysis by laser ablation ICP-MS. Here, a spread of CaO content from 52 to 55 wt% (>5% variation) in several well-characterized apatites can be reproduced within 1% error by measuring all relevant elements (e.g., Ca, P, Cl, REE, Na, As, S), adding O stoichiometrically, assuming F to be 1-Cl and normalizing the result to 100 wt%.

Such an improvement may be trivial when trace element patterns are plotted on a logarithmic scale (e.g., for REE pattern evaluation), but is critical when high precision analysis are required, as in laser ablation based fission track analysis (e.g., Soares *et al* 2014). We have further reduced the uncertainty of the fission track age by developing apatite standards (homogeneous fragments from Durango and Mud Tank) with known uranium concentrations (<2% error by ID-ICPMS; Stockli unpublished). Contrary to earlier studies, errors on laser ablation-based fission track ages on apatite can be reduced to «10% and will primarily depend on counting statistics of the counted fission tracks.

Unlocking the wealth of information stored in apatite by means of highly variable halogen (only Cl, Br and I are considered; F cannot be ionized in ICP-MS) is becoming possible using LA-ICP-MS, by overcoming a number of analytical challenges, in particular a lack of standards, low sensitivity and high backgrounds. While standards for chlorine can easily be obtained from EMPA measurements of apatite standards, no widely available bromine and iodine standards exist. This can be compensated by using synthetic halides as standards (e.g., RbBr and RbI). They reveal sensitivities of iodine comparable to most lithophile elements, while bromine has only 10% of the sensitivity of iodine and chlorine only 1%. Reduction of background is an ongoing challenge, making it necessary to replace all Tygon tubing (Cl-based polymere) by Teflon tubing. Significant reduction in the Br and I background signal was reached by adding a charcoal trap to clean the carrier gas.

[1] Soares *et al* (2014) *Phys Chem Minerals* **41**, 65-73.