Contribution ID : **55**   Type : **Talk**

Neutron Imaging for Palaeontology

Wednesday, 6 November 2024 15:40 (20)

Palaeontology and evolutionary studies are dependent on the physical measurement of bone dimensions to determine relationships between organisms, determine age at death, interpret lifestyles, predator-prey interactions and physical adaptions to a constantly changing world. These measurements have traditionally demanded the physical extraction of specimens from their surrounding rock. This process risks damage to small and fragile bones, loss of contextual information associated with the environment at that time, mode of preservation and articulation. For this reason, 3D imaging using X-rays has become a critical tool for the investigation and preservation of fossilised remains, which can now be investigated while remaining in their original matrix. For many fossil localities, the applicability of X-rays is limited due to the prevalence of authigenic pyrite - pyrite that forms within, and surrounding fossils due to the localised reduction of sulfate (from decomposing organic remains) in iron-rich pore waters. These iron-rich minerals are opaque to X-rays, and therefore obscure the fossil remains.

Neutron imaging is a relatively new tool for palaeontology and has revolutionised the field for two reasons: a high-sensitivity to hydrogen, and greater ability to penetrate through iron-rich minerals such as pyrite.

This presentation draws on high-profile palaeontological studies conducted using the DINGO neutron imaging instrument at ANSTO to demonstrate the complementarity of neutrons with X-rays. The method has become a game-changer for Australian palaeontology, attracting specimens for study from around the globe. It will highlight the advantage of neutrons in revealing cartilaginous soft-tissue remains, complete internal organs, stomach contents and entire organisms that are invisible to traditional X-ray tomography.

Topics

Earth, Environment and Cultural Heritage

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