Durham University
Department of Earth Sciences

Prof. James Baldini: james.baldini@durham.ac.uk
Prof. Colin Macpherson (University of Durham)
Dr Olga Kwiecien (Northumbria University)
Dr Sebastian Breitenbach (Northumbria University)
Miranda Prendergast-Miller (Northumbria University)
Gideon Henderson (Oxford University)
Beth Fox (University of Huddersfield)
Thorsten Hoffmann (JGU Mainz)
Tim Lawson (Grampian Speleological Group)

RECONSTRUCTING LAST INTERGLACIAL CLIMATE USING A SPELEOTHEM FROM NORTHERN SCOTLAND

1. Background

Stalagmite records are now considered some of the most critical recorders of past climate available. Their amenability to absolute dating via the uranium-thorium disequilibrium dating method means that geochemical records can be linked to extremely robust chronologies. This, combined with the high resolutions possible via modern analytical techniques[1,2], means that stalagmite records are exceptional terrestrial records, and provide key information for particularly Late Pleistocene intervals. However, the action of subsequent glaciations can destroy stalagmites, so older records from higher latitudes are rare. T**he aim of this project is to develop a annual-to-seasonal-scale record of climate using oxygen and carbon isotopes using an Eemian speleothem from Assynt, northern Scotland.** A sample of this age from such a northerly location is rare, and will yield critical information about North Atlantic climate during this time interval (~115,000 to 130,000 years ago)[3].

Fig 1. The modern landscape of Assynt, Scotland. The project will determine whether the last interglacial period was characterised by a climate and vegetation cover similar to that currently present.

2. Aims and methods

The aim of this project is to generate a monthly-to annual-scale speleothem-based palaeoclimate record for northern Scotland. Specifically:

- Micromill the carbonate samples;
- Run the samples on a gas source mass spectrometer;
- Interpret the $\delta^{18}O$ and $\delta^{13}C$ records
- Clarify how North Atlantic climate shifted during the Eemian at a fine scale.

3. Scientific approach

This project will use several geochemical datasets to produce a rare record of last interglacial (Eemian - ~115,000 to 130,000 years ago) climate change from northern Scotland. The $\delta^{18}O$ record will yield information regarding local climate as well as North Atlantic climate, and will be linked to Greenland ice core records, insolation, and global greenhouse gas concentrations. It is expected that the $\delta^{18}O$ record will reflect regional temperature and the general climate state of the North Atlantic. The $\delta^{13}C$ record may reflect total rainfall, soil bioproductivity, or the type of vegetation present at the site.

4. Training

As a PhD student in the Durham Earth Sciences Department you will become part of a vibrant research culture in which ~70 postgraduate students work on a wide range of Earth Science research projects. In particular, you will closely collaborate with the academic staff, postdoctoral researchers and fellows, and postgraduate students in your research group. Training will be provided on micromilling, time-series analysis, statistics, and scientific writing, and you will

learn how to generate, analyse, and interpret palaeoclimate datasets.

5. Further reading & information

For further information contact: Prof. James Baldini, Dept of Earth Sciences, University of Durham, tel. no 0191 334 2334. james.baldini@durham.ac.uk

1 Ridley, H. E. *et al.* Aerosol forcing of the position of the intertropical convergence zone since AD1550. *Nature Geoscience* **8**, 195–200, (2015).

2 Jamieson, R. A. *et al.* Intra- and inter-annual uranium concentration variability in a Belizean stalagmite controlled by prior aragonite precipitation: A new tool for reconstructing hydro-climate using aragonitic speleothems. *Geochimica Et Cosmochimica Acta* **190**, 332-346, (2016).

3 Drysdale, R. N., Zanchetta, G., Hellstrom, J. C., Fallick, A. E. & Zhao, J.-x. Stalagmite evidence for the onset of the Last Interglacial in southern Europe at 129 ± 1 ka. *Geophysical Research Letters* **32**, (2005).