We acknowledge the Turrbal and Yuggera peoples, the Traditional Owners of the land where we gather for our Symposium, and pay our respects to Elders past, present and emerging. We recognise their connection to Country and their role in caring for and maintaining Country over thousands of years.

WELCOME

Thank you for joining us for the 7th International Symposium on Palaeohistology (ISPH 2025) in Brisbane, Queensland, Australia, also known as Meanjin in Turrbal language. It is a pleasure welcoming you to our beautiful St Lucia campus of the University of Queensland (UQ). We hope you enjoy your visit and find all the presentations stimulating as well as use the Symposium as an opportunity to catch up with colleagues and collaborators in person! Last time we met in person at IPSH was in Cape Town, South Africa in 2019.

We are pleased to present the program for ISPH 2025 along with research abstracts for podium, poster, and keynote presentations. We are excited to see a range of taxa and methods represented, along with a truly international gathering of delegates from 18 countries and six continents. We extend huge thanks to the scientific committee—Dr Blanca Moncunill-Solé (Universidade do Porto, Portugal), Dr Aurore Canoville (Museum für Naturkunde Berlin, Germany), Professor Anusuya Chinsamy-Turan (University of Cape Town, South Africa), Professor Timothy Bromage (New York University, USA), and Dr Justyna Miszkiewicz (UQ)—for their time and expertise in reviewing abstract submissions. We also thank Dr Scott Hocknull from the Queensland Museum for his time and expertise showing delegates around the newly opened *Dinosaurs Unearthed* exhibition, and Ellen-Thérèse Lamm for running the palaeohistology techniques workshop. Thank you to all the delegates who offered to chair sessions and Professor Anusuya Chinsamy-Turan, Dr Blanca Moncunill-Solé, and Professor Natalie Sims (St. Vincent's Institute of Medical Research, Australia) for delivering keynote lectures. Everyone's involvement in the Symposium is much appreciated.

Throughout the Symposium we will be using our Bluesky (@isph2025.bsky.social) social media account to promote the presentations using a hashtag #isph2025. We would like to extend a friendly reminder to the speakers to indicate at the start of their presentation, and to poster authors to note on their posters or verbally, whether any or parts of the presented content can be shared on social media. We also kindly remind to familiarise yourself with our Code of Conduct on our website and what to do in an unlikely event that something goes wrong. Members of the organising committee will be in attendance throughout the Symposium, and you can identify us from 'organiser' badges.

The Symposium presentations with morning and afternoon tea all will take place at the **14-212 Learning Theatre** in the **Sir Llew Edwards Building** at the UQ St Lucia campus between Wednesday 18 and Friday 20 June 2025.

To access Wi-Fi, open the wireless settings on your device, select **UQ Guest** from the list of available wireless networks. Once connected, your browser will open a Free Wi-Fi Service captive portal screen. Click Accept to agree to Terms and Conditions. You will be advised that you are now connected to UQ's Guest Wi-Fi network. If you are unable to browse the internet after following the steps above, please close and then reopen your browser. The UQ Privacy Management Policy and UQ Guest Wi-Fi terms and conditions are included on each login screen.

We look forward to engaging with you at ISPH 2025!

Dr Justyna Miszkiewicz, University of Queensland
Professor Julien Louys, Griffith University
Associate Professor Gilbert Price, University of Queensland
Ms Meg Walker, Griffith University
Associate Professor Laura Wilson, Australian National University

PROGRAM

All times are AEST, speaker names are underlined

Welcoming reception Tuesday 17 June 2025

3.00 – 5.00pm The Ship Inn, Sidon St, South Brisbane QLD 4101

Day 1 Wednesday 18 June 2025

14-212 Learning Theatre in the Sir Llew Edwards Building

10:00 – 10:45am Morning tea and registration

10:45 – 11:00am Acknowledgment of Country, welcome, health and safety, announcements

11:00 – 12:00pm Palaeohistology keynote

Professor Anusuya Chinsamy-Turan, University of Cape Town, South Africa

From osteohistology to biology: highlights from my research

12:00 – 1.30pm Lunch break

1.30 – 3.15pm Session 1 chaired by Laura Wilson

Bone histology and growth patterns in fossil vertebrates

1.30 – 1.50pm Teschner EM

The growth pattern in long bones of Triassic pseudosuchians – is there even a pattern of growth?

1.50 – 2.10pm Canoville A, Fröbisch J

Late Paleozoic tetrapods from Bromacker (Germany) and North America had different life history traits

2.10 – 2.30pm Botha J, Choiniere JN, Moopen A, Chapelle KEJ, Kulik Z, Benson RBJ

Sauropodomorph growth history trends across the Triassic-Jurassic boundary

2.30 – 2.50pm Calderón T, van der Geer AE

Small but intriguing: the unusual growth dynamics of the dwarf Candiacervus

2.50 – 3.10pm Pereyra ME, Bona P, Chinsamy A

Skeletochronology and bone appositional rates of Crocodylus niloticus *Laurenti, 1768*

3.15 – 3.45pm Afternoon tea and close of Day 1

Day 2 Thursday 19 June 2025

14-212 Learning Theatre in the Sir Llew Edwards Building

09:30 – 10:30am Early Career Researcher Keynote

Dr Blanca Moncunill-Solé, Universidade do Porto, Vairão, Portugal

Extinct lagomorphs under the microscope: what palaeohistology reveals about their evolution

10:30 – 12:00pm Morning tea + networking break

12:00 – 1:00pm Session 2 chaired by Gilbert Price

Functional morphology and evolutionary adaptations

12:00 – 12:20pm Bromage TG, Adames A, Eustache R-P, Sander M, Boyde A, De Jesus CL, Erdjument-Bromage H, Hu B, Khan NA, Siddiqui R, Neubert TA

Jurassic ichthyosaur palaeometabolomes yield metabolic and ecologic insights on a lifestyle evolutionarily convergent with deep-diving toothed whales

12:20 – 12.40pm Hand SJ, Wilson LAB, López-Aguirre C, Houssaye A, Archer M, Bevitt JJ, Evans AR, Halim AY, Hung T-T, Rich TH, Vickers-Rich P, Beck RMD

Bone microanatomy supports a Mesozoic origin for an amphibious lifestyle in monotremes (Mammalia)

12.40 – 1.00pm Anné J, Canoville A, Zanno LE

Using high-resolution chemical analyses to distinguish bone tissue types

1.00 – 2.30pm Lunch break

2.30 – 4.10pm Session 3 chaired by Jennifer Anné

Bone remodelling and hard tissue microstructure in mammals

2.30 – 2.50pm Chakraborty P, Sathe V

Preliminary insights into the histological structure of fossil cervid antlers in India

2.50 – 3.10pm Sathe V

Microstructure of the ivory of the Pleistocene hippos and elephants in India

3.10 – 3.30pm Chakraborty P, Sathe V

Bone histomorphology in hexaprotodonts of the Indian Late Pleistocene

3.30 – 3.50pm Miszkiewicz JJ, Athanassiou A, Lyras GA, van der Geer AE

Rib remodelling and body size in insular dwarf and common fossil hippopotamuses

3.50 – 4.10pm Basilia PA, Miszkiewicz JJ, Lyras GA, Athanassiou A, van der Geer AE

Rib bone remodelling in fossil elephants from Greece

4.10 – 4.40pm Afternoon tea and close of Day 2

Day 3 Friday 20 June 2025
14-212 Learning Theatre in the Sir Llew Edwards Building

09:30 – 10:30am Interdisciplinary Keynote

Professor Natalie Sims, St. Vincent's Institute of Medical Research, Melbourne, Australia

