Dinosaur surprise: Scientists find collagen inside a 195-million-year-old bone

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Dinosaur paleontology has long been the domain of bones and teeth - but now soft tissues could be changing the game. Scientists say they have discovered collagen preserved in a 195-million-year-old rib from a long-necked Lufengosaurus.

The protein fragments, described in the journal *Nature Communications*, are more than 100 million years older than the previous record-holder, shattering the notion that such soft tissues are short-lived and cannot be preserved. These kinds of samples could offer paleontologists a whole new window through which to study these long-gone creatures.

"This finding extends the record of preserved organic remains more than 100 million years, and highlights the importance of using in situ approaches to these types of investigations," the study authors wrote.

For a long time, scientists believed that protein molecules, which make up soft tissues, could only last about 4 million years or so; only hard tissues like bone and teeth could be preserved over longer geologic time scales. Soft tissues like cartilage and muscle typically decay long before they can be preserved.

Recent studies have begun to challenge that notion. A study in 2015 found evidence of collagen fibers and red blood cells within a 75-million-year-old claw from a carnivorous dinosaur. That finding met with no small amount of skepticism, said Susannah Maidment, a vertebrate paleontologist at the University of Brighton who was not involved in the

current study but who co-authored that 2015 paper.

"Now, the weight of evidence has really shifted," she said. "There are instances in the fossil record where protein can be preserved over really quite long geologic timescales, and we haven't hit the boundary yet of what those geologic timescales are."

The new fossil evidence comes from a Lufengosaurus, a genus of early sauropodomorph dinosaurs that probably walked on two legs instead of four (unlike their fellow long-necked cousins, the sauropods). Rather than removing the sample from the bone, and thus risk damaging or contaminating it, the scientists used confocal Raman spectroscopy and a type of infrared spectroscopy to study the insides of the bones in detail.

Within a rib, the scientists found fragments of proteins, likely from the collagen in the bone's vascular canals. Those canals were also polka-dotted with collections of hematite - an iron oxide that may have come in part from hemoglobin and other iron-rich proteins in the dinosaur's red blood cells. It's possible that this iron may have acted as an antioxidant, the authors wrote, preventing the proteins from decaying further.

"The characteristic infrared absorption spectra of collagen and protein provide undeniable, clear evidence that collagen and protein remains were preserved inside the osteonal central vascular canals of this early dinosaur," the study authors wrote.

Comparing the collagen locked in the bones of different species could compel researchers to redraw parts of the dinosaur family tree, Maidment said. That's because the proteins in collagen are closely tied to their particular animal group - which could allow scientists to use the samples almost like soft-tissue "fingerprints."

"As paleontologists, the only thing we have to build a family tree of the dinosaurs is their bones," she explained. "Now biologists of course have DNA, but we don't have DNA so we only look at the bones. Our family tree is very much restricted to looking at the hard parts - and that might be swaying our calculations a little bit. If we were able to extract collagen and carry out collagen fingerprinting on these bones, then we would have a whole independent line of evidence."

For now, scientists are still trying to figure out how these protein fragments really managed to last so long in the first place. And the next challenge, Maidment said, will likely be figuring out how to safely extract these collagen remnants so they can be studied in even greater detail.

More information: Yao-Chang Lee et al. Evidence of preserved collagen in an Early Jurassic sauropodomorph dinosaur revealed by synchrotron FTIR microspectroscopy, *Nature Communications* (2017). DOI: 10.1038/ncomms14220