

Neutron-based computed microtomography: *Pliobates cataloniae* and *Barberapithecus huerzeleri* as a test-case study

Alessandro Urciuoli¹, Clément Zanolli², Josep Fortuny^{3,1}, Sergio Almecija^{4,1}, Burkhard Schillinger⁵, Salvador Moyà-Solà^{1,6,7}, David M. Alba¹.

¹Institut Català de Paleontologia Miquel Crusafont, Universitat Autònoma de Barcelona, Edifici ICTA-ICP, c/ Columnes s/n, Campus de la UAB, 08193 Cerdanyola del Vallès, Barcelona, Spain.

²Laboratoire AMIS, UMR 5288 CNRS, Université Toulouse III Paul Sabatier, Toulouse, France.

³Centre de Recherches en Paléobiodiversité et Paléoenvironnements, Muséum National d'Histoire Naturelle, Bâtiment de Paléontologie, CP38, 8 rue Buffon, 75005 Paris, France

⁴Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University, Washington, DC 20052, USA.

⁵Technische Universität München, Fakultät für Physik E21, James-Franck-Str.1, D-85747 Garching, Germany.

⁶Institució Catalana de Recerca i Estudis Avançats, Pg. Lluís Companys 23, 08010, Barcelona, Spain.

⁷Unit of Anthropology, BABVE department, Universitat Autònoma de Barcelona, 08193, Cerdanyola del Vallès, Barcelona, Spain.

Abstract:

Constant improvements in image detectors and computing power have enabled high-resolution imaging with X-ray tube and synchrotron radiation microtomography (μ CT) of sediment-embedded fossils. Although this represents a very powerful tool for anatomical analysis, bone and dental tissues do not always provide a distinct structural signal with X-rays. Here we compare the results of neutron μ CT scans performed at the ANTARES facilities of the FRM II research reactor in Munich with standard X-ray results for several fossil remains. In particular, we scanned fossils of two Miocene catarrhines from the Vallès-Penedès Basin that had been previously proven problematic with X-rays: the holotype skull (IPS58443) of the stem hominoid *Pliobates cataloniae*; and three lower molars (IPS1724m,n,o) from the holotype of the pliopithecoid *Barberapithecus huerzeleri*. X-ray-based μ CT for these specimens failed to retrieve any contrast between the fossil tissue components (i.e., the normal distribution of the contrast histogram was shifted to the low or high end of the curve). This is due to the extreme similarity between the chemical composition of the embedding matrix and fossil in IPS58443 and to the presence of high-density elements in IPS1724. In contrast, neutron-based μ CT delivered high-contrast images of the studied specimens. In fact, neutron radiation easily penetrates metals and may return very different contrasts of different isotopes of the same element, thereby enabling a correct definition of the bone/sediment interface and a proper segmentation of the images stack. In conclusion, neutron-based μ CT represents a viable alternative to X-rays for the extraction of anatomical information from sediment-embedded fossils.