Control of bone composition by osteocytes: insights from mice and women

10:30 – 12:00pm Morning tea, poster session chaired by Karen Cooke

Blanco A, Moncunill-Solé B, Hübner TR, Rauhut OWM: *Palaeohistological evidence of a dwarf hadrosauroid dinosaur from the Late Cretaceous of the Ibero-Armorican Island*

Burrow CJ: *Antithetical early gnathostome mineralised cartilages, in chondrichthyans and* Palaeospondylus

Fritzen MR, Long JA, Trinajstic K, Clement AM: *Determining cell size change in lungfishes over 400 million years of evolution*

Grabski SG, Price G: *Reassessing coprolites: an overlooked approach to understanding palaeoecology*

Hu B, Eustache R-P, Sander M, Boyde A, Erdjument-Bromage H, De Jesus CL, Neubert TA, Bromage TG*: Integrative heuristic and holistic palaeohistology of exceptionally well-preserved Jurassic ichthyosaurs*

Sathe V, B Khongwir: *Comparative histomorphology of bones in extinct and modern horses*

Smith TM, Ferrell RJ, Reid DJ: *Variation and error in the assessment of dental long-period line timing: a cautionary tale*

12:00 – 1.30pm Lunch break

1.30 – 3.10pm Session 4 chaired by Ella Teschner

Pathology, stress, and diagenesis in fossil and archaeological bone

1.30 – 1.50pm Sarkar P, Ray S

Bone microanatomy reveals vertebrate palaeopathologies from various Triassic horizons of India

1.50 – 2.10pm Cooke KM, Buckley H, Kinaston R, Kiko L, Oxenham MF, Miszkiewicz JJ

Progression of histological changes in skeletal lesions caused by treponematosis in an archaeological human sample

2.10 – 2.30pm Smith TM

Inferring stress histories from trace elements: promises and pitfalls from tooth histology

2.30 – 2.50pm Walker MM, Miszkiewicz JJ, Reed E, Jacobsen G, Kumar S, Levchenko V, Fallon S, Esmay R, Monks J, Louys J

Using histotaphonomy to determine wet and dry diagenesis across subfossil and fossil bones from underwater caves

2.50 – 3.10pm Price GJ, Leonard ND, Louys J, Wilkinson JE, Zhao J

Megafauna under the microscope: trace element mapping of Pliocene fossil vertebrates from Chinchilla, Australia

3.10 – 3.50pm Afternoon tea

3.50 – 4.30pm General meeting and close of Symposium

6.00pm Dinner at the Regatta Hotel, 543 Coronation Dr, Toowong QLD 4066

KEYNOTE SPEAKER PROFILES

Palaeohistology Keynote

Professor Anusuya Chinsamy-Turan, University of Cape Town, South Africa

Anusuya is a palaeobiologist in the Department of Biological Sciences at the University of Cape Town. She is a global expert on the microscopic structure of the bones of extinct and extant vertebrates. Her work has been recognised by several highly acclaimed awards, including a 1995 NRF President Award, and a 2005 the South African Woman of the Year Award, which acknowledges her contribution to science both in terms of research and science communication to the wider public. In 2005 she also won the "Distinguished Women Scientist Award" from the South African Department of Science and Technology, and in 2012 she was awarded the NRF Transformation Award. In 2013 she was awarded The World Academy of Science's (TWAS), sub-Saharan prize for the Popularisation of Science. Professor Chinsamy-Turan has published extensively - both in international scientific journals (including 4 publications in *Nature* and 1 in *Nature Communications*) as well as in the popular press. She is former President of the Association of South African Women in Science and Engineering (SA WISE), former Deputy President of the Academy of Science of South Africa, and she has also served as Director of Iziko Museums Natural History Collections (which includes the SA Museum). Prof Chinsamy-Turan currently Chairs the Advisory Boards of Scifest Africa, the biggest science festival in Africa and she is a member of the Advisory Board the Cape Town Science Centre, and in addition she is Chair of the Romer-Simpson Prize Committee of the US-based Society of Vertebrate Palaeontology and serves as a board member for the Jurassic Foundation (US). She is also a Fellow of the Royal Society of South Africa, the University of Cape Town and The Word Academy of Sciences. She has published extensively in high-ranking international scientific journals and has an H-index of 50. In addition, she has authored two academic books, *The Microstructure of Dinosaur Bone* (Johns Hopkins University Press, USA, 2005) and *The Forerunners of Mammals: Radiation. Histology. Biology* (Indiana University Press, USA, 2012). Besides these academic works, she has four popular level books: *Famous Dinosaurs of Africa* (RandomHouseStruik, SA, 2008); *Fossils for Africa* (Cambridge University Press, 2014); *Dinosaurs of Africa* (RandomHouseStruik, 2021); *Dinosaurs and other Prehistoric Life* (Dorling Kindersley, UK, 2021).

Early Career Researcher Keynote

Dr Blanca Moncunill-Solé, Universidade do Porto, Vairão, Portugal

Blanca is a palaeobiologist interested in unravelling the biology and evolutionary dynamics of extinct small mammal taxa, particularly the lagomorphs. During her early career, she developed models for reconstructing the size of past small mammals, and the use of palaeohistology for disentangling their biology and evolutionary history. These studies allow her to establish the first long-term database of evolutionary responses of small mammals to insularity, being useful for conservation purposes of extant ones. She is an active researcher in outreaching (articles, workshops, media interviews, exhibition curator, social and outreaching projects, etc.), to bring science to society and to share her results. At present, her research lines are focused on determination of the evolutionary and ecological dynamics of extinct lagomorphs to past climate and environmental changes, identifying the drivers, biological shifts and extinction rates. Revealing how this family evolved to past environmental changes will contribute to the development of more effective conservationist strategies and policies for threatened extant taxa, helping, hence, in the present and future ecosystem management and protection.

Interdisciplinary Keynote

Professor Natalie A. Sims, St. Vincent's Institute of Medical Research, Melbourne, Australia

Natalie is Head of the Bone Cell Biology and Disease Unit at St. Vincent's Institute of Medical Research, where she is also the Deputy Director, and is a Professorial Fellow at The University of Melbourne, and at the Australian Catholic University. She completed her PhD at the University of Adelaide in 1995, followed by postdoctoral work at the Garvan Institute (Sydney) and Yale School of Medicine (Connecticut, USA). Her laboratory studies the cellular interactions responsible for development, maintenance and strength of the skeleton, including the IL-6 family of cytokines and estrogen receptor isoforms in bone through the use of genetically altered mouse models and *in vitro* systems. Her work has been recognised by the American Society of Bone and Mineral Research Fuller Albright Award (2010) and their Paula Stern Award (2020), and the International Bone and Mineral Society Herbert A Fleisch Award (2013). She was appointed a Fellow of the American Society of Bone and Mineral Research (2018). She is a Deputy Editor of the *Journal of Bone and Mineral Research*, and serves on the Editorial Board of the *Journal of Biological Chemistry*. She is Past-President of the Australia and New Zealand Bone and Mineral Society and on the Council of the International Federation of Musculoskeletal Research Societies.

