

Climates from stalagmites: multiproxy records
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Background: Over the past 10 years, speleothems (calcareous cave deposits) have been the fastest-developing type of proxy record for past environments and climates in the Quaternary, and Birmingham scientists have been at the forefront of these developments. A huge range of parameters can be measured in speleothems, some of them on a micro-scale, providing records of the state of the global climate system, and unique information about the response of specific regions to changing climate. Within this growing area of research, this studentship offers the opportunity to develop new combinations of techniques to enable further application of speleothem data using samples from a number of geographic areas.



Aims and Objectives: To explore the development of multiple proxies to derive palaeoclimate/ palaeo-environment records from speleothems. The generic objectives are 1) to identify a particular combination of techniques that are likely to be productive in examination of speleothems from one or more geographic areas; 2) develop the skills base to obtain high-quality data and perform the speleothem analyses (some can be carried out by collaborators) and any cave monitoring that will be needed; 3) develop skills in data interpretation and apply these to the new data.

Methods: The most commonly used proxies are oxygen isotopes, growth rate, carbon isotopes, and alkaline earth trace elements (Sr, Mg), but there are few studies that use them all together in an optimal manner. Opportunities are available to develop these approaches with collaborators who have extensive collections in Europe or Australasia. Powerful techniques that are under-utilized include Sr isotopes (changing source materials), sulphate (pollution histories and potentially volcanic activity), trace elements associated with organic colloids (infiltration history), and study of seasonal processes by multi-proxy microanalysis. Potential new proxies include nitrate (history of the N cycle), and experimental crystal growth work could also be undertaken.

There is a flourishing cross-disciplinary research culture at Birmingham, with expertise in carbonate geology, colloid science, hydrology and hydrochemistry, and palaeoclimate modelling. There will be opportunities for field visits and a contribution to cave monitoring which will involve training in appropriate methods. Hands-on training for specific techniques is available in-house, including stable isotope analysis, trace elements by ICP-MS, conventional and electron backscatter diffraction petrography and specific colloid science methods for which Birmingham is a national facility. We can also arrange access to other techniques via either national international facilities (synchrotron X-ray analysis, ion microprobe, radiocarbon) or world-leading collaborators including Sr isotopes (University of Texas), U-series dating (Universities of Minnesota and Melbourne), laser-ablation ICP-MS (Royal Holloway, University of London) and oxy-anions (Louisiana State University).

References:

Fairchild, I.J. et al. 2006 Modification and preservation of environmental signals in speleothems. *Earth Sci. Rev.* 75, 105-153.

Fairchild, I.J. & Treble, P.C. 2009 Trace elements in speleothems as recorders of environmental change. *Quaternary Sci Rev* 28, 449-468.

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Applicants with BSc or MSci in Geoscience are invited to contact Ian Fairchild (i.j.fairchild@bham.ac.uk) to discuss potential directions that the project may take