The last 3 million years at a snail's pace

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Scientists at the University of York, using an 'amino acid time capsule', have led the largest ever programme to date the British Quaternary period, stretching back nearly three million years.

It is the first widespread application of refinements of the 40-year-old technique of amino acid geochronology. The refined method, developed at York's BioArCh laboratories, measures the breakdown of a closed system of protein in fossil snail shells, and provides a method of dating archaeological and geological sites.

Britain has an unparalleled studied record of fossil-rich terrestrial sediments from the Quaternary, a period that includes relatively long glacial episodes – known as the Ice Age --interspersed with shorter 'interglacial' periods where temperatures may have exceeded present day values.

However, too often the interglacial deposits have proved difficult to link to global climatic signals because they are just small isolated exposures, often revealed by quarrying..

Using the new method, known as amino acid racemization, it will be possible to link climatic records from deep sea sediments and ice cores with the responses of plants and animals, including humans, to climate change over the last three million years. The research is published in the latest issue of *Nature*.

The new method was developed by Dr Kirsty Penkman, of the

Department of Chemistry, alongside Prof. Matthew Collins of the Department of Archaeology at York, and measures the the extent of protein degradation in calcareous fossils such as mollusc shells. It is based on the analysis of intra-crystalline amino acids – the building blocks of protein --preserved in the fossil opercula (the little 'trapdoor' the snail uses to shut itself away inside its shell) of the freshwater gastropod Bithynia. It provides the first single method that is able to accurately date such a wide range of sites over this time period.

Dr Penkman said: "The amino acids are securely preserved within calcium carbonate crystals of the opercula. This crystal cage protects the protein from external environmental factors, so the extent of internal protein degradation allows us to identify the age of the samples. In essence, they are a protein time capsule.

"This framework can be used to tell us in greater detail than ever before how plants and animals reacted to glacial and interglacial periods, and has helped us establish the patterns of human occupation of Britain, supporting the view that these islands were deserted in the Last Interglacial period."

In a close collaboration with palaeontologist Dr. Richard Preece in the Department of Zoology at the University of Cambridge, the study examined a total of 470 fossil remains from 71 sites in the UK and three on continental Europe. The method proved highly reliable with more than 98 per cent of samples yielding useful results, resulting in the largest ever geochronological programme of the British Pleistocene.

Professor Collins said: "When we started this work 11 years ago, we thought it was going to be relatively straightforward to identify a good material for dating, but the first 3 years of research on shells showed that the stability of the mineral itself was vital. The tiny trapdoor of a snail proved to be the key to success."

Dr Preece added: "Luckily, fossil opercula are common in Quaternary sediments around the world, so the new technique can be used to build regional Ice Age chronologies everywhere, giving it enormous international scope".

Provided by University of York