Using high-resolution chemical analyses to distinguish bone tissue types

Anné J[1*], Canoville A[1,2], Zanno LE[3]

*jennifer.anne@naturalsciences.org

[1]Paleontology, North Carolina Museum of Natural Sciences, Raleigh, NC, USA
[2]Museum für Naturkunde, Berlin, Germany
[3]Department of Biological Sciences, North Carolina State University, Raleigh, NC, USA

Distinguishing bone tissue types can be problematic when tissues of interest share depositional properties (e.g. rapid growth). This is particularly true for medullary bone (MB), a rapidly deposited bony tissue used by female birds to store calcium for egg laying. Identifying MB in the fossil record is essential for understanding its evolutionary origin within extinct avemetatarsalians. Yet, prior studies demonstrate similarities in the microstructure and chemical composition of MB when compared to specific pathologic bone tissues (PB) within extant avians. Recent studies have shown that some bone tissues can be identified by their chemical signature, specifically the identification, spatial distribution, and bond structure of key trace elements using synchrotron-based X-ray fluorescence (SRS-XRF) and X-ray absorption spectroscopy (XAS). The latter has also allowed for the identification of biologically derived trace element preservation in deep time. Coupling traditional histology, synchrotron-based microCT and SRS-XRF/XAS, we analysed an array of extant avians and fossil archosaurs with potential MB and confirmed PB to distinguish between tissue types. Preliminary results of elemental composition show several similarities between fossil and extant tissues in chemical distributions in Zn and S. Differential distributions of key trace elements, primarily different S species and Zn, between MB and PB are also observed, as well as between different types of PB tissues in extant avians. The study of fossil archosaur bone chemistry is still in its early stages; however, the approach holds promise as a tool for MB tissue differentiation.

Rib bone remodelling in fossil elephants from Greece

Basilia PA[1,2*], Miszkiewicz JJ[3,4], Lyras GA[5], Athanassioue A[6], van der Geer AE

*pgbasilia@feu.edu.ph

[1]Institute of Arts and Sciences, Far Eastern University, Manila, Philippines
[2]Australian Research Centre for Human Evolution, Griffith University, Brisbane, Australia
[3]School of Social Science, University of Queensland, St Lucia, Queensland, Australia
[4]Vertebrate Evolution, Development and Ecology, Naturalis Biodiversity Center, Leiden, The Netherlands
[5]Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, Athens, Greece
[6]Ministry of Culture, Ephorate of Palaeoanthropology–Speleology, Athens, Greece

Large and long living mammals experience dense cortical bone remodelling, yet surprisingly little is known about this process in the largest land mammals — elephants. In the Mediterranean, during the Middle and Late Pleistocene, straight-tusked elephants (*Palaeoloxodon antiquus*) evolved repeatedly into endemic dwarf species on islands, including *P. creutzburgi* on Crete (Greece). We tested whether this body size reduction due to insularity was accompanied by related changes in remodelling since bones of *P. creutzburgi* became smaller. Bone histology of non-weight bearing ribs was compared between the Cretan dwarf (n=5) and mainland *P. antiquus* (n=20) specimens from Greece. Rib cortical bone in both elephant samples displayed dense Haversian bone with evidence of remodelling up to the periosteal border. When osteon densities and area, and Haversian canal to osteon ratio were adjusted by bone size, they were statistically significantly (p<0.0001) higher in *P. creutzburgi* than *P. antiquus*. This suggests remodelling in the smaller ribs was characterised by relatively larger and more numerous osteons than in the bigger ribs of *P. antiquus*. We interpret these findings as indicative of a bone metabolic adaptation in *P. creutzburgi* around its need for deposition of higher quantity of bone within individual osteons and through maintaining osteon numbers that are comparable to the mainland ancestor. We propose that despite the size reduction of *P. creutzburgi's* skeletal frame, bone quantity was maintained at higher levels to ensure metabolic viability.

Palaeohistological evidence of a dwarf hadrosauroid dinosaur from the Late Cretaceous of the Ibero-Armorican Island

Blanco A[1,2,3*], Moncunill-Solé B[1,2,4], Hübner TR[5], Rauhut OWM[3,6,7]

*alejandro.blancoc@udc.es

[1]Grupo BIOpast, Departmento de Física e Ciencias da Terra, Universidade da Coruña, Coruña, Spain
[2]Centro de Innovación Tecnolóxica en Edificación e Enxeñería Civil (CITEEC), Universidade da Coruña, Coruña, Spain
[3]SNSB, Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany
[4]Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO), Universidade do Porto, Vairão, Portugal
[5]Friedenstein Stiftung Gotha, Gotha, Germany
[6]Department für Geo- und Umweltwissenschaften, Ludwig-Maximilians-Universität München, Munich, Germany
[7]GeoBioCenter, Ludwig-Maximilians-Universität München, Munich, Germany

At the beginning of the 20th century, Baron Ferenc Nopcsa observed that dinosaurs inhabiting the European archipelago, and specifically the Transylvanian Island (80,000 Km²), during the Late Cretaceous were notably smaller than their mainland relatives. He proposed that insular dwarfism might have occurred within these faunas. Subsequent studies confirmed this phenomenon in several dinosaur groups (sauropods, ornithopods, and hadrosauroids) from the Haţeg Basin in Romania as well as in other settings (e.g., sauropods in the Late Jurassic of central Europe). However, it is still debated whether similar dwarfing occurred on other, larger European islands. Specifically, on the Ibero-Armorican Island (>600,000 Km²), several researchers have noted that endemic dinosaur faunas exhibit smaller body sizes compared to their continental counterparts. Nevertheless, palaeohistological studies of Ibero-Armorican dinosaurs have yet to provide conclusive evidence supporting dwarfism. In this study, we examine a tiny humerus (total length <170 mm) attributed to a Maastrichtian (Late Cretaceous) hadrosauroid from Ibero-Armorica. Palaeohistological analysis reveals an almost fully remodelled bone tissue composed of Haversian systems, bounded externally by primary tissue representing very slow growth, indicating that it belongs to an individual of advanced ontogenetic stage. These findings support the hypothesis that certain ornithopods on the Ibero-Armorican Island also evolved towards reduced body sizes, coexisting alongside other dinosaurs of standard dimensions.

Sauropodomorph growth history trends across the Triassic-Jurassic boundary

Botha J[1,2], Choiniere JN[1], Moopen A[1], Chapelle KEJ[3], Kulik Z[4], Benson RBJ[4]

*jennifer.botha1@wits.ac.za

[1]Evolutionary Studies Institute and School of Geosciences, University of the Witwatersrand, Johannesburg, South Africa
[2]GENUS: DSTI-NRF Centre of Excellence in Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
[3]Department of Anatomical Sciences, Stony Brook University, New York City, USA
[4]Division of Paleontology, American Museum of Natural History, New York City, USA

Sauropodomorph dinosaurs, the largest terrestrial animals to ever exist, reached adult body masses over 50 tonnes. The earliest sauropodomorphs were small-bodied bipeds (10–30 kg) that are first documented in the Carnian. These rapidly diversified into a wide range of body sizes, up to several tonnes, before the end–Triassic. Sauropodomorphs survived the End-Triassic Extinction (ETE), apparently with little biased effect on large-bodied lineages, and by the middle Jurassic had evolved species with body masses exceeding any other terrestrial animal. A key debate in sauropodomorph evolution centres on when plesiomorphic annual, interrupted growth throughout ontogeny transitioned to derived rapid, sustained growth until late ontogeny. Recent studies using osteohistology have provided insights into these questions from Late Triassic sauropodomorphs. Here, we collate previous datasets and novel osteohistological data from Late Triassic species in South Africa, providing the largest dataset to date for understanding the evolution of sauropodomorph growth patterns and the effects of the ETE on growth. Our findings support previous observations that sauropodomorphs as well as the more derived sauropodiforms had interrupted growth from young stages. We find evidence for allometric variation in growth rate, particularly among the small-bodied Massospondylidae, as well as intra-lineage growth strategy variation near the sauropod transition in Lessemsauridae. We find no evidence for a change in growth patterns either before or after the ETE. This contrasts with patterns in crocodylomorphs which had slow growth rates and survived the ETE. These observations falsify hypotheses invoking growth rate macroevolution as an explanation of extinction survivorship.

