Squid ink from Jurassic period identical to modern squid ink, study shows

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A photo of the cuttlefish Sepia officinalis

(Phys.org) -- An international team of researchers, including a University of Virginia professor, has found that two ink sacs from 160-million-year-old giant squid fossils discovered two years ago in England contain the pigment melanin, and that it is essentially identical to the melanin found in the ink sacs of modern-day squid.

The study is published online in the May 21 edition of the journal Proceedings of the National Academy of Sciences.

The finding - in an extremely rare case of being able to study organic material that is hundreds of millions of years old - suggests that the ink-screen escape mechanism of squid has not evolved since the Jurassic period, and that melanin could be preserved intact in the fossils of a range of organisms.

"Though the other organic components of the squid we studied are long gone, we've discovered through a variety of research methods that the melanin has remained in a condition that could be studied in exquisite detail," said John Simon, one of the study authors, a chemistry professor and the executive vice president and provost at the University.

One of the ink sacs studied is the only intact ink sac ever discovered.

An ink sac from a 160-million-year-old giant cephalopod fossil contains the pigment melanin; it is essentially identical to the melanin found in the ink sac of a modern-day cuttlefish.

Phillip Wilby of the British Geological Survey found it in Christian Malford, Wiltshire, England, west of London near Bristol. He sent samples to Simon and Japanese chemist Shoskue Ito, both experts on melanin, who then engaged research colleagues in the United States, the United Kingdom, Japan and India to investigate the samples using a combination of direct, high-resolution chemical techniques to determine whether or not the melanin had been preserved.

It had.

The investigators then compared the chemical composition of the fossil melanin to the melanin in the ink of the modern squid, Sepia officinalis, common to the Mediterranean, North and Baltic seas.

They found a match.

"It's close enough that I would argue that the pigmentation in this class of animals has not evolved in 160 million years," Simon said. "The whole machinery apparently has been locked in time and passed down through succeeding generations of squid. It's a very optimized system for this animal and has been optimized for a long time."

Generally animal tissue, made up mostly of protein, degrades quickly. Over the course of millions of years all that is likely to be found from an animal is skeletal remains or an impression of the shape of the animal in surrounding rock. Scientists can learn much about an animal by its bones and impressions, but without organic matter they are left with many

unanswered questions.

But melanin is an exception. Though organic, it is highly resilient to degradation over the course of vast amounts of time.

"Out of all of the organic pigments in living systems, melanin has the highest odds of being found in the fossil record," Simon said. "That attribute also makes it a challenge to study. We had to use innovative methods from chemistry, biology and physics to isolate the melanin from the inorganic material."

The researchers cross-checked their work using separate complementary experiments designed to capitalize on various molecular features unique to melanin and determined the morphology and chemical composition of the material. This combination of in-depth, multidisciplinary techniques is not normally used by paleontologists to study fossil samples.

"I think the strength of this paper is that it is not tied to a single method," Simon said. "Any one technique would have brought some insights, but potentially more questions than insights. It was really the more holistic approach that fully characterized it and allowed us to actually do a real comparison between what existed during the Jurassic period and what exists now.

"It's also given us a handle on ways of identifying organic components in fossils that might have been missed using standard methods."

More information: "Direct chemical evidence for eumelanin pigment from the Jurassic period," by Keely Glass et al. *PNAS*, 2012.

Provided by University of Virginia