Coupled LA U-Pb chronology of detrital zircon and rutile: A powerful provenance tracer

L. BRACCIALI[12]*, R.R. PARRISH[13], M.S.A. HORSTWOOD[1] AND Y. NAJMAN[2]

[1]NERC Isotope Geosciences Laboratory, British Geological Survey, Keyworth, UK
(*correspondence: laur@bgs.ac.uk)
[2]Lancaster Environment Centre, Lancaster University, UK
[3]Department of Geology, University of Leicester, UK

The development of improved precision dating methods, increased diversity of methods and proliferation of high spatial resolution approaches in recent years has made a dramatic impact to Earth Science research. However, focusing on the right method/procedure to address different geological problems is essential to solve problems and maximise the impact of research. Dating techniques are widely applied to provenance studies in order to discriminate between potential source areas, to track the evolution of river drainage basins, to assess sediment budgets and erosion patterns across orogens and to infer feedback relationships between erosion, tectonics and climate. These methods involve high throughput analysis, and it is not uncommon to lose sight of the complexity of zircon and other grains in relation to the problem being addressed.

We have developed a new approach to LA-ICP-MS U-Pb dating of rutile and characterised two new reference materials [1]. We have also refined an approach to LA ICP-MS U-Pb dating of detrital zircons that uses CL imaging to identify and date all zircon components with a focus on very thin (<5 μm) rims that record the latest growth events that otherwise would be missed due to their <5 μm width on a polished surface.

U-Pb dates on zircon and rutile records medium- to high-temperature igneous and metamorphic crystallisation events and cooling through ~500 ºC, respectively. The U-Pb analysis of detrital zircon and rutile from the same sample allows tracking of multiple crystallisation and tectono-thermal events of the source areas over a broad range of temperatures in a much more definitive and revealing manner than zircon alone. This is key to provenance studies where the detritus is sourced from areas with complex polyphase metamorphic histories such as collisional orogens. We have applied our method to Himalayan-derived sediments in the Eastern Himalaya to unravel Neogene tectonic-erosion relationships, and have found rutile and zircon rim ages as young as 1 and 5 Ma, respectively, inferring derivation from the Namche Barwa eastern syntaxis area.

[1] Bracciali et al. (2013) Chemical Geology

Insight on formation and evolution of cratonic mantle: Re-Os dating of single sulfides from Somerset mantle xenoliths (Rae Craton, Canada)

A. BRAGAGNI[1]*, A. LUGUET[1], D. G. PEARSON[2], R.O.C. FONSECA[1] AND B. A. KJARSGAARD[3]

[1] Steinmann Institute, Universitaet Bonn, Germany
(*correspondence: bragagni@uni-bonn.de)
[2] Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Canada
[3] Geological Survey of Canada, Ottawa, Canada

Cratonic mantle xenoliths provide an unique opportunity to study the formation and evolution of the Archean lithosphere. However, widespread metasomatic processes that cause profound textural and geochemical changes, make it difficult to determine the original melting age. Mantle xenoliths from Somerset Island (North Rae Craton) are characterized by a large range of whole-rock Re-depletion ages (T_{RD}) ranging between 1.3 and 2.8 Ga [1]. Moreover, the oldest samples have low Pd/Ir ratio inherited from the original melting process, whereas younger samples are characterized by variable enrichments in Pd, Pt and Re suggesting extensive metasomatic overprint [1].

To better constrain the age distribution in the mantle root of the Rae Craton and to evaluate whether cratonic lithosphere formation may be older than recorded by the whole-rocks, we performed a Re-Os isotopic study on sulfides from four mantle peridotite xenoliths showing variable HSE (highly siderophile elements) signature (Pd/Ir=0.03-0.6). Sulfides (down to ⌀<10 μm) were micro-sampled from thick sections, with Os extracted via μ-distillation and analyzed by N-TIMS.

Sulfides from the peridotite with the most HSE residual signature yield T_{RD} ages of 2.7-2.8 Ga, in agreement with its whole rock T_{RD} age. Sulfide T_{RD} ages from metasomatised xenoliths vary from 2.8 Ga to future ages, with the 2.8 Ga age significantly older than the whole rock T_{RD} ages (even T_{MA}). The 2.7-2.8 Ga age, recorded in sulfides from three xenoliths out of four, overlaps with widespread magmatism in the Rae Craton [2] suggesting possibly a synchronous event of crustal and lithospheric mantle formation. Our results show that xenoliths with residual HSE signatures are likely to preserve the original melting age while the more metasomatic xenoliths have been rejuvenated by extensive addition of 'younger' sulfides.

[1] Irvine *et al*. (2003) *Lithos* **71**, 461-488. [2] Hartlaub *et al*. (2004) *Precambrian Research* **131**, 345-372.

DOI:10.1180/minmag.2013.077.5.2
www.minersoc.org