Jurassic ichthyosaur palaeometabolomes yield metabolic and ecologic insights on a lifestyle evolutionarily convergent with deep-diving toothed whales

Bromage TG[1,2*], Adames A[3], Eustache R-P[4], Sander M[5], Boyde A[6], De Jesus CL[7], Erdjument-Bromage H[7], Hu B[1], Khan NA[8], Siddiqui R[9], Neubert TA[7]

[*]tim.bromage@nyu.edu

[1]Department of Molecular Pathobiology, New York University College of Dentistry, New York, USA
[2]Department of Paleoanthropology, Senckenberg Research Institute and Natural History Museum, Frankfurt, Germany
[3]Syracuse University Science Research track in partnership with Rachel Carson High School for Coastal Studies, New York, USA
[4]27 rue de la Forge, 27170 Combon, France
[5]Bonn Institute of Organismic Biology, University of Bonn, Bonn, Germany
[6]Dental Physical Sciences Unit, Queen Mary University of London, London, UK
[7]Department of Neuroscience and Physiology, New York University Grossman School of Medicine, New York, USA
[8]College of Science and Engineering, University of Derby, Derby, UK
[9]Institute of Biological Chemistry, Biophysics & Bioengineering, School of Engineering & Physical Sciences, Heriot-Watt University, Edinburgh, UK

We seek to obtain molecular evidence of metabolisms of ancient organisms reflecting endogenous physiological responses to environmental conditions and exogenous biomolecules derived of inferred diets that fuelled their metabolisms. To achieve this, we innovated methods to obtain metabolic profiles from fossil hard tissues. We sampled Late Jurassic ichthyosaurs of Ophthalmosauridae genus sp. indet. from centra of a 157-152 Ma juvenile (status based on remaining unremodelled primary trabeculae), Abingdon, UK, and a mature individual from 153 Ma deposits, Octeville, France. Bone samples were subject to biomolecule extraction solutions, proteins and metabolites were separated, and then each was evaluated by liquid chromatography-tandem mass spectrometry for proteomics and metabolomics respectively. Proteomics confirmed collagen and thus some intact bone ultrastructure. The two individuals yielded 1,692 small molecules from which 339 unique metabolite identifications were confirmed by mass, formula, and compound name, and then subject to pathway analysis. Endogenous metabolites of the two individuals conveyed very nearly identical canonical metabolic pathways expressing convergent evolutionary adaptations to those of deep-diving toothed whales, which include cardiovascular solutions to hypoxic conditions, lipogenesis using the valine metabolic pathway, skin protecting waxes and insulating blubber of consequence to benthic cold-water environments, and acoustic fat for echolocation of prey in darkness. We show that metabolites once in the free circulation and bone protein may remain intact in the bone ultrastructure for at least 150 Ma and be generally interpretable to organismal biology. Exogenous metabolites for inferring diet and ecology are presently uninterpretable due to the lack of basic science metabolomics knowledge.

Antithetical early gnathostome mineralised cartilages, in chondrichthyans and *Palaeospondylus*

Burrow CJ

carole.burrow@gmail.com

Biodiversity and Geosciences, Queensland Museum, Brisbane, Australia

Palaeozoic vertebrates exhibit a range of different patterns of cartilage mineralisation. The oldest known type is globular calcified cartilage in the Ordovician (455 Mya) agnathan *Eriptychius* from the Harding Sandstone, USA. By the earliest Devonian (410 Mya), some stem chondrichthyans, e.g. *Climatius* and *Ischnacanthus* from the Dundee Flagstone Formation, Scotland, had developed jaws composed of nonprismatic subtessellate calcified cartilage. Prismatic tessellate calcified cartilage is first known from late Early Devonian (~400 Mya) isolated fragments from the Craven Peak Beds in western Queensland, probably from *Maiseyodus*. Vertebrate hard tissues from the site – the only Devonian marine limestone in central Australia - show amazingly well-preserved histology. The same locality which yielded this material is also the type locality for the newly erected species *Palaeospondylus australis*. *Palaeospondylus* is an enigmatic taxon, first described in the late nineteenth century from Scotland. The genus is characterised by a unique endoskeletal tissue comprising a honeycomb-like calcium+phosphate+fluorite scaffold which housed cartilage cells. *Palaeospondylus* and crown chondrichthyan endoskeletons are thus antithetical – the former having only extracellular matrix mineralised, and the latter having only the cartilage tesserae mineralised. Phylogenetic analysis resolves *Palaeospondylus* as a stem chondrichthyan, but the endoskeletal tissue structure resembles that of embryonic osteichthyan bone.

Small but intriguing: the unusual growth dynamics of the dwarf *Candiacervus*

Calderón T[1,2*], van der Geer AE[2]

[*]tcalderon@unizar.es

[1]University of Zaragoza
[2]Vertebrate Evolution, Development and Ecology, Naturalis Biodiversity Center, Leiden, The Netherlands

Insular faunas are particularly fascinating, where low resource availability and reduced predator pressure have led to remarkable morphological and physiological adaptations, resulting in bizarre forms such as dwarf and giant species. The Pleistocene Cretan deer genus *Candiacervus* provides an example, evolving into contemporaneous, differently sized morphotypes with body mass ranging between ~28 and ~245kg. We performed histological analysis on 24 femora from dwarf *Candiacervus* of different age stages to obtain detailed information on growth dynamics and life-history traits. Bone microstructure was composed of fast-growing tissue in all femora, with a slow-growing band towards the outer cortex of adult specimens, as in most mammals. Bone tissue was interrupted by growth marks in all femora. However, the arrangement of the growth lines did not follow the common vertebrate pattern (decreasing distance between subsequent growth marks due to ontogenetic decline of growth rates). Instead, most specimens exhibited a splitting pattern in the inner growth marks, resulting in double or multiple lines towards the anterior part of the bone, hindering the interpretation of growth periods. These unusual findings raise more questions than answers regarding the *Candiacervus* growth pattern: Could phylogeny underlie this pattern? Could it be related to the changing climatic conditions throughout the Pleistocene? Could this pattern be the result of an ontogenetic component (heterochrony) related to insularity? Could it be explained by a shift in biomechanical loadings associated with dwarfism? Further analysis of the other *Candiacervus* morphotypes and other insular taxa will be key to understanding this intriguing growth pattern.

Late Paleozoic tetrapods from Bromacker (Germany) and North America had different life history traits

Canoville A[1,2*], Fröbisch J[1,3]

[*]canoville.aurore08@gmail.com

[1]Museum für Naturkunde Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Berlin, Germany
[2]North Carolina Museum of Natural Sciences, Raleigh NC, USA
[3]Humboldt-Universität zu Berlin, Berlin, Germany

The early Permian Bromacker locality of central Germany is known for its exceptional fossil record, including tracks and burrows, but also body fossils of plants, arthropods, and diverse tetrapods. A wealth of studies shows that this palaeo ecosystem was unique and differed from coeval North American (NA) fossil assemblages. The latter mostly represented lowland environments with perennial rivers and tetrapod communities of aquatic to terrestrial taxa dominated by large carnivores. On the contrary, Bromacker palaeoclimate was highly seasonal with ephemeral water bodies. Its tetrapod fauna was exclusively terrestrial, with abundant herbivores, but scarce and small to medium-sized predators. Environmental conditions are expected to impact the growth strategies and lifestyle adaptations of tetrapods. However, this has rarely been reported for late Palaeozoic tetrapod communities. Here we investigate, for the first time, the long bone histology of the six largest Bromacker tetrapods (*Seymouria sanjuanensis*, *Diadectes absitus*, *Orobates pabsti*, *Dimetrodon teutonis*, *Martensius bromackerensis*, *Tambacarnifex unguifalcatus*), with the aim to infer their life history traits and compare them to NA relatives. Preliminary observations reveal that most specimens found at Bromacker represent subadult to adult individuals, with few young juveniles. Unlike all other investigated species, Bromacker diadectids exhibit highly remodelled long bone cortices; a feature potentially related to fossorial adaptations. *D. teutonis* shows nearly avascular and thin bone walls, differing from the well vascularised and thicker cortices of its dwarf NA counterpart, *D. natalis*. Overall, Bromacker species show relatively slower growth rate than their NA relatives. Local environmental conditions might explain these contrasting growth strategies.

