A MICROSCOPIC & GEOCHEMICAL ANALYSIS OF MELANOSOMES IN A FOSSILIZED FISH EYE FROM THE FUR FORMATION, DENMARK

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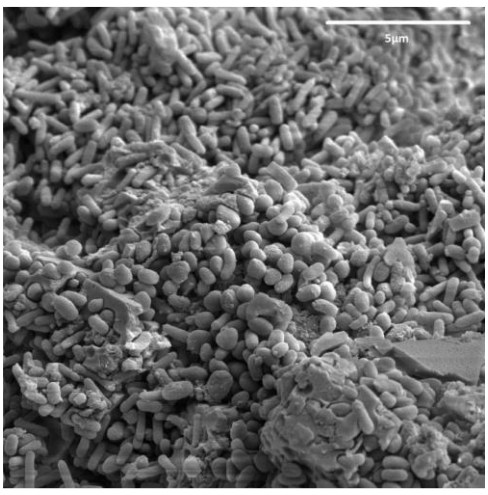
Introduction

Fossilized pigments are important remains provide information on the ecology and evolution of ancient life. Melanin, one of the most important pigments, gives colors to hair, feathers, skin and eyes, which is stored in melanosomes. It has been assumed that these micro-bodies in exceptionally well-preserved soft tissue, such as fish eyes, are biofilms made by bacteria. However, recent studies have provided morphological and chemical evidence that these microstructures are melanin-bearing melanosomes, a kind of colour-bearing organelles, rather than bacterial biofilms. A study on a fossil fish eye by imaging techniques and organic analyses showed the presence of melanin-bearing melanosomes, colour-bearing organelles[1]. By applying time-of-flight secondary ion mass spectrometry (ToF-SIMS), the molecular composition of putative melanosomes from a fish eye fossil from the early Eocene (the Fur Formation, Denmark) showed a close agreement of the mass spectra compared to a natural melanin standard[2].

However, the preservation mechanism of melanosomes during burial process is still not determined[3,4]. In this study, a fish fossil containing an eye from Fur Formation, Denmark (early Eocene, -56.0 Ma, associated with a greenhouse paleoclimate[5]), is under investigation. Microscopic & geochemical techniques will be applied to identify melanin from an approx. 2mm fish eye fossil, thereby pushing the limits of melanosomes detection on small-scale samples. Also, the morphological & geochemical inventory of fossilized melanosomes will be examined, thus shedding new light on ancient pigment reconstruction. In addition, the fossilisation potential & preservation mechanism of melanosomes in exceptionally preserved fossils during burial process will be explored.

Results



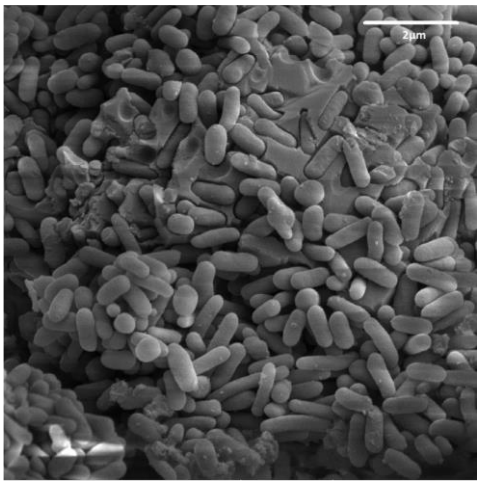


Fig. 1 SEM images of the melanosome-like ultra-structures in the eye of fish fossil sample at different magnifications

Conclusions

The SEM & SEM-EDS used in this study showed that the fish fossil is highly organic rich containing masses of well-preserved micrometre-sized structure remains, indicating the potential presence of melanosomes. Also, certain trace elements concentrated in microstructures may be potential biomarkers for identifying melanin pigments. Future analysis will focus on the preparation of fish eye fossil for higher resolution ToF-SIMS; elemental analysis on fish eye, matrix & modern melanin standard using SEM-EDS & XANES to obtain information about the elemental composition & oxidation states; Pyrolysis-GCMS on fish eye & matrix to identify any biomarker for melanin.

References

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