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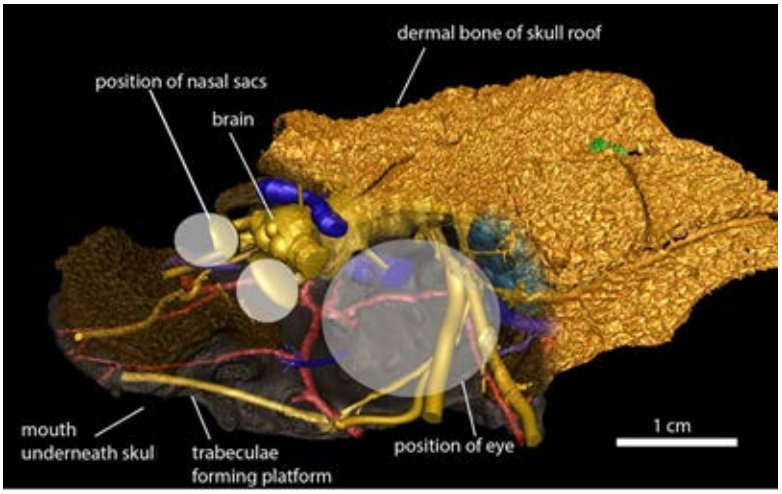
The braincase of *Nefudina qalibahensis* (Vertebrata, Placodermi, Rhenanida) revealed by computerised tomography

The aim of the project is to create an anatomically accurate virtual 3D-model of the braincase of a fossil fish, which will increase our knowledge of our early evolutionary history.



The digital 3D model of the skull of the primitive placoderm *Romundina* sheds light on the formation of our face.

The student will have to segment, that is, discriminate anatomical structures on the radiographs and 3D model the internal structures of the skull. From the generated 3D model, he/she will propose some anatomical hypotheses and possibly draw phylogenetic conclusions. He/she will be supervised by a placoderm specialist, and will be in touch with the rest of the team at Per Ahlberg's lab in Uppsala, a pioneer and worldwide renowned team for the quality of the data and its research outcomes such as publications in *Nature*, especially in the field of early vertebrate evolution. He/she may communicate with other collaborators of this project from the Belgian Royal Institute of Natural Sciences in Brussels, Belgium, and from Naturalis in Leiden, Netherlands. He/she will be associated with the publication using this model (a sub team in Leiden is already working on a smaller data set). A short thesis/report and a presentation is expected to be given by the student at the end of the segmentation project.

In order to conduct successfully the project, the student will be given an introductive course to early vertebrates in general and placoderms in particular. He/she will be using a segmentation and 3D-modelling software (Materialise Mimics which is the best option in this case) in a state of the art facility at EBC. Mimics is a very straight forward and user-friendly software developed by a Belgian company (Materialise) with which our team in Uppsala has been in relation for over ten years. An introduction course to Mimics will be given too. The student will have the whole summer to perform the segmentation. Supervision including but not limited to regular meetings, palaeontology and technical teaching, will reveal the importance of the studied group, the methodology, and the outcomes of such study, as well as one of the research tracks of Per Ahlberg's team.

Placoderms, also known as armoured fishes, are the first vertebrates to have acquired jaws and were the most diversified vertebrates of their time (-450 to -360 million years, roughly), and among them, rhenanids are consistently sorted as basal forms. They are thus a very important

group to study in order to understand our own deep origins and the first steps of the vertebrate evolutionary history.

For a long time, palaeontologists could only study fossil bones to build hypotheses and propose phylogenies, reconstruct past environments, etc. However, since the last decade we have an opportunity to use cutting edge technologies such as computerised tomography in the present case. This method of analysis works in the same way as a classic radiograph of a broken bone, but allows tri-dimensional vision at various levels of resolution (from coarse millimetre to micrometre and even below). The alliance of this technology with exceptionally well preserved fossil specimens allows palaeontologists to expand the collection of data and hence explore new hypotheses, including the reconstruction of nerve and blood vessel paths, the origin of teeth and bone, tissular growth, etc.

The project revolves around a rhenanid placoderm from Saudia Arabia, curated at the national Museum of natural history in Paris, France (MNHN), and of which the external morphology was published in 1995. A colleague and I recently scanned the corresponding skull at the CT-facility of the MNHN, and acquired exquisite dataset, revealing numerous important new anatomical bits of information in the braincase. We believe this new data will increase our knowledge of the anatomy of the group, as well as its phylogenetic and evolutionary implications.

The project is somewhat flexible and adaptable to suit individual student backgrounds and needs with regard to how experienced you are, which course length you prefer and your needs for which exact course to register for. Research training or Project work of some 10-30 credits would be the primary courses of interest.

For any supplementary information, please contact Vincent Dupret : vincent.dupret [at] ebc.uu.se.