Palaeoclimate records from >500ka speleothems: New chronology and imaging methods

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Speleothems are widely used archives of palaeoclimate variation and have yielded some remarkable insights into climatic conditions during the late Quaternary. Compared to other proxy methods, they offer the possibility of furnishing palaeoprecipitation as well as palaeotemperature records and are eminently suited to dating by U-series analysis, a technique which is highly robust for materials up to ~500 ka in age. Unfortunately, beyond this time their value has been limited by a lack of appropriate chronometers.

Expanding upon our previous study [1], we have developed a method for producing detailed age models for speleothems beyond the range of the U-Th method using the U-Pb decay scheme. Realising the increased potential for post-depositional modification in older speleothems, we have also developed innovative elemental imaging techniques (using LA-ICPMS) to help distinguish true palaeoclimate signals from alteration and grain-scale effects.

These techniques will find immediate use in extending speleothem-based climate proxy records beyond ~500 ka and will also find other applications, such as the dating of associated sub-fossil remains, and providing constraints on rates of landscape evolution and neo-tectonic processes. Examples will be shown from both the Quaternary and much more distant geological history.

[1] Woodhead *et al*. (2006) *Quaternary Geochronology* **1,** 208-221.

African kimberlites revisited: *In situ* Sr-isotope analysis of groundmass perovskite

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Although isotopic data have been employed for many years in the study of mantle-derived rocks, obtaining reliable primary magmatic signatures for kimberlitic rocks has proved problematic owing to the combined effects of crustal contamination and element mobility during weathering processes. Heaman [1] first suggested a possible method for circumventing these problems by analysis of groundmass perovskite ($CaTiO_3$), a phase that is both robust during weathering and free of entrained materials. This approach has not been widely adopted, however, possibly owing to the difficulty in efficiently separating often very small (<50 micron) perovskite grains for chemical analysis.

Recently we have developed methods for *in situ* Sr-isotopic analysis of groundmass perovskite using laser ablation multi-collector ICPMS [2, 3] and showed that this technique greatly improved both the reliability and resolution of Sr-isotope results in a study of Indian kimberlites [4].

In this presentation we revisit the classic Sr-isotope study of South African kimberlites by Smith *et al.* [5]. A suite of African kimberlites encompassing over 40 individual intrusions, representing both group I and II types, and covering both on- and off-craton locations has been analysed using these new methodologies. Our analytical technique was modified to allow automated analysis of pre-digitised files, an approach which proved essential especially for the analysis of Group II perovskites which are often ~20 micron in size.

[1] Heaman (1989) *Earth & Planetary Science Letters* **92,** 323-334. [2] Woodhead *et al.* (2005) *Journal of Analytical & Atomic Spectrometry* **20,** 22-27. [3] Paton *et al.* (2007a) *Geostandards & Geoanalytical Research* **31,** 321-330. [4] Paton *et al.* (2007b) *Geology* **35,** 1011-1014. [5] Smith (1983) *Nature* **304,** 51–54.