Spatial and Temporal Variation of Quaternary Uplift Rates from Dating of Cave Deposits

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Project description: Estimates of surface and rock uplift are required for calibrating models of landscape evolution and tectonic uplift; considering the location of nuclear waste repositories; constraining the dimensions of former ice sheets; deciphering the fluvial terrace record. In addition, modelling the evolution and vulnerability of groundwater systems over time is dependent on changes in aquifer boundary conditions, especially in karst aquifers.

To obtain rates of base-level lowering, uplift and scarp retreat, landforms need to be placed in a chronological framework. Dating surface landforms over Quaternary timescales is often hampered by weathering, surface erosion and the lack of datable material, especially in upland areas, an issue that becomes more acute further back in time. Fortunately, evidence for former landscapes and environments is often preserved in caves, by both passage morphology and cave sediments including speleothems (Farrant et al., 1995). Moreover, caves can be precisely and accurately dated by U-Th, U-Pb, cosmogenic and palaeomagnetic dating methods (Richards and Andersen, 2013).

This study proposes to investigate Quaternary landscape evolution through the application of multiple dating techniques to cave deposits. The principal study area will be the South Wales karst. This region contains many cave systems, with over 300 km of mapped passages. Each contains a wealth of information on landscape and climatic change. Recent U-Th and U-Pb dating of speleothems (C. Smith and A. Farrant, unpublished data) demonstrates that they span over 1.2 Ma, thus preserving data far longer than surface glaciated environments (typically <40 ka). Data from other sites in the UK and overseas, include the Gunung Mulu National Park in Sarawak (Farrant, 1995), and the Matienzo karst in northern Spain will be used as a comparison.

The student will build upon previous studies of both cave and surface geomorphology, and apply dating methods to put these into chronological context by U-Th and U-Pb dating of speleothem, backed up by cosmogenic burial and palaeomagnetic dating of cave sediments. The student will be based at Bristol, with access to state of the art U-Th and U-Pb laboratories at Bristol and NIGL.

Farrant, A. R., Smart, P. L., Whitaker, F. F., & Tarling, D. H. (1995). Long-term Quaternary uplift rates inferred from limestone caves in Sarawak, Malaysia. *Geology*, 23(4), 357-360. Richards D. A. and Andersen MB (2013) Time constraints and tie-points in the Quaternary Period, *Elements* 9, 45-51