Hf isotopes and zircon recrystallization: A case study

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'Metamorphic zircon' is a broad term that encompasses precipitates from partial melts and fluids, solid-state diffusive growth from the breakdown of Zr- and Si- bearing phases, and *in situ* recrystallisation products of pre-existing zircon. Each of the above may result in complexly-structured zircon grains in which metamorphically grown or modified layers partly or completely surround remnants of older grains. Features such as transgressive core-rim boundaries and poorly-zoned rims with distinctive Th/U ratio are common but non-unique indicators of metamorphic zircon. In order to correctly interpret the equally complex U-Pb age data obtained from such zircon grains in terms of geological events and processes, it is useful to be able to distinguish between the different types of metamorphic zircon, whether representing newly-grown or recrystallized older material.

We have made *in situ* hafnium isotope determinations by LA-MC-ICPMS coupled with U-Pb age determinations by SHRIMP on zircon samples from high-grade metamorphic rocks of the Lewisian Gneiss Complex and Moine Supergroup of northern Scotland. In samples of granulite-facies tonalitic and trondhjemitic gneisses of the LGC, no detectable difference in $^{176}Hf/^{177}Hf$ was found between zoned zircon cores and poorly-zoned to unzoned metamorphic rims, despite variable resetting of the U-Pb systems. In contrast, samples from migmatitic rocks showed distinctly different $^{176}Hf/^{177}Hf$ ratios between cores and rims.

The results of our study support the prediction that where there is a sufficient time difference between zircon formation and subsequent metamorphic modification, Hf isotopic composition can discriminate between recrystallization and new growth because newly added zircon would be expected to have a more radiogenic Hf composition with respect to original zircon, whereas recrystallized zircon should essentially retain its original Hf composition.