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Speleothems as monitors of landscape evolution

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Speleothems (stalagmites, stalactites, flowstones and other secondary cave carbonates) are widely recognized as important archives of past climate variability. Less well known, however, is that they also record valuable information on the evolution of landscapes [1]. Residing below the Earth's surface, within a stable environment, they may remain remarkably well-preserved for many millions of years retaining data where other less robust archives have long since been eroded away. Most importantly, however, they are also well suited to absolute radiometric dating techniques, in particular U-series chronology (for samples up to 600 Ka in age) and the more recently developed U-Pb method (for samples ~300 Ka to hundreds of millions of years in age).

Speleothem probability density distributions, when appropriately corrected for preservation biases, offer the prospect of reconstructing palaeo-precipitation trends across vast periods of time (tens of millions of years). Fossil pollens, incorporated into speleothems at the time of their formation, allow us to quantify these palaeo-rainfall variations and to reconstruct contemporary landscapes. U-Pb dating of multiple speleothems provides perhaps the only robust method of estimating the longevity of cave systems in karst landscapes with important implications for the development of drainage systems and the evolution of troglobitic faunas.

Examples of these applications will be drawn from the Nullarbor and Gregory karsts of Australia.

Figure 1: Speleothems of the Nullarbor karst, Australia

References:

[1] Woodhead J.D. and Pickering R (2012) Chemical Geology 322: 290-299