Finding a perfect match using underground insight from the Cayman Islands

March 9 2016, by Joe Paxton

We all want to improve our chance of having a great date, but when it comes to radiocarbon dating, incompatibly of a poor sample can result in a failed pairing with a familiar technique. The job of many archaeologists is to create the perfect match between sample and dating technique, resulting in a successful date, albeit measuring in hundreds or thousands of years.

The successful analyses of both living and extinct plants/animals are essential when trying to understand the evolution life on Earth. Two key pieces of information are required: accurate species identity and an accurate chronological (dating) framework. For archaeological and palaeontological material the former of these is typically obtained through studying the shape and form of bones (and other objects), whereas the latter can be achieved through various dating methods, but most accurately through the use of radiocarbon dating (when samples are less than 50,000 years old).

The tropics, most noted for their high biodiversity, have the poorest survival record for animal remains due to the high temperature and humidity that adversely affects protein (e.g. collagen) survival, thereby reducing the probability of fossilisation. Specimens that may appear to be relatively well preserved, often lack sufficient collagen yields for successful radiocarbon dating, resulting in failed dating. Advanced methods of proteomic characterisation have been used by a team from the University of Manchester and the College of Charleston to investigate collagen preservation for successful and reliable dating, with

the added bonus of species identification.

Virginia Harvey, lead author on the paper said, "Surprisingly little work has been conducted on bone collagen preservation in the tropics, although it is well known that collagen survival is subject to a number of factors that work together to facilitate its breakdown; namely time, temperature, bacterial presence, geochemistry and hydrology. Through the successful acquirement of collagen and radiocarbon dates, we can clearly demonstrate that the cave systems of Cayman Brac offer excellent preservation that is very unusual in the tropics."

Collagen is a key protein within bone that is intimately locked within the mineral component of this ubiquitous biomaterial that dominates both archaeological and palaeontological assemblages. Radiocarbon analysis of extracted collagen is one of the most common approaches to dating bone for sub-50,000 year old sites, but dating is relatively expensive compared to other biochemical techniques. The newly developed technique offers a global solution to screening samples across multiple disciplines.

Dr. Mike Buckley, project lead and creator of the technique said, "Our new method has so far exhibited a 100% success rate with regards to successfully categorising samples as suitable for dating or not, a figure significantly larger than the success rates achieved via previously used techniques. Our collagen fingerprinting technique, also known as 'ZooMS', can reduce time and expense, whilst lowering the risk of unreliable dates, preventing unnecessary sample destruction and providing additional information on species identification."

The team tested the new ZooMS method on a series of sub-fossil bone specimens from cave deposits from Cayman Brac (Cayman Islands). They successfully recovered six radiocarbon dates from five distinct caves on Cayman Brac, ranging from 390-1588 years old.

Dr. Egerton, co-author on the paper from the College of Charleston, said "Through the application of ZooMS, we are able to rapidly determine species identity and collagen integrity within bone remains, the latter permits us to track the presence or extinction of species through time. With such insight, we have the opportunity to investigate biodiversity through time on the Cayman Islands in order to understand and offer protection to this subterranean ecosystem."

All of the bone samples that yielded radiocarbon dates, also generated excellent collagen fingerprints, and conversely those that gave poor fingerprints were no use for dating. The new method offers a 100% success rate when utilising ZooMS as an alternative screening mechanism to identify bone samples that are suitable for radiocarbon analysis.

Professor Phil Manning (University of Manchester and College of Charleston), co-author on the paper said, "ZooMS offers a unique perspective to understanding how biodiversity has changed in response to key factors, such as geological time and prevailing environmental chemistry, along with climatic or human impact through time. Such insight permits identification of species that have become introduced or extinct within a temporal framework. This understanding can provide supporting evidence for reintroductions or culls, towards the regeneration of natural biotas."

More information: Virginia L. Harvey et al. Collagen Fingerprinting: A New Screening Technique for Radiocarbon Dating Ancient Bone, *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0150650

Provided by University of Manchester