Bone histomorphology in hexaprotodonts of the Indian Late Pleistocene

Chakraborty P*, Sathe V

*prateek.chakraborty@dcpune.ac.in

[1]Department of Ancient Indian History, Culture and Archaeology, Deccan College Post Graduate and Research Institute, Pune, India

The ancestral relationship of hippopotami and whales is well documented, in terms of genetics as well as morphology (such in the inner ear). However, the skeletal morphology does not show any major morphological traces of this ancestral connection. While the dermal histology of modern *Hippopotamus* points to inherited features from cetaceans, the histomorphology of bones can be examined for such possibilities (if any). On the other hand, recent studies on the relationship between buoyancy, bone density and histomorphology in African hippopotami have established parameters connecting these factors to aquatic behaviour (swimming) and have demonstrated the efficacy of such studies in connecting histomorphology with aquatic adaptations. The present study examines the histomorphology of fossilised long bones from *Hexaprotodon* spp. of Peninsular India to identify any of the adaptations seen in African hippopotami that point to buoyancy and aquatic behaviour as seen from modern samples, and whether any taxonomic parameters can be established between bone histomorphology and aquatic adaptation in the Indian hippopotamus. The bones examined in this study are obtained from the fossil assemblage of the Narmada Valley dating to approximately Middle to Late Pleistocene, and from the Manjra Valley with AMS dates of 22,000 BP (Late MIS-3), representing two different river systems with a similar landscape, separated by roughly 1000km within Peninsular India.

Preliminary insights into the histological structure of fossil cervid antlers in India

Chakraborty P*, Sathe V

*prateek.chakraborty@dcpune.ac.in

[1]Department of Ancient Indian History, Culture and Archaeology, Deccan College Post Graduate and Research Institute, Pune, India

The present work examines the microstructure and histological characteristics of several antlers of *Cervus* sp. (cf. *unicolour*) from different parts of the Indian subcontinent, all dating to the latest of Pleistocene and Holocene. The formation of antler tissue, much like its skeletal and dental counterparts, is affected by factors such as pathology, environment and diet. Additionally, phenomena such as fighting behaviour during mating season leave noticeable biomechanical stress marks in the internal structure. However, antlers are unique in the relatively short cycle of their formation and shedding, which usually ranges within one year for most deer species. Prior studies on fossil antlers elsewhere in the world have noted various histological and biomechanical markers correlating to formation, use and shedding, comparing the same to data from modern cervid antlers. Other studies have attempted to reconstruct the duration of antler retention from histological analysis. However, no notable attempts at examining the palaeohistology of fossil antlers has been carried out to date within the Indian subcontinent. The present work therefore serves as a pilot study in examining the palaeohistology of fossil antlers through optical microscopy, noting variations in microstructure, vascular patterns and evidence of bone remodelling from a number of specimens across various fossil localities in the Indian subcontinent. The fossil samples are obtained from sites ranging from the Lower Pleistocene to the Holocene, along with specimens from modern Sambar deer (*Cervus unicolor*) for further comparison.

From osteohistology to biology: highlights from my research

Chinsamy-Turan A

anusuya.chinsamy-turan@uct.ac.za

Department of Biological Sciences, University of Cape Town, Rhodes Gift, South Africa

In this talk I will explore my forays into the osteohistology of modern and extinct vertebrates, and I will show how this research has led to a better understanding of the biology of prehistoric animals. My early work on nonavian dinosaurs, modern birds and crocodiles shaped my approach to palaeohistological studies and laid the foundations for my subsequent research on a wide range of living and extinct vertebrates. My investigations into osteohistology are largely based on the analysis of petrographic sections of undecalcified mineralised tissues (bones and teeth), under both polarised light and ordinary transmitted light microscopes. Although, these days we routinely micro-CT (or occasionally synchrotron scan) our specimens prior to thin sectioning to obtain a 3D perspective of the microanatomy. In this talk, through selected case studies, I will highlight some aspects of my research on dinosaurs (including Mesozoic birds), nonmammalian therapsids and mammals. In addition, in celebration of Australia's unique prehistoric fauna, I will focus on some of my recent work on Australian vertebrates, such as the giant "thunder birds", the dromornithids, the huge arboreal "drop bear", *Nimbadon lavarackorum*, the extant Western Grey Kangaroo, *Macropus fuliginosus*, as well as my ongoing work on some of this continent's extraordinary crocodilians, the mekosuchines.

Progression of histological changes in skeletal lesions caused by treponematosis in an archaeological human sample

Cooke KM[1,2*], Buckley H[3], Kinaston R[4], Kiko L[5], Oxenham MF[1,6], Miszkiewicz JJ[1,7]

[*]karen.cooke@uq.edu.au

[1]School of Archaeology and Anthropology, Australian National University, Canberra, Australia
[2]School of Social Science, University of Queensland, Brisbane, Australia
[3]Department of Anatomy, University of Otago, Dunedin, New Zealand
[4]BioArch South, Waitati, New Zealand
[5]Solomon Islands National Museum, Honiara, Solomon Islands
[6]Department of Archaeology, University of Aberdeen, Scotland
[7]Vertebrate Evolution, Development and Ecology, Naturalis Biodiversity Center, Leiden, The Netherlands

Prior research in the palaeohistopathology of treponematosis has described diagnostic microstructural features, been limited to the syphilis variants of treponematosis only, and targeted early stages of disease progression. Here, we conduct the first histological examination of a broad spectrum of skeletal lesions caused by treponematosis in the Pacific, a region with historic and ongoing endemicity of the yaws variant of treponematosis. We examine bone histomorphological changes caused by treponematosis in an archaeological human sample from Taumako, Solomon Islands (700-300bp). Tibial samples from 64 individuals were examined, forming n=39 control samples and n=25 diagnosed macroscopically with treponematosis. Our histomorphological examination confirmed previously described micro-morphological features (e.g., polsters, grenzstreifen) and noted new microscopic features (e.g., brushstroke lamellae), all of which occurred statistically significantly more frequently in those diagnosed skeletally with treponematosis ($p \leq 0.05$). We use our observations to propose a guide of progression of bone microstructural change as a result of treponematosis. The observed progression follows this sequence: the formation of periosteal histomorphological features, increased porosity from the endosteal surface outwards, through to trabecularisation of the cortical bone. The presence of novel bone microscopic features noted in the Taumako sample demonstrates the breadth of histological change associated with treponematosis, and may suggest differences in bone infection manifestation between treponematosis variants. Our proposed progression sequence of changes in bone microstructure caused by treponematosis demonstrates radical transformation in bone microstructure which occurs over the course of the disease. Our findings have implications for diagnosis in palaeopathology, and the understanding of treponematosis pathophysiology in bone.

