European Mineralogical Conference
Vol. 1, EMC2012-568, 2012
European Mineralogical Conference 2012

Single grain rutile U-Pb geochronology by LA-MC-ICP-MS: new approach and reference materials and applications to sedimentary provenance in the Eastern Himalaya

L. Bracciali (1,2), R. R. Parrish (1,3), D. J. Condon (1), M. S. A. Horstwood (1), Y. Najman (1,2)

(1) NERC Isotope Geosciences Laboratory, British Geological Survey, Keyworth, United Kingdom (laur@bgs.ac.uk), (2) Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom, (3) Department of Geology, University of Leicester, United Kingdom

Rutile is an accessory mineral widely distributed in many igneous and metamorphic rocks and due to its stability during sedimentary processes is commonly found in the heavy mineral suite of detrital rocks. Similarly to zircon and other U-bearing minerals, it can be dated by the U-Pb method, but it has so far received less attention because it usually has a lower U content compared to zircon (which in turn leads to lower radiogenic Pb content) and it can contain a relatively large proportion of common (non radiogenic) Pb. In addition, there is a lack of large natural rutile reference materials that can be used to assess reproducibility and accuracy of the dating technique, with the exception of e.g. rutile R10 and R19 (Luvizotto et al. 2009, Chem Geol; Zack et al. 2011, Contrib. Min. Pet.).

Compared to zircon, rutile is characterized by a lower closure T for Pb diffusion (around 500ºC, although there is not yet agreement on closure temperature estimates) and hence rutile U-Pb ages of unzoned grains primarily indicate the time since the last significant metamorphism or cooling below ~500ºC. It follows the importance of this mineral as a geochronometer in a variety of studies aimed at determining the timing of low T metamorphism or constraining the cooling histories of metamorphic terranes. In sedimentary provenance, rutile has the potential to become a key provenance tracer, as it adds an important lower temperature complement to zircon (or in general to other detrital minerals that retain Pb at a different temperature range), and together comprise a much more unique isotopic fingerprint of the source region, allowing more confident identification of source areas or reconstruction of basin depositional histories.

In this study we have developed the rapid U-Pb dating of single grains of rutile by laser ablation multi-collector ICP-MS (LA-MC-ICP-MS), a technique that only in the last years has been applied to rutile dating. We introduce the use of two new natural rutile materials as primary and secondary reference material during the analysis (Sugluk4 and PCA-S207, for which new high precision ID-TIMS U-Pb data are also presented). Laser ablation U–Pb data were collected using a solid state or an excimer 193 nm wavelength laser ablation system (New Wave Research) coupled to a multiple-collector inductively coupled plasma mass spectrometer (Nu Plasma HR, Nu Instruments). The latter has a specially designed collector block to allow simultaneous detection of all masses in the range 202–207, 235 and 238. The analytical measurement of rutile U-Pb data is rapid, has comparable precision to zircon and high spatial resolution (the laser sampling protocol employs a 50 or 35 μm static spot) and does not include common lead correction.

Examples of detrital rutile grains from modern rivers draining the Eastern Himalaya dated following this approach are presented in this study, and compared to detrital zircon U-Pb data from the same sample.