Cave Calcite deposits to record palaeo climates - Dr Lisa Baldini, University of Durham

In our January meeting Dr Lisa Baldini described evidence for climatic changes in Europe which have taken place during the last 14,000 years, by using ratios of oxygen and carbon isotopes of the carbonate stalagmite deposits in Europe as proxies of temperature and rainfall. The seasonal correlation of data and palaeoclimate has been very good Accompanying trace element analysis on the same stalagmites allowed proxy measures to be made of palaeo-soil and environmental factors. The findings agreed with climatic estimates taken from Greenland ice cores.

The project linked many researchers and countries allowing 35 limestone caves with stalagmites across Europe to be studied. Thin stalagmites were used since they actively grow forming simple structures in a wet environment free from diagenetic reconstruction. The proportion of isotopes of oxygen, namely $^{\delta 18}O/ ^{\delta 16}O$, in the carbonate of the stalagmites is used as a proxy to measure both temperature and rainfall, since the heavier isotope is the first to fall out during heavy precipitation. A steady easterly depletion (termed a rain-out)of $^{\delta 18}O$, the heavier isotope, is seen, demonstrating the oceanic influence and the dominant westerlies which give rise to the rain-out effect. A clear Mediterranean effect of high $^{\delta 18}O$ due to evaporation was observed. This pattern extends back 12,000 years to end of the Younger Dryas, the last severe climatic change in Europe. As the temperature rapidly rose there was a steep drop in the proportion of the heavier oxygen isotope.

In the second part of her study, Dr Baldini carried out detailed work using isotopes of carbon found in the stalagmites. A cave site in Cantabria, Northern Spain, was chosen because it is adjacent to the boundary between the polar and Azores tropical air masses which is strongly driven by AMOC (Atlantic Meridional Overturning Circulation in which Atlantic warm water returns north, cools and sinks returning south). However, low correlation was found between temperature and AMOC as the precipitation is low in Iberia. The proportion of the heavier isotope dropped steadily as the climate warmed, and the mid-Holocene was wet, with increased soil productivity.

Trace elements in the stalagmites were analysed as hydrological and environmental proxies of soil productivity. At the end of the Younger Dryas trace element analysis indicated low soil bioproductivity and fewer organic colloids. This resulted in trace elements not being flushed through with less vegetation and evapotranspiration due to an increased recharged aquifer. However, many climatic questions still need to be answered, particularly whether a dry climate in the Iberian Peninsula indicates the passage of sea ice giving rise to cold, dry air. These results are being used to support archaeological work at the La Garma cave.

http://www.dur.ac.uk/earth.sciences/staff/?id=5379

http://www.sepm.org/CM_Files/SedimentaryRecord/SedRec8_2.pdf – scroll down to page 3

http://sp.lyellcollection.org/content/336/1/283.full