Determining cell size change in lungfishes over 400 million years of evolution

Fritzen MR[1*], Long JA[1], Trinajstic K[2], Clement AM[1]

*frit0043@flinders.edu.au

[1]College of Science and Engineering, Flinders University, Adelaide, Australia
[2]School of Molecular and Life Sciences, Curtin University, Perth, Australia

Lungfishes (Dipnoi) are a monophyletic group within the Sarcopterygii, first appearing in the Early Devonian and persisting to the present day. As the sister group to tetrapods, dipnoans provide important information on early vertebrate evolution. At some point during their 410-million-year lineage, lungfish evolved the largest vertebrate genome, associated with substantial increases in cell size. Yet, the precise timing and evolutionary pressures that triggered this genomic enlargement remain unknown. Our study aims to address this gap by examining osteocyte lacunae within fossilised lungfish specimens. Leveraging high-resolution synchrotron micro-CT technology, we analyse 33 fossil samples spanning 400 million years of evolution with 3D imaging that allows for precise measurement of cell volumes in ways previously unattainable. The comparison of these fossilised cellular dimensions with those in extant lungfish species will shed light on when genome elongation began and what evolutionary pressures might have driven this unique trajectory. Our methodology overcomes previous barriers in fossil analysis, such as low microscopy resolution and the requirement for destructive slicing. By assessing cellular evolution through time, we hope to correlate putative external (i.e., environmental) or internal (biological) factors to this significant genomic shift. This project not only illuminates lungfish evolutionary biology but also demonstrates the crucial role of specific geological settings in creating fossils with cellular-level detail, offering new perspectives for both palaeontology and geology.

Reassessing coprolites: An overlooked resource for palaeoecology

Grabski SG*, Price G

*Sggrabski@gmail.com

School of the Environment, University of Queensland, Brisbane, Australia

Since their initial description in 1829, coprolites have proven invaluable to a range of scientific disciplines, including palynology, parasitology, microbiology, and archaeology. Despite their potential to inform paleoenvironmental, paleoclimatic, and ecological reconstructions, coprolites are often presented with poor contextual data and overlooked in favour of more recognisable and charismatic body fossils. This issue is particularly prevalent in Australia, where only a handful of coprolite studies exist in the literature. In this study, we analyse six samples recovered from the Chinchilla local fauna of the Darling Downs region, tentatively attributed to coprolites based purely on their morphology. To evaluate their classification as true coprolites, we employ a combination of scanning electron microscopy, energy-dispersive X-ray spectroscopy, and optical microscopy for mineralogical and taphonomic characterisation. Additionally, we utilise a morphological framework to further attribute the samples to various taxa. Our analyses identify several key characteristics supporting the classification of these samples as coprolites. Excessively fragmented bone indicates mechanical digestion, while an apatitic geochemistry enriched in iron and sulphur suggests the digestive demineralisation of both soft and hard animal tissues. Additionally, the presence of bacterial pseudomorphs, pollen assemblages, phytoliths, and fungal remains further corroborates a biogenic origin and reflects diverse dietary components. Notably, phytoliths may be particularly useful for reconstructing controversial aspects of the floral assemblage at the site. By characterising the faunal and floral inclusions within these samples, we demonstrate that coprolites hold valuable yet underutilised palaeoecological information. This study highlights the potential of coprolites within fossil assemblages, advocating for their inclusion in palaeoecological research.

Bone microanatomy supports a Mesozoic origin for an amphibious lifestyle in monotremes (Mammalia)

Hand SJ[1], Wilson LAB[1,2,3*], López-Aguirre C[4,5,6], Houssaye A[7], Archer M[1], Bevitt JJ[8], Evans AR[9,10], Halim AY[11], Hung T-T[12], Rich TH[10], Vickers-Rich P[13], Beck RMD[14]

*laura.wilson@anu.edu.au

[1]School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, Australia
[2]School of Archaeology and Anthropology, Australian National University, Canberra, Australia
[3]Australian Research Council Training Centre for Multiscale 3D Imaging, Modelling and Manufacturing, Research School of Physics, Australian National University, Canberra, Australia
[4]Department of Anthropology, University of Toronto Scarborough, Scarborough, Canada
[5]Museo de La Salle, Universidad de La Salle, Bogotá, Colombia
[6]Escuela de Biología, Universidad Industrial de Santander, Bucaramanga 680003, Colombia
[7]UMR 7179 Mécanismes adaptatifs et Évolution, Centre National de la Recherche Scientifique, Muséum National d'Histoire Naturelle, Paris, France
[8]Australian Centre for Neutron Scattering, Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia
[9]School of Biological Sciences, Monash University, Melbourne, Australia
[10]Museums Victoria Research Institute, Museums Victoria, Melbourne, Australia
[11]Tyree X-ray Micro-Computed Tomography Laboratory, Mark Wainwright Analytical Centre, University of New South Wales, Sydney, Australia
[12]Biological Resources Imaging Laboratory, Mark Wainwright Analytical Centre, University of New South Wales, Sydney, Australia
[13]School of Earth, Atmosphere and Environment, Monash University, Melbourne, Australia
[14]School of Science, Engineering, and Environment, University of Salford, Manchester, United Kingdom

The platypus and four species of echidna are the only living egg-laying mammals and are the sole extant representatives of the order Monotremata. The platypus and echidnas are very disparate both morphologically and ecologically: the platypus is a specialised semi-aquatic burrower that forages for freshwater invertebrates, whereas echidnas are fully terrestrial and adapted for feeding on social insects and earthworms. It has been proposed that echidnas evolved from a semi-aquatic, platypus-like ancestor, but fossil evidence for such a profound evolutionary transformation has been lacking, and this hypothesis remains controversial. Here we present new data about the Early Cretaceous (108–103 Ma) Australian mammal *Kryoryctes cadburyi*, currently only known from a single humerus, that provides key information relating to this question. Phylogenetic analysis of a 536-character morphological matrix of mammaliaforms places *Kryoryctes* as a stem-monotreme. Three-dimensional bone comparisons show that the overall shape of the humerus is more similar to that of echidnas than the platypus, but analysis of microanatomy reveals specialisations found in semi-aquatic mammals, including a particularly thick cortex and a highly reduced medullary cavity, features present in the platypus but absent in echidnas. The evidence suggests *Kryoryctes* was a semi-aquatic burrower, indicating that monotremes first evolved an amphibious lifestyle in the Mesozoic, and providing support for the hypothesis that this is ancestral for all living monotremes. The lineage leading to the modern platypus appears to have been characterised by extremely long term (>100 My) niche conservatism, with echidnas representing a much later reversion to a fully terrestrial lifestyle.

Integrative heuristic and holistic palaeohistology of exceptionally well-preserved Jurassic ichthyosaurs

Hu B[1*], Eustache R-P[2], Sander M[3], Boyde A[4], Erdjument-Bromage H[5], De Jesus CL[5], Neubert TA[5], Bromage TG[1,6]

*bin.hu@nyu.edu

[1]Department of Molecular Pathobiology, New York University College of Dentistry, New York, USA
[2]7 rue de la Forge, 27170 Combon, France
[3] Bonn Institute of Organismic Biology, University of Bonn, Bonn, Germany
[4]Dental Physical Sciences Unit, Queen Mary University of London, London, UK
[5]Department of Neuroscience and Physiology, New York University Grossman School of Medicine, New York, USA
[6]Department of Paleoanthropology, Senckenberg Research Institute and Natural History Museum, Frankfurt, Germany

We seek to convey an integrative heuristic palaeohistological approach to enable the study of fossil microanatomy. To achieve this, we employ several microscopal and diagnostic technologies. We sampled exceptionally well-preserved Late Jurassic ichthyosaurs of Ophthalmosauridae genus sp. indet. from centra of a 157-152 Ma juvenile at Abingdon, UK, and a mature individual from 153 Ma deposits at Octeville, France. We employed prevailing palaeohistological preparation methods. We then performed 2D gigapixel light microscopy (LM) montaging of histological thin sections in transmitted (TLM) and polarised (PLM) light, 3D transmitted and reflected LM, and 2D and 3D field emission-scanning electron microscopy (FE-SEM) of bulk samples in secondary electron and backscattered electron imaging modes together with elemental analysis by energy-dispersive X-ray spectroscopy (EDS). To support the nature of the histology, we complimented the palaeohistology with protein extraction and evaluation by liquid chromatography-tandem mass spectrometry. Proteomics confirmed collagen peptides that may partly explain PLM birefringence. EDS revealed Ca/P ratios similar to modern bone combined with other elements that, together, were significantly different from their $CaCO_3$-based matrices. Spectra also include Fe and Zn in their reduced forms, thus the brown hues in TLM are unlikely due to an oxidative diagenetic environment. Because of exceptionally well-preserved bone tissue, details observed at various LM and FE-SEM length scales often equalled what can be obtained from fresh bone preparations. We show that an integrative heuristic and holistic approach provides details pertinent to the numerous purposes of palaeohistological investigations.

