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Towards an understanding of phosphorus cyclicity in stalagmites: a year of P, TOC, and drip rate monitoring at Ballynamintra Cave, S. Ireland

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Stalagmites are important archives of terrestrial palaeoclimate, reflecting their ability to preserve several climate sensitive parameters simultaneously and their amenability to uranium-series dating. Previous research has demonstrated that trace element cycles found in stalagmite calcite can provide valuable information regarding deposition rate, hydrological conditions, and surface bioproductivity. Phosphorus cycles are among the most pervasive and well resolved of the annual trace element cycles, and appear in stalagmites from a wide variety of climatic conditions. However, the underlying mechanisms controlling P incorporation into speleothem calcite remain poorly understood. Stalagmites from Ballynamintra Cave in southern Ireland show distinct banding and P cyclicity, suggesting seasonal changes in the hydrochemistry of the cave drips. The shallow ($<$5 m deep) relict cave is developed in Carboniferous limestone and is overlain by a deciduous forest. Drip water samples collected approximately every two weeks between April 2004 and March 2005 are attempting to characterise any annual hydrochemical cycle in drip rate, P concentrations, TOC, and soil biomass indicators, with the aim of elucidating the relationships between these parameters and stalagmite P cyclicity. Preliminary water data suggest that peaks in phosphorus concentrations occur in spring and autumn, while P concentrations are below detection limits (ca. 1 ppb) for most of the summer months. Data for the winter months will clarify whether P concentrations remain elevated from autumn to spring or if two distinct peaks exist.

Automatic high-resolution (daily) sampling at one drip site suggests an anticorrelation between TOC and drip rate for one month of data in December 2004, and this high-resolution sampling is continuing. A link between TOC, P, and particulate flux is hypothesised based on the observed relationship between dark laminae and P in stalagmites, but further research is needed to investigate their synchroneity in drip waters.