Hydrodynamic properties of the triassic fish *Saurichtys* compared to the extant fish *Belone belone* (Linnaeus, 1761)

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The basal actinopterygian genus *Saurichthys*, which possibly appeared in the Latest Permian and flourished throughout the Triassic, is the oldest fish known to have developed a peculiar shape with an elongated head and a long, slender body with far posteriorly positioned fins. Although saurichthiyds became extinct in the Early Jurassic, this morphotype must have proved efficient as it arose later independently in several groups of extinct and extant fishes. *Saurichthys* is generally assumed to have been an ambush predator with an elaborated fast-start capability, enabling the fish to catch the prey with its large, wide-opening mouth by quick, sudden darts. Evolutionary novelties in *Saurichthys*, like gradually reduced squamation, unsegmented fins, symmetrical tail, strengthened caudal peduncle and stiffened endo- or exoskeletal elements stabilizing the posterior body portion, are mostly interpreted as functional adaptations to this mode of swimming and chasing.

In order to understand the actual swimming behaviour of *Saurichthys*, we are exploring its hydrodynamic properties in comparison to those of the extant teleost *Belone belone*, which possesses an extremely similar body shape despite virtually no phylogenetic affinity. A 3D surface model is generated by scanning a generalized three-dimensional reconstruction of *Saurichthys* and a specimen of *Belone belone*. The numerical model applied for the calculations is based on the conservation of mass and momentum in fluid mechanics, which is the Navier-Stokes equation. The result of such a calculation is the distribution of all flow variables in the calculated region. In consideration of the geometry the fundamental equations are solved for time-dependent 3D incompressible flow of a Newtonian fluid. The turbulence is described by the standard k-epsilon model. The equations of the numerical model are solved with the code OpenFOAM 1.7.1. The solution is based on the Finite volume method. The code uses the UDS interpolation scheme. For the discretization of derivatives the CDS scheme is used. This solution procedure employs the PISO algorithm for pressure correction.

The advantage of this method is the possibility to compare the hydrodynamic properties of a fossil fish with those of a fish whose swimming behaviour and mode of life is known. This allows to test if a swimming mode inferred from the similar body form would be efficient in *Saurichthys*. As a first step, we present the 3D surface model and the calculated hydrodynamic properties of *Saurichthys* and *Belone belone* in comparison to each other. In further studies, we aim to reconstruct the probable swimming movement and to investigate the influence of morphological features such as squamation or fin structure on the hydrodynamic properties.

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The Late Cretaceous deep-sea fish assemblage (Chondrichthyes, Actinopterygii) of the island of Timor, SE Asia

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Fossil deep-sea sediments are quite rare and only reported from few localites, e.g., the Alpine-Mediterranean region (Jurassic-Cretaceous), Borneo (Palaeocene-Eocene), Washington State, U.S.A. (Eocene), Barbados (Eocene-Oligocene), and Sicily (Oligo-Miocene). The island of Timor, SE Asia, is well-known for deep-sea sediments of Mesozoic and Cenozoic age. Ferromanganiferous nodules and crusts of Late Cretaceous and Eocene in age, which were accumulated at the continental margin at greater depth are exposed in eastern Timor. In western Timor island, Late Cretaceous ferromanganese micronodules were embedded in red clays, which were deposited on the deep-sea floor of a Cretaceous ocean and occur ca. 500 m above sea-level today. These nodules and sediments were most probably north of the subduction zone along which Timor and the Outer Banda Arc collided in the Late Cretaceous–Eocene. The deep-sea sediments survived subduction because they formed parts of one or several rafts in a clay olistostrome, which was thrust upon Timor Island during the Miocene.