Rib remodelling and body size in insular dwarf and common fossil hippopotamuses

Miszkiewicz JJ[1,2*], Athanassiou A[3], Lyras GA[4], van der Geer AE[2]

[*]j.miszkiewicz@uq.edu.au

[1]School of Social Science, University of Queensland, Brisbane, Australia
[2]Development and Ecology, Naturalis Biodiversity Center, Leiden, The Netherlands
[3]Ministry of Culture, Ephorate of Palaeoanthropology and Speleology, Athens, Greece
[4]Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Athens, Greece

Large species isolated on islands can evolve extreme degrees of dwarfism. Little is known about physiological processes that accompany such extreme transitions in extinct dwarf species. Here we test whether bone remodelling in dwarf adult hippopotamuses correlates with insular body mass shifts. Our hypothesis posits that hippopotamuses with the smallest body size should have higher densities of osteocyte lacunae (proxies for osteoblast proliferation during remodelling), when compared to larger dwarf forms, and much larger mainland common hippopotamuses. Twenty ribs from three extinct Pleistocene *Hippopotamus* species spanning a gradient in body size: *H. minor* (~132 kg, Cyprus), *H. creutzburgi* (~398 kg, Crete), and *H. antiquus* (~3200 kg, mainland Greece) were examined. Densities of osteocyte lacunae (Ot.Dn) were recorded from 864 individual secondary osteons observed in histology sections. The highest average Ot.Dn was noted in *H. minor* ribs. The values of Ot.Dn were intermediate in *H. creutzburgi* ribs and the lowest in *H. antiquus* ribs. These data suggest that Ot.Dn distinguishes these three species, possibly indicating a gradient in bone remodelling such that bone tissue optimises maintenance in the face of insularity-driven reduction of body size. Our findings contribute further to recently emerging research showing links between bone remodelling and dwarfism in insular deer and elephants.

Extinct lagomorphs under the microscope: what palaeohistology reveals about their evolution

Moncunill-Solé B

blanca.moncunill@udc.es
blanca.moncunill@cibio.up.pt

Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO), Universidade do Porto, Vairão, Portugal
Grupo BIOpast, Departmento de Física e Ciencias da Terra, Universidade da Coruña, Coruña, Spain
Centro de Innovación Tecnolóxica en Edificación e Enxeñería Civil (CITEEC), Universidade da Coruña, Coruña, Spain

Lagomorpha is a successful order of medium-sized mammals that includes rabbits, hares, and pikas. Although some species are currently prolific, others are confined to relictual areas, and the overall biodiversity of the group is low. Fortunately, their exceptionally rich fossil record offers a valuable opportunity to understand their evolution and to delve deeper into their palaeobiology and palaeoecology. Research on hard biological tissues at the microstructural and microanatomical level, conducted in my lab over the past years, has yielded novel biological insights into extinct lagomorph species. In particular, our research has aimed at uncovering the eco-evolutionary dynamics of Miocene-Holocene insular lagomorphs from Mediterranean Islands (southern Europe). These species have sparked significant scientific interest due to their distinctive sizes, morphologies, and biological and behavioral traits. Our most recent assessment of osteohistology and skeletochronology in *Prolagus sardus*, the Pleistocene-Holocene Sardinian pika (Italy), revealed that their pups were weaned at relatively larger sizes (50-60% of adult size), in addition to exhibiting delayed maturation and a longer lifespan. Palaeohistological and morphological analyses of their joints showed a high prevalence of degenerative disorders, primarily driven by aging. Additionally, we also approached to the biological strategy to *Prolagus apricenicus* (Late Miocene, Gargano, Italy), suggesting a similarly delayed life-history. All this evidence led to characterizing, for the first time, the life-history strategy of lagomorphs to insularity, and aligns with the theoretical framework of life history theory. Our current efforts focus on advancing the evolutionary knowledge of insular lagomorphs, alongside the osteohistological and bone microanatomical analyses in living relatives.

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Skeletochronology and bone appositional rates of *Crocodylus niloticus* Laurenti, 1768

Pereyra ME[1*], Bona P[2], Chinsamy A[1]

[*]m.eugenia.pereyra@gmail.com

[1]Department of Biological Sciences, University of Cape Town, Rhodes Gift, South Africa
[2]División Paleontología Vertebrados, Museo de La Plata (Unidad de Investigación Anexo), Facultad de Ciencias Naturales y Museo, La Plata, Argentina

The fossil record of Crocodyliformes exhibits a great disparity in body sizes, which raises pertinent questions about their palaeobiology and palaeoecology. To understand the biology of the fossil crocodylians, it is imperative to enhance our understanding of the biology of modern species. Osteohistology allows us to assess various aspects of the biology of vertebrates, such as longevity, growth dynamics, and maturation. Thus, by studying the bone microstructure of extant taxa, with known life history data (e.g., sex, age, sexual maturity, etc.), it is possible to infer palaeobiological information about extinct forms. Here, we conducted a detailed osteohistological study of postcranial elements of specimens of *Crocodylus niloticus* Laurenti, 1768 on thin sections of the bones of forelimbs and hindlimbs of four (two males and two females) two-year-old captive specimens from a crocodile farm in Cape Town, South Africa. These specimens were labelled *in vivo* with two different fluorochromes over three specific time periods to assess the daily bone appositional rate, as well as to validate the occurrence of annual growth marks. The results revealed that the daily bone appositional rate tends to be higher in the ulna and femur, and lower in the fibula. Growth marks (lines of arrested growth and/or annuli) were found in all bones under study. These results demonstrate intraskeletal variability of both primary bone tissue types and rates of apposition in the postcranial skeleton of *C. niloticus*. Our findings are consistent with previous studies on other modern crocodilian species. This study contributes to our understanding of the diversity of growth dynamics of extant crocodilian taxa, which is essential for assessing the palaeobiology of their extinct relatives.

Megafauna under the microscope: trace element mapping of Pliocene fossil vertebrates from Chinchilla, Australia

Price GJ[1*], Leonard ND[1], Louys J[2], Wilkinson JE[3], Zhao J[1]

[*]g.price1@uq.edu.au

[1]School of the Environment, University of Queensland, Brisbane, Australia
[2]Australian Research Centre for Human Evolution, Griffith University, Brisbane, Australia
[3]Geosciences, Queensland Museum, Hendra, Australia

The Chinchilla Sand, exposed along the Condamine River valley in Queensland's Western Darling Downs, preserves the richest and most diverse Pliocene vertebrate assemblage yet known from Australia. Despite collections dating back to the mid-1800s, stratigraphically controlled excavations have been scarce, and the palaeobiology of many taxa, particularly the 'megafaunal' marsupials and crocodiles, remains poorly understood. Over the past decade we have renewed investigation of the Chinchilla Rifle Range, which includes the type section of the unit and several additional fossil-bearing horizons. Here we report the first trace-element maps of Chinchilla megafauna teeth, generated with laser-ablation mass spectrometry. Preliminary results reveal well-preserved geochemical zonation within enamel and dentine despite >3 Ma burial, capturing ontogenetic and/or seasonal signatures in elements such as Sr, Ba and Zn. These patterns provide rare proxies for diet, physiology and habitat use in Australia's deep-time megafauna. Interpreting the full palaeobiological and palaeoecological significance of these signals, however, is presently constrained by the lack of modern comparative datasets for extant marsupials and crocodilians. Establishing such baselines will be critical for distinguishing diagenetic overprints from life-history signals and for refining reconstructions of Pliocene ecosystems in eastern Australia. Overall, our results showcase the power of high-resolution geochemical histology to extract behavioural signals from Australia's extinct megafauna, while underscoring the urgent need for robust modern reference datasets to unlock its full interpretative potential.

