

## Atlantic Seaboard Climatic Reconstructions including Bounding Errors (ASCRIBE)



The ASCRIBE project was funded from the Natural Environment Research Council (NERC) RAPID climate change programme in the period 2003-2007. It aimed to use records from speleothems (stalagmites and related calcareous deposits from caves) to constrain the Holocene history of the Atlantic seaboard of Europe.

The idea was to attempt to distinguish between atmospheric modes of variation such as the North Atlantic Oscillation (NAO), which has differential effects in North and South Europe, and variations in the strength of the Meridional Overturning Circulation, which would be expected to alternately warm and cool the whole seaboard. The project ran in parallel with a project with a similar sub-set of objectives funded by the Irish government, allowing complementary data collection.

Results of the project show that stalagmites preferentially record low frequency (decadal to millennial) surface climate signals rather than high frequency variability. Stalagmites are demonstrated to be a mixed proxy: both temperature and rainfall reconstructions can be obtained depending on the sample location and choice of proxy; this has been demonstrated in reconstructions of both North Hemisphere temperature, low frequency variations in the NAO strength, and a marked prehistoric aridity event in South Europe. Importantly, the low frequency signal can still contain seasonal climate information depending on the timing of climate signal transfer from the surface to the cave, and the project has helped develop and test a range of techniques revealing this seasonality.

Another highly positive outcome of the project is in training and exchange of ideas and data between 30 researchers in the field through a series of project meetings, several of them close to field sites. These researchers have had funding from a variety of other sources, and some of these projects have spun out of Ascrite. Examples are a NERC studentship on modelling of atmospheric isotopes at UEA, a NERC grant on NAO reconstructions from Gibraltar and a Birmingham-funded studentship on chemical and physical systematics of rain events. Investigators funded by the project have also provided international leadership in good practice in speleothem research, disseminated through numerous invited lectures and publications, including linkage to the EU-funded Millennium project.

### Publications

Publications from research funded partly or largely from the ASCRIBE project and its sister Irish-funded project:

#### 2009

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

Smith, C.L., Fairchild, I.J., Spötl, C., Frisia, S., Borsato, A., Moreton, S.G. and Wynn, P.M. 2009 Chronology-building using objective identification of annual signals in trace element profiles of stalagmites. *Quaternary Geochronology* 4, 11-21.

#### 2008

Baldini, L.M., McDermott, F., Foley, A.M. and Baldini, J.U.L. 2008. Spatial variability in the European winter precipitation  $\delta^{18}\text{O}$ -NAO relationship: Implications for reconstructing NAO-model climate variability in the Holocene. *Geophysical Research Letters*, 35, L04709, doi:10.1029/2007GL032027.

Jex, C., Claridge, E., Baker, A. and Smith, C. 2008 Hyperspectral imaging of speleothems. *Quaternary International*, doi:10.1016/j.quaint.2007.05.011.

Mattey, D., Lowry, J., Duffet, J., Fisher, R., Hodge, E. and Frisia, S. 2008. A 53 year seasonally resolved oxygen and carbon isotope record from a modern Gibraltar speleothem: Reconstructed drip water and relationship to local precipitation. *Earth and Planetary Science Letters*, 269, 80-95.

#### 2007

Fairchild, I.J. and McMillan, E.A. 2007 Speleothems as indicators of wet and dry periods. *International Journal of Speleology*, 36, 79-84.

#### 2006

Smith, C.L., Baker, A., Fairchild, I.J., Frisia, S. and Borsato, A. 2006 Reconstructing hemispheric-scale climates from multiple stalagmite records. *International Journal of Climatology*, 26, 1417-1424.

Fairchild, I.J., Smith, C.L., Baker, A., Fuller, L., Spötl, C., Mattey, D., McDermott, F. and E.I.M.F. 2006 Modification and preservation of environmental signals in speleothems. *Earth Science Reviews* 75, 105-153.

Tan, M., Baker, A., Genty, D., Smith, C., Esper, J. and Cai, B. 2006. Applications of stalagmite laminae to paleoclimate reconstructions: comparison with dendrochronology/climatology. *Quaternary Science Reviews*, 25, 2103-2117.

Vonhof, H.B., van Berukelen, M.R., Postma, O., Rowe, P.J., Atkinson, T.C. and Kroon, D. 2006. A continuous-flow crushing device for on-line  $\delta^2\text{H}$  analysis of fluid inclusion water in speleothems. *Rapid Communications in Mass Spectrometry*, 20, 2553-2558.

#### 2005

Hoffmann, D.L., Richards, D.A., Elliott, T.R., Smart, P.L. and Hawkesworth, C.J. 2005. Characterisation of secondary electron multiplier nonlinearity using MC-ICPMS. *International Journal of Mass Spectrometry*, 244, 97-108.

McMillan, E., Fairchild, I.J., Frisia, S., Borsato, A. and McDermott, F. 2005. Annual trace element cycles in calcite-aragonite speleothems: evidence of drought in the western Mediterranean 1200-1100 yr BP. *Journal of Quaternary Science*, 20, 423-433.

