

Synchrotron tomography as a perfect tool to successfully image large and flattened fossils

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Acanthothoracid fish belong among the most primitive jawed vertebrates and may have a major impact on our understanding of early vertebrate evolution. Potentially the most important acanthothoracid collection in the world is the Lochkovian (Lower Devonian, approximately 415 million years old) material from the Czech Republic. However, it is problematic to study. The specimens contain semi-articulated heads and trunks with parts of the posterior body embedded in large blocks of dark, fine-grained limestone. The colour contrast of the limestones is very low and they don't respond well to mechanical or chemical preparation. These specimens are extremely important because the anatomy of the cheek, gill arches, shoulder and pelvic girdle are all poorly known or completely unknown in early vertebrates. The only non-destructive method able to image these specimens is phase contrast synchrotron microtomography (PPC-SR μ CT) at ID19 beamline of ESRF. This powerful beam capable of high energies is by far the best tomographic facility in the world for vertebrate fossil specimens of this size. Most of the scans proved to be very informative; the scanning characteristics of the limestone are excellent, with high bone-rock contrast and little background noise. One observation of particular importance is the discovery of tooth-bearing jaw bones (Figure 1). The dentitions in our specimens combine features seen in bony fishes and cartilaginous fishes in an unexpected manner.

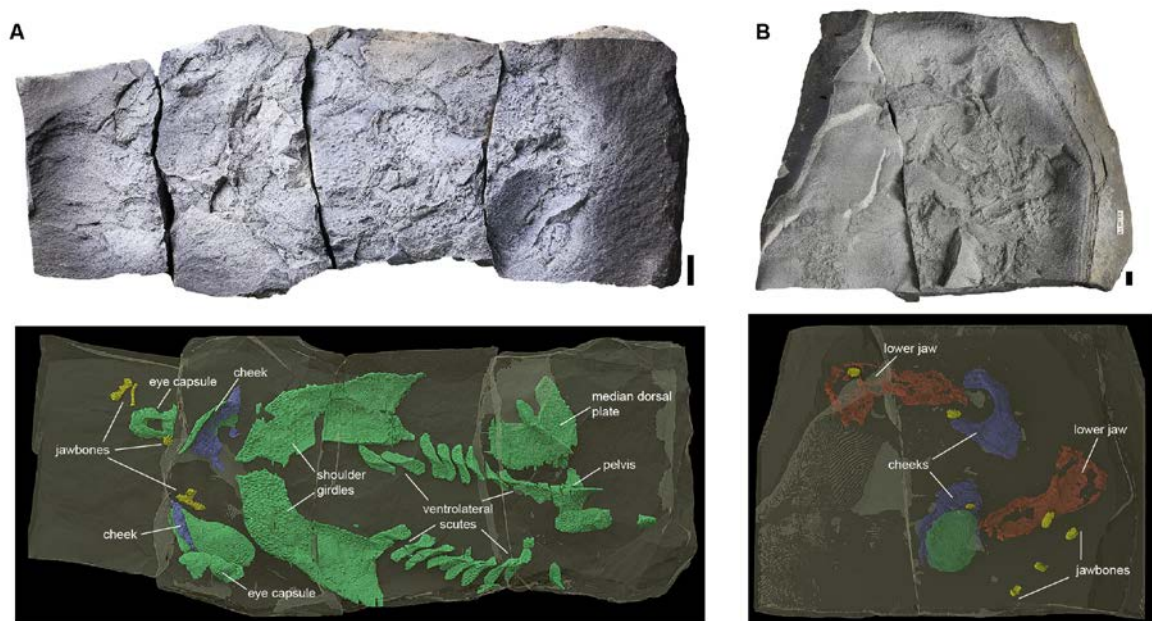


Figure 1: **A**, Specimen of *Kosoraspis* (above) and a partly modelled scan (below) showing jawbones, the postcranial skeleton and the first articulated pelvic girdle ever seen in a basal gnathostome. **B**, Specimen of *Tlamaspis* (above) and partly modelled scan (below) showing the upper and lower jaws with associated jawbones. Dermal bones in green, perichondral bones in violet and red, jawbones in yellow. Voxel size of scans 24.59 μ m. Scale bar equals 10 mm.