Bone microanatomy reveals vertebrate palaeopathologies from various Triassic horizons of India

Sarkar P*, Ray S

*Sarkar.pratyusha14@gmail.com

Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, Kharagpur, India

Palaeopathology is the study of trauma and disease that affected extinct life forms, and helps in providing insights into the physiology, behavioural ecology and living conditions of an extinct animal. The different Triassic horizons of India host a rich and varied vertebrate fossil record that has been extensively studied as is evident from a plethora of work, though only a single study on palaeopathology based on a Middle Triassic azendohsaurid exists. We used X-ray micro-computed tomography (μCT) scanning and bone histology to determine abnormal bone growth or tissue type in three different tetrapod clades of various Triassic horizons of India. These included (i) an isolated tibia of a temnospondyl from the Lower Triassic Panchet Formation of the Damodar Basin, where detailed morphological and X-ray μCT scanned images revealed abnormal bone growth / lesion with a pitted surface; (ii) a reactive periosteal growth along the metaphyseal region of the femur of a juvenile adult individual of a kannemeyeriid dicynodont, *Wadiasuarus indicus,* from the Middle Triassic Yerrapalli Formation of the Pranhita-Godavari Basin; and (iii) an epidemic of bone infection involving a juvenile-dominated community of the giant Mystriosuchinae phytosaur, *Colossosuchus techniensis,* from the Upper Triassic Tiki Formation of the Rewa Gondwana Basin, a sub-basin of Son-Mahanadi Basin. Although these abnormalities require detailed study for diagnosis, it is apparent that major and life-threatening diseases existed throughout deep time because of multiple and varied triggering effects that may be genetic and/or epigenetic factors such as unfavourable environmental conditions, intraspecific competition, predatory/parasitic attacks and many others.

Microstructure of the Ivory of the Pleistocene hippos and elephants in India

Sathe V

vijay.sathe@dcpune.ac.in

Deccan College Postgraduate and Research Institute, Pune, India

Like the tusks and teeth of narwhals, walruses, sperm whales and orcas, the incisors of hippos and elephants are also essentially made up of calcified tissue called dentine, which is capped by a thin layer of cement. The length and circumference of incisors and their total number in the jaw(s) varies as per the species and so its application. The incisors are a weapon of showcasing their strength and aggression, sensing water temperatures and salinity, sorting the weeds and aquatic plants, and digging the earth and removing the bark of the tree for food. In Indian palaeofaunas, the multiple species of elephants (*Stegodon insignis ganesa*, *Elephas hysudricus*, *Palaeoloxodon namadicus*) and hippopotami (*Hexaprotodon palaeindicus*, *Hexaprotodon namadicus* and *Hexaprotodon deccanensis*) existed until the end of the Pleistocene. The fossil assemblages have sizeable evidence of these ivory fossils whose identification as one of the elephant or hippo taxa is greatly limited by the state of preservation. The ivory microstructure has been demonstrated to be useful in identifying elephant species but similar attempts on the ivory (incisors) of hippopotami have not been undertaken. The present communication offers fresh microstructural data on the fossilised ivory of elephants and hippopotami from the Late Pleistocene fossiliferous deposits in Peninsular India. The histological data have multifold applications in palaeontology as well as in archaeology. Identification of the ivory used as raw material for making artefacts and identifying their prehistoric presence has far reaching palaeoenvironmental and cultural implications.

Comparative histomorphology of bones in extinct and modern horses

Sathe V*, Khongwir B

*vijay.sathe@dcpune.ac.in

Deccan College Postgraduate and Research Institute, Pune, India

The genus *Equus*, encompassing modern horses, zebras, and asses, presents a fascinating subject for comparative anatomical and evolutionary studies due to its long-standing relationship with human civilisation and its rich fossil record. Histological examination of osseous tissue can yield significant information regarding the growth patterns, life history strategies, and environmental adaptations of both contemporary and extinct *Equus* species. The purpose of this proposed study is to look at the histology of present domestic horses (*Equus caballus*) and a Pleistocene Indian wild horse (*Equus namadicus*) to see whether there are any evolutionary tendencies in bone structure, growth patterns, and physiological adaptations to their surroundings. This study will address key questions about how environmental factors such as diet, climate, and predation pressures may have influenced bone structure. Comparing extinct and extant *Equus* species allows for a better understanding of the evolutionary pressures that shaped the modern horse and its relatives. A comparative investigation of histological characteristics will be carried out using both qualitative and quantitative approaches. Extant (n=6) and extinct (n=5) species will be compared on key factors such as osteon size and Haversian canal eccentricity, as well as osteonal population density. This study will provide a complete comparison of bone microstructure among present and extinct *Equus* species, as well as aid in the identification of environmental variables that influence bone structure, such as feeding habits or locomotion.

Control of bone composition by osteocytes: insights from mice and women

Sims NA

nsims@svi.edu.au

St. Vincent's Institute of Medical Research, Melbourne, Australia
Department of Medicine, St. Vincent's Hospital, University of Melbourne, Melbourne, Australia
Faculty of Health Sciences, Australian Catholic University, Melbourne, Australia

Osteocytes are mature osteoblast-lineage cells, residing within the mineralised matrix of bone, where they form a highly interconnected network within a fluid-filled system of canals and lacunae. From this location, osteocytes detect changes in bone strain and signal to cells on the surface to regulate bone formation and resorption and thereby change bone mass. Our laboratory has studied their functions using cell-targeted gene deletion in mice. By combining this with micro-computed tomography, strength testing, histomorphometry, and Fourier-transform infrared microspectroscopy (FTIR) we have identified that osteocytes also control bone strength in the cortex by limiting three processes associated with bone mineralisation: mineral accrual, carbonate substitution within the hydroxyapatite crystal, and compaction of the collagen fibres within bone matrix. Given that mice lack osteonal structures, which comprise the bulk of adult human cortical bone, we have more recently turned to studying bone composition in samples of cadaveric human bone, from the Melbourne Femur Research Collection. These are samples of healthy bone from a modern urban population, but as they were collected from individuals who died suddenly, they lack tetracycline labels to mark osteonal age. We have developed an approach combining FTIR with back-scattered electron microscopy to identify stage-specific markers of osteon maturity. This method has revealed significant differences between young (19-35 years of age) and older (71-95 years of age) women in the way they produce bone matrix and establish osteocyte networks. Our initial findings will be presented.

Inferring Stress Histories from Trace Elements: Promises and Pitfalls from Tooth Histology.

Smith TM

tanya.smith@griffith.edu.au

Australian Research Centre for Human Evolution, Griffith University, Brisbane, Australia
Griffith Centre for Social and Cultural Research, Griffith University, Gold Coast, Australia

Decades of histological study have hinted at an intriguing relationship between microscopic developmental defects in teeth and numerous stressors, including infections, malnutrition, psychosocial