RESEARCH HIGHLIGHTS

GEOSCIENCES

Fossilization of soft tissues

Michael Benton

A hot topic in palaeontology is the fossilization of soft tissues. It is evident that hard tissues such as bones, shells and cuticles can be preserved, but what about other biomolecules? Do we believe all the recent reports of blood cells, melanin and collagen?

Many will remember the excitement over the Hollywood film *Jurassic Park* back in 1993, in which it was hypothesized that molecular biologists could extract DNA from the blood of a dinosaur locked in the stomach of a mosquito preserved in amber. At just that time, several papers were published in *Science* and *Nature* showing examples of DNA extracted from dinosaur bones, insects and plants of Cretaceous and Paleogene age. All of these were quickly shown to be the result of contamination—the researchers had been too enthusiastic in rushing to print without checking their results. The DNA they examined in each case was modern, not ancient—sweat or saliva from the researchers or DNA from modern animals also being sequenced in the same laboratories.

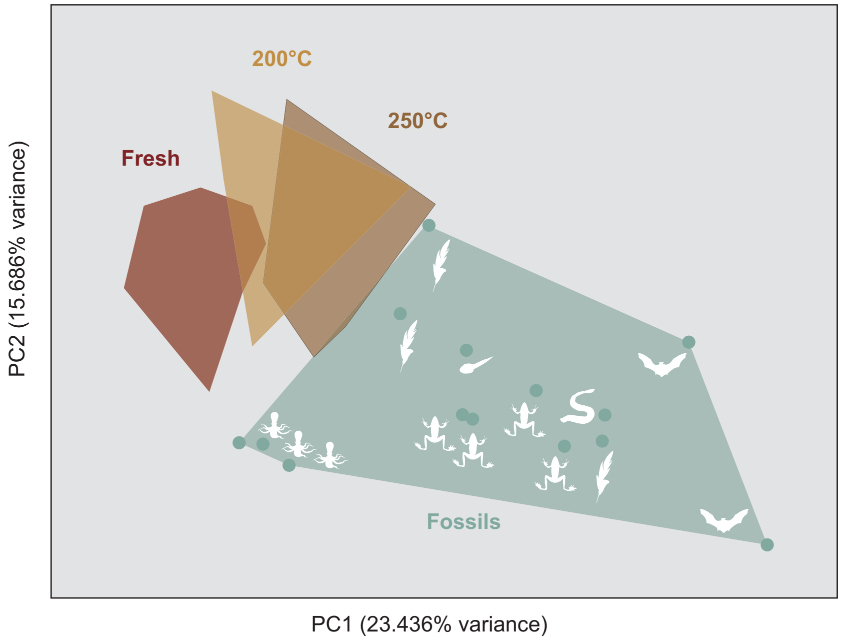

Figure 1. Experiments show that the pigment melanin is chemically refractory, meaning that it does not decay readily. Under high temperature, as shown in these experiments, fresh melanin traverses morphospace, based on a range of metrics, and converges on the chemical properties of extensive samples of known fossil melanin. Courtesy of Caitlin Colleary, based on [2].

Organic chemists kept reminding the palaeontologists to be careful. It turns out that DNA is one of the most labile of biomolecules, beginning to break up a few days after death, and hard to sequence even in the 100-year-old skins and feathers of museum specimens. Truly ancient DNA may be detectable back to around 50 000 years in early human and mammoth specimens, and the oldest reliable record is from a horse dated to 560 000–780 000 years ago [1]. Blood cells, blood vessels, skin, muscle and other tissues are also unlikely to be preserved in their original molecular form, all of them being likely to decay fast, but they may be replicated in minerals, commonly calcium phosphate, if they were rapidly buried in the near-absence of oxygen.

Many of the Jehol birds and dinosaurs preserve original organic molecules, even if somewhat modified. For example, feathers are commonly found, and they are especially well preserved when invested with melanosomes, organelles containing the pigment melanin. Experiments have shown [2] that melanin degrades under high temperature and pressure, but retains a recognizable chemical signature when analysed with time-of-flight mass spectrometry (Fig. 1). In addition, collagen, a key component of bone and the main component of cartilage, is noted in the current specimen [3] and elsewhere, but there are serious doubts about the likelihood that collagen can survive, and chemical tests are needed [4].

In the description of a new specimen of the bird *Eoconfuciusornis* [3], Xiaoting Zheng and colleagues discover remarkable preservation of feathers and skin. The feathers contain various shapes of melanosomes, indicating a range of black, grey and ginger colours, based on earlier epochal studies that first showed the original feather colours of dinosaurs and early birds [4].

More intriguing than the feathers are the skin impressions in the new specimen [3]. These impressions are seen in front of the wing and behind, and they clearly show fibrous fascial bundles that define elastic components within the skin. These structures provide support for the components of the skin making up the wing surface, and they stretch and contract as the wing changes shape during flight and when folded back against the bird's sides.

Michael Benton
University of Bristol, School of Earth Sciences, UK
E-mail: glmjb@bristol.ac.uk

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