The Late Cretaceous deep-sea red clays of western Timor crop out along a small river called Noil Tobee close to Nikiniki containing an abundant and diverse fossil fish assemblage. L.F. de Beaufort [Jaarboek van het Mijnwezenet in Ned. O. — [In] Verhandlingen, 1920, 4:61–70, Pl. 5] and W. Weiler [Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, B, 1932, 67. Beilage-Band:287–304, Pl. 12] presented taxonomic accounts of the material and identified 14 selachian and three actinopterygian taxa. W. Weiler concluded that the fish assemblage is characteristic for the early Late Cretaceous based on the supposed stratigraphic distribution of the taxa. However, most of the taxa identified consist of few isolated or heavily damaged teeth rendering their identification difficult.

In the course of a project on SE Asian Mesozoic and

Cenozoic fishes, we examined several thousand teeth and some vertebrae from the Noil Tobee locality housed in the Natural History Museum London, UK and the NBC Naturalis in Leiden, The Netherlands. Preliminary results of this revision are: (1) some but not all of the taxa identified by L.F. de Beaufort and W. Weiler could be confirmed; (2) the selachian fauna comprises a diverse assemblage of open-sea and pelagic taxa; (3) only a single incomplete and thus questionable hybodont tooth could be identified; (4) the enigmatic shark taxon *Ptychodus*, which is characteristic for the Late Cretaceous is represented by several species; (5) teeth of lamniform sharks are most common but identification of most specimens is compilcate due to their fragmentary nature; (6) teeth and tooth remains of *Carcharocles megalodon* are very common; (7) isolated tooth crowns of *Mitsukurina lineata* occur in high numbers; (8) remains of Hexanchiformes are rare; (9) other selachians include *Galeocerdo* and *Hemipristis*; (10) teeth of Cretaceous enchodontids are quite common in most samples; (11) teeth of *Lophius* occur prevalently; (12) several tooth plates of *Diodon* were recovered. The most important result of this study is that the fish fauna of Noil Tobee represents a mixture of fish assemblages of different age ranging from the Late Cretaceous to the Miocene contradicting previous interpretations. This age assumption is in good accordance with the tectonic model for the red clays of western Timor island.

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Fossil brittle stars from the Paratethys (Miocene, Europe) – state of the art

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The Paratethys was a large sea that formed during the Eocene and was separated from the Mediterranean by the rise of the alpidic mountain chains. This shallow epicontinetal sea is one of the best investigated fossil basins. Being easily accessible in abundant artificial and natural outcrops, its deposits were intensely studied by 19th and 20th century palaeontologists. Yet some taxonomic groups received considerably less attention than others. Brittle stars which are common in equivalent modern settings were largely ignored so far. In part this may be explained by their multi-element skeleton which tends to fall apart rapidly after death. Here we present the current state of knowledge on Cenozoic brittle star assemblages of the Paratethys. Articulated specimens are exceedingly rare, only few localities have delivered whole individuals. In most cases these specimens are embedded in silt and clay and appear to have been killed by obruption. Isolated ossicles are much more common, but tend to be restricted to a specific time slice during the Middle Miocene. In this interval tropical conditions prevailed, providing for abundant and diverse habitats ranging from soft bottoms to coral reefs. A survey of the ophiuroid species described from these deposits shows that most are in serious need of taxonomic re-assessment, often being placed indiscriminately in a few genera (mostly *Amphiura* and *Ophiura*). Detailed analysis of topotypic material, however, shows a rich diversity similar to analogous modern environments (e.g. the Caribbean).

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From bone to pixel – 3D reconstruction and visualization of *Erlikosaurus andrewsi*

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The study of anatomical and morphological features of fossils relies heavily on their preservation and completeness. This is especially true for complex and articulated structures, such as cranial elements. Although the vertebrate skull holds a multitude of informative characters, it is rarely fully preserved in fossil animals and prone to damage – not only through taphonomic and diagenetic processes, but also by preparation. Until recently, mechanical or chemical preparation was the only possibility to expose fossils encased in matrix, often at the cost of losing valuable information, or even impossible for fragile specimens. The advent and wider availability of non-destructive methods, such as computed tomographic (CT) scanning, has changed that.

Exemplified by the skull of the therizinosaur dinosaur *Erlikosaurus andrewsi* from the Late Cretaceous, we demonstrate the effectiveness of using CT generated data