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Caught in the act: variable εHf in zircons formed by in source hybridisation of crustal melts

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The Hf isotopic composition of zircon in evolved continental crustal rocks (i.e. granitoids) is typically complex. Variation of up to 9 εHf units between individual cogenetic zircon domains can occur within a single sample[1] as well as across a pluton[2]. Explanations for this variability include: magma mixing of crust- and mantle-derived magmas with different Hf isotopic composition[1,3], a heterogeneous (crustal) source[4], variable dissolution of pre-existing zircon during disequilibrium melting resulting in different proportions of zircon-derived Hf to individual melt batches ("zircon effect")[5], or localised dissolution-(re)precipitation resulting in transfer of variable Hf isotopic compositions from inherited zircon domains to new magmatic domains[2].

We present Hf isotope, U-Pb age, O isotope, and trace element data for zircons from a mafic migmatite and co-eval, unmelted units from the Kapuskasing uplift, Superior Province, Canada. A ~20cm-wide felsic sheet (melt channel) fed by leucosomes from the host migmatite contains zircons with a significant and continuous spread of ~4 εHf units. Zircon morphology and trace element data link the more radiogenic Hf analyses to zircons in the mafic migmatite and associated unmelted lithologies. These zircons were likely derived locally, directly from the migmatite. The less radiogenic zircons in the melt channel are distinctly different in morphology and trace element composition and must have been inherited from a different, but presumably nearby, rock unit.

Our findings show that hybridisation of intracrustal melts and formation of a highly variable zircon Hf isotopic record typical of evolved crustal rocks can be captured entirely within small melt channels hosted in the melting region. They also highlight the power of, and necessity for, a careful and holistic analysis of zircon and its diverse range of proxies compared to restricting analytical campaigns to age and Hf data alone.

[1] Griffin et al., (2002) *Lithos* 61, 237-269. [2] Farina et al., (2014) *Contrib Mineral Petrol* 168, 1-18. [3] Belousova et al., (2006) *JPet* 47, 329-353. [4] Villaros et al., (2012) *Contrib Mineral Petrol* 163, 243-257. [5] Tang et al., (2014) *EPSL* 389, 188-199.