

U-Pb dating of speleothems from Sterkfontein Cave, South Africa

R. PICKERING¹, J.D. KRAMERS¹, T.C. PARTRIDGE² AND
T.M. VENNEMAN³

¹Institute for Geological Sciences, University of Bern,
Switzerland, robyn.pickering@geo.unibe.ch

²Institute for Human Evolution, University of the
Witwatersrand, Johannesburg, South Africa

³Institute of Mineralogy and Geochemistry, University of
Lausanne, Switzerland

The absolute dating of the South African hominid bearing caves remains an outstanding issue in Palaeoanthropology. Biostratigraphic age constraints and cosmogenic isotope burial dating indicate the breccia deposits of Sterkfontein Cave are between 1 and 4 Ma. Thus speleothem material preserved at Sterkfontein is too old to date by U-Th. U-Pb dating of speleothems is possible and has been undertaken on material as young as 200 ka [1] but is a challenging task. We have adapted the method of the pioneering work of [2]. Without modelled or measured initial $^{234}\text{U}/^{238}\text{U}$ ratios only maximum ages can be obtained. We model initial conditions, i.e. excess initial ^{234}U and depleted ^{230}Th .

Samples are pre-screened using β -scanner imaging to identify U rich layers. Initial MC-ICP-MS results indicate that relatively U-rich layers can exist near the base of flowstones, with U concentrations of between 0.1 and 2.4 ppm. Strong initial ($^{234}\text{U}/^{238}\text{U}$) disequilibrium is found for samples younger than 2.5 Ma. Both high U and large initial ^{234}U excess may result from slow weathering of bedrock, without leaching, in the arid phase preceding conditions conducive to flowstone formation.

[Pb] ranges between 20 – 200 ppb and is highly heterogeneous. Small scale (~cm spaced) sampling of U rich speleothem layers provides a range of U-Pb ratios. Using MC-ICP-MS in static mode, with ^{204}Pb in an electron multiplier, gives relative precision on $^{206}\text{Pb}/^{204}\text{Pb}$ better than 0.13 %. Thus ^{204}Pb can be used as a reference for isochrons.

A number of problems remain: discrepancies between ages obtained by different dating methods, poor stratigraphic control of the breccias at Sterkfontein and estimates of initial $^{234}\text{U}/^{238}\text{U}$ values for samples > 3 Ma. Efforts to constrain the latter using O and C isotopes as proxies are underway.

References

- [1] Richards, D.A., Bottrell, S.H., Cliff, R.A., Ströhle, K and Rowe, P.J. (1998) *Geochim. Cosmochim. Acta*, **62** (23/24), 3683-3688.
[2] Walker, J (2005) *PhD Thesis*, University of Leeds, UK.