Insights into the 2300Ma magmatic shutdown

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Zircon geochronology and isotope geochemistry allows insights into the temporal and geodynamic controls on tectonic events. The global record of magmatic events reflected from zircon spectra is episodic, with large widespread events in zircon geochronology occurring periodically and related to supercontinent amalgamation. Conversely large troughs in the zircon spectra have been inferred to tectonic shutdown and magmatic hiatus. A large trough in the global zircon record around 2300Ma is interpreted to reflect this phenomenon, with widespread reduction in magmatic activity beginning at 2.45Ga to 2.2Ga (Condie *et al*. 2009). Whilst no direct outcrop of 2.3Ga magmatic lithologies has been sampled, a number of detrital samples record distinct populations at 2.3Ga allowing for interrogation of this geodynamically distinct time in the Earths evolution. The detrital zircon spectra in the Warumpi Province sediment samples display peaks at 1.8Ga, 2.5Ga with minor 2.3Ga comparable to the North China Craton and to a lesser extent Antarctica. Coupled U-Pb geochronology and Hf isotopic data from detrital samples in the central Australian Warumpi Province reveals distinct populations of 2300Ma zircons and the source mantle composition. The similarities in the age distributions raise the possibilities of co-evolution between these cratons and the links to the Nuna Supercontinent formation in the Paleoproterozoic. The coupled Hf isotope and U-Pb age analysis for zircons between 2.45-2.2Ga display variable arrays and large distribution between juvenile mantle to evolved sources, with distinct clusters observed. The variable spread of the Hf isotopic data indicates there are varied geodynamic systems at large during a period of proposed tectonic quiescence.

CONDIE K. C., O'NEILL C. & ASTER R. C. 2009. Evidence and implications for a widespread magmatic shutdown for 250 My on Earth. *Earth and Planetary Science Letters* **282**, 294-298.

The U-Th-Pb allanite petrochronometer: a combined ID-TIMS and LA-ICP-MS study

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Abstract

Allanite ($(Ce,Ca,Y,La)_2(Al,Fe^{+3})_3(SiO^4)_3(OH)$) is important as a U-Th-Pb petrochronometer of metamorphic and igneous crustal processes. Largely, this is because of its extended *P—T—X* stability field over other U-Th-Pb mineral chronometers [1], its ubiquity in felsic to aluminous melts [2] and its ability to retain radiogenic Pb at temperatures > 650ºC [3]. Furthermore, allanite plays a key role in the transport of LREE, U, Sr and Th in subducted crust [4].

Weight % concentrations of U and Th mean that both U-Pb and Th-Pb systems can potentially be used to constrain the age of radiogenic Pb in-growth. Th/U values up to 1000 mean that the Th-Pb system is preferentially targeted. However, successful U-Th-Pb allanite geochornology is hampered by: (**i**) the propensity of allanite to sequester high levels of non-radiogenic Pb (up to 95%); (**ii**) the presence of excess-^{206}Pb arising from incorporation of ^{230}Th; (**iii**) its common lack of crystallographic integrity, and (**iv**) compositional solid-solution with the epidote group minerals. Therefore, as the use of allanite U-Th-Pb data becomes more widespread, it is vitally important to understand the limitations and strengths of allanite as a petrochronometer.

Available allanite reference materials are poorly characterised; notably, there is a dearth of accurate U-Pb, and particularly, Th-Pb ID-TIMS data. Given that allanite is most commonly dated by LA-ICP-MS and SIMS, this means that many published datasets likely conceal considerable uncertainty in the accuracy of calculated age estimates.

This contribution presents the results of a combined ID-TIMS and LA-ICP-MS U-Th-Pb study on a suite of allanite reference materials, including two of the most commonly used allanite standards: the SISS and Tara allanites [5], in addition to a new potential allanite reference material. Both ID-TIMS and LA-ICP-MS analyses have been performed on the same allanite grain fractions so as to minimise normalisation-induced uncertainty. The high spatial resolution of the LA-ICP-MS technique, together with WDS-SEM imaging and powder XRD shows that allanite retains closed-system U-Th-Pb isotope systematics despite its pervasively metamict state. Open-system behaviour is restricted to clearly-identifiable zones of fluid-mediated alteration.

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