Marine larvae in Cretaceous amber–important insight into the evolution of parasitic life habits of epicaridean isopods

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Talk

Computational fluid dynamics and its applications in palaeontology

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Inferring the life habits of ancient organisms from fossils is key for reconstructing ecosystems in deep time. The recent development and increasing availability of techniques for computer-aided visualization and analysis of fossil specimens has lent greater rigor to such work, as virtual modelling approaches enable analyses of functional morphology to be carried out within an explicit hypothesis-testing framework. One such method for palaeontological functional analysis is computational fluid dynamics (CFD). CFD is tool for simulating flows of fluids and their interaction with solid surfaces that is widely used in engineering. Equations describing the motion of fluids are solved numerically using a computer, and the results can be visualized as plots of fluid properties within the flow domain. Here, I will present case studies of CFD applied to fossil taxa, spanning a range of specimen sizes, taxonomic groups and geological ages. These case studies demonstrate the great potential of CFD for rigorously addressing long-standing functional hypotheses, making it more feasible than ever before to reconstruct the ecological roles of extinct organisms.

Poster

Marine larvae in Cretaceous amber – important insight into the evolution of parasitic life habits of epicaridean isopods

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Isopods – generally known as woodlice – are crustaceans which not only managed to establish a terrestrial lifestyle from primary marine ancestors, but also show a great diversity in numerous aquatic lineages. Isopods are found in all water depths, occurring in the deep sea as well as in freshwater. Ecologically they perform various functions, from decomposing dead plant matter to hyperparasitism. Fossil isopods are relatively rare and in most cases are not very informative from a paleoecological view. Non-compressed, three-dimensional fossils, at best from Konservat-Lagerstätten, provide more details and may provide deeper insights into the ecology via functional morphology. Even better comparable to modern forms are specimens preserved in amber. There are quite some records of terrestrial as well as very few marine isopods from amber deposits from all over the world. However, we present here new findings that make a special case. Most isopods have offspring very similar to the adults, yet the new specimens are true larvae. Additionally, they represent the so far oldest record of a lineage of obligate parasitic isopods with a complex life cycle. The specimens are larvae of Epicaridea. As their name suggests, adults are found on shrimps (and other crustaceans) on which they feed as adults. Compared to other parasitic isopods the larvae of epicarideans are very small and feed on a different organisms than their parents, namely on small copepod crustaceans. Their development including the host change involves three distinct larval stages. Our findings represent the last true larval stage that searches for the final host while being part of the plankton. With the help of fluorescence microscopy we were able to reveal delicate structures on the very small fossils (ca. 0.5 mm body length) down to single sensory setae. We compare the morphology of our fossils with the available information on modern forms as well as to the only other fossil record of epicaridean larvae. Our findings provide an exceptional glimpse on the “morphology through time” for this very special isopod group.

Talk

Micro-computed tomography reveals head posture in Pleistocene rhinoceroses

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The head posture in extinct rhinoceros skulls is normally reconstructed with the shape of the occiput. The occiput is oriented backwards in rhinos with hanging skulls. These rhinos are grazers with the muzzle near the ground, like the extant white rhinoceros. Rhinos with a more horizontal head posture show a forward inclined occiput. An example for such browsing rhinos is the extant Javan rhinoceros. The usage of micro-computed tomography allows insight in internal skull structures. Within this study, the inner ear of rhinos was virtually reconstructed to show the head posture using the orientation of the lateral semicircular canal within the skull. The lateral semicircular canal is one of the three semicircular canals of the mammalian inner ear and it is assumed that the lateral canal is held horizontally during normal activity. This approach is applied to skull remains of the woolly rhinoceros (*Coelodonta antiquitatis*), as well as remains of *Stephanorhinus etruscus*. The woolly rhino is known from glacial periods of the Pleistocene, while *Stephanorhinus* is known from interglacial periods. Following the inner ear reconstructions and the orientation of the lateral semicircular canal within the skull, the head posture of the woolly rhino is reconstructed with a hanging skull, while *S. etruscus* had a more horizontally carried skull. The reconstructed downward inclined head posture in the woolly rhino is in accordance with a backward inclined occipital crest, teeth showing adaptations to a grass diet, preserved nasal horns showing an anterior abrasion from removing snow cover, and gut content showing a diet consisting of low browse plants. On the other hand, *S. etruscus* shows a reconstructed horizontal head posture and therefore an adaptation for a browsing diet. This is in accordance with the cheek teeth which are showing cingula. Cingula in rhinoceros cheek teeth are an adaptation to preferably feed on leaves. The approach of using the lateral semicircular canal of the inner ear to reconstruct the head posture was also