Zukunftspreis

Analysis of fluid dynamics of suspension feeding mechanisms in recent and fossil crinoids (Echinodermata: Crinoidea)

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Crinoids belong to the phylum Echinodermata, which today include echinoids (sea urchins), asteroids (star fish), ophiuroids (brittle stars), crinoids (sea lilies) and holothuroids (sea cucumbers). Due to the long and complete fossil record, the great diversity, the wide morphological range, and the passive suspension feeding strategy, crinoids represent suitable objects to study effective biological filter mechanisms and ecological performance.

The presented ongoing project is an interdisciplinary study to analyze filter feeding mechanisms of recent and fossil crinoids. Extant and extinct forms are compared using flume experiments (Particle Image Velocimetry PIV) as well as modern computational approaches (Computational Fluid Dynamics = CFD). Performing both flume experiments and numerical simulations permits a comparison of these methods. In a first attempt, two crinoids are analyzed: the middle Triassic *Encrinus liliiformis* with ten simple arms, and recent *Hyocrinus sp.* with 5 unbranching arms. Today, crinoids open their arms in a parabolic fan, creating a three dimensional filter to capture food particles out of the water. Some of the fossil representatives were possibly not able to bend their arms to such an extent. Furthermore, fossil crinoids mainly lived in shallow water habitats, while recent stalked forms are constricted to deep sea environments with different flow conditions.

Results include information on: (1) general suspension feeding mechanisms of crinoids; (2) different filter architectures and their effect on filter efficiency; (3) different feeding positions and their effect on flow patterns; and (4) palaeoecology of extinct forms.

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Freies Thema

Taxonomic diversity and evolutionary development of Eurasian ochotonids

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Ochotonids belong to the order Lagomorpha which is one of the ancient group of mammals having an origination in the Paleogene of Asia. Order Lagomorpha includes four families: Leporidae Fischer, 1817; Palaeolagidae Dice, 1929; Ochotonidae Thomas, 1897; Prolagidae Gureev, 1960.

Family Ochotonidae consists of two subfamilies which include 17 genera. The earliest record of this group is known from the Middle Oligocene of Asia. Among lagomorphs at that time the dominant forms in both quantity and diversity were desmatolagins represented by a number of different taxa. Ochotonids and leporids were not numerous. At the end of Oligocene in Asia the climate became to change towards cool and arid which led to reduction of forest and to formation of open landscapes that resulted in appearance of steppe dweller ochotonids of the genus *Sinolagomys*. The earliest species were rooted forms having reduced roots (*Sinolagomys tatalgolicus, S. kansuensis*). More advanced species (*S. ulungurensis, S. pachygnathus, S. major*) became rootless at the end of Oligocene-beginning of Miocene. That time appeared to become favourable for diverse and wide distributions of sinolagomyins, when they distinguished the Europe, Africa and North America. They became to extinct at the Late Miocene.

At the beginning of Miocene new advanced rootless ochotonids of subfamily Ochotoninae appeared. The genera *Marcuinomys, Lagopsis, Albertona* distributed rapidly across Europe and the genera *Bellatona* and *Alloptox* are flourished in Asia. At the Middle Miocene *Alloptox* distinguished Turkey and Hungary in the west. New genera *Paludotona* and *Proochotona* appeared in the Europe, and in Asia – *Ochotonoides, Ochotonoma and Bellatonoides*. At the Late Miocene all sinolagomyins and some peculiar archaic ochotonins of the Europe disappeared completely. At that time new genus *Ochotona* appeared for the first time in Asia. It included a number of species - *Ochotona lagrellii, O. minor, O. tedfordi, O. magna, O. chowmincheni, O. guizhongensis*.

At the end of Miocene and Early Pliocene ochotonids migrated to North America (*Ochotona spanglei*) and to the Europe (*Ochotona* sp.).

The Pliocene appeared to be the time of high diversity and abundance of ochotonids, especially in Asia, where it became the dominant forms until the Late Pliocene due to the wide distribution of open landscapes. Arvicolids appearance, their explosive radiations and diversity resulted in decrease the ochotonid distribution area and variety. Like ochotonids arvicolids use grass as a

nourishment and they became the main trophic competitors to ochotonids and occupied the most favourable open biotopes.
At the Early Pleistocene all Pliocene ochotonid genera except the genus *Ochotona* which continues to exist. In total 35 extinct species of the genus *Ochotona* and in addition fossil records are known at least for 8 extant species. It is need to stress that during the Late Pleistocene the only one species *Ochotona pusilla* occupied vast plain territory of Eurasia from England, France, Italy in the west to the western shore of Lake Baikal in the east. The modern species of the genus *Ochotona* appeared at least at the end of the Middle – beginning of Late Pleistocene. At present time there are 30 extant species: 28 inhabit Asia, 2 North America and 1 Europe.

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Taphonomie und Paläoökologie

Diversitätsdynamik und Evolutionsmuster devonischer Bryozoen

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Bryozoen waren eine wichtige Gruppe in benthischen Vergesellschaftungen des Devons, wobei sie eine nahezu globale Verbreitung in unterschiedlichen Biotopen aufwiesen. Das Ziel des DFG Projekts ER 278/4-1 u. 2 war eine umfassende Bearbeitung der Bryozoen aus Europa und Nordafrika.
Im Laufe dieser Arbeit entstand eine Datenbank über die Verbreitung devonischer Bryozoen im Untersuchungsgebiet, die 273 Arten von 112 Gattungen umfasste, von denen 65 Arten und 11 Gattungen neu sind. Des Weiteren, wurde diese Datenbank durch Literaturdaten ausgeweitet, um die globale Verbreitung und Diversitätsdynamik der Bryozoen im Devon zu untersuchen. Diese globale Datenbank zeigt die regionale und stratigraphische Verbreitung von 209 Gattungen, vorkommend in neun Zeitscheiben des Devons. Die Dauer der Zeitscheiben variiert von 3,5 bis 10,8 Ma, und beträgt im Durchschnitt 6,3 Ma. Die Auswertung dieser Daten zeigt, dass die Bryozoendiversität auf Gattungsniveau zwei deutliche Peaks hatte: im unteren Devon (Emsium) und im mittleren Devon (Eifelium). Im Rheinischen Schiefergebirge nahm die Bryozoendiversität bereits im Givetium erheblich ab, und das Minimum der Diversität ist im Frasnium zu verzeichnen. Das Massensterben im Frasnium wurde anscheinend durch einen Meeresanstieg verursacht. Im Devon erlebten die Bryozoen eine schnelle morphologische Diversifikation, welche die Radiation der Bryozoen im Emsium und Eifelium begünstigt hat. Diese Diversifikation weist zwei deutliche Trends auf: die Entwicklung von diversen Schutzvorrichtungen und die Verstärkung des Skeletts sowie komplexe interne Strukturen. Diese Entwicklungen wurden wahrscheinlich durch zwei Faktoren ausgelöst: Zunehmender Druck durch Räuber (Abgrasen) und Nahrungsknappheit. Gegen Abgrasen schützten sich die Bryozoen mit Entwicklung von unterschiedlichen Schutzstrukturen ihres Skeletts. Als mögliche Räuber könnten Fische und möglicherweise Nudibranchen auftreten. Im Devon wird auch ein Rückgang des Phytoplanktons postuliert („Phytoplankton blackout"), welcher vorwiegend die Nahrung der Bryozoen darstellt. Die Bryozoen reagierten mit Entwicklung von unterschiedlichen internen Strukturen, die möglicherweise einer verbesserten Nahrungsaufnahme dienten.

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Freies Thema

On the fossil record of chondrichthyan egg capsules

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Fossil chondrichthyan egg capsules have been known for more than 180 years, although the early findings were often misinterpreted as various plant organs like inflorescences or fructifications. Since the first discovery of these fossils our knowledge of their morphological and taphonomical variability, geographical and stratigraphical distribution, and potential producers has significantly advanced. Currently, seven morphotypes of fossil chondrichthyan egg capsules are discerned:
(1) *Palaeoxyris* Brongniart, 1828 (also known by its synonym *Spirangium*) has a three-fold division consisting of a fusiform body tapering gradually at one end into a pointed beak and at the other into a long and slender pedicle accompanied by spirally twisted membranous flanges (collarettes). Twenty-six valid species of Early Carboniferous to Late Cretaceous age have been described from predominantly freshwater to brackish deposits of Europe, Russia, Asia, Australia, and the USA. Hybodont sharks are considered to be the most probable producers.
(2) *Vetacapsula* Mackie, 1867 shows a three-fold division