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# Detrital apatite Lu-Hf and U-Pb geochronology

**STIJN GLORIE**[1], ALEXANDER SIMPSON[1], JACK GILLESPIE[2], MARTIN HAND[1], SARAH GILBERT[1] AND CHRIS KIRKLAND[2]

[1]The University of Adelaide
[2]Curtin University

Presenting Author: stijn.glorie@adelaide.edu.au

Sediment provenance studies commonly use zircons, which are generally robust to weathering and isotopic open system behaviour. In recent years, other mineral phases such as titanite, rutile and apatite have been used to ascertain provenance, as they can record complementary information to zircon concerning the tectonic history of the hinterland. Apatite, particularly, has been a focus of recent studies, which can be used to evaluate the contribution of mafic rocks to the detrital record. However, detrital apatite U-Pb geochronology can be challenging. Apatite commonly incorporates non-radiogenic Pb posing difficulties to single-grain dating, particularly for U-poor crystals. Furthermore, the apatite U-Pb clock can easily be reset by metamorphic processes, which may complicate data interpretations. While the apatite trace element composition can be used to determine a potential metamorphic or metasomatic genesis as well as reveal protolith rock types (and $SiO_2$ contents), the timing of apatite crystallization can remain elusive, particularly for old detritus.

Here we present the first Lu-Hf age spectra for detrital apatites from Siberia. The Lu-Hf clock is more robust to thermal resetting and particularly suited to date old (e.g. Archaean) apatite grains. Conventional Lu-Hf dating, involving time-consuming clean-lab procedures for individual grains, realistically is not suitable for detrital studies. We have developed an in-situ Lu-Hf dating technique [see Simpson et al., session 6d] that allows rapid and cost-effective analysis, required for detrital apatite studies. The method involves innovative mass-filtering procedures in an Agilent 8900 reaction-cell mass spectrometer, which allows high order reaction products of $^{176}Hf$, $^{175}Lu$ and $^{178}Hf$ to be measured free from isobaric interferences. Given that apatite generally doesn`t incorporate initial Hf during crustal growth, single grain ages can be computed without the need to strip non-radiogenic Hf. The method is most suited to date Precambrian detritus to allow sufficient radiogenic ingrowth. Using samples from Siberia, we demonstrate (1) excellent correlations between U-Pb and Lu-Hf dates for igneous apatites and (2) that Lu-Hf dating can constrain Palaeoproterozoic crystallization ages for Mesoproterozoic metamorphic grains. Hence, when used in tandem with U-Pb zircon and apatite geochronology, Lu-Hf apatite age spectra provide a powerful new tool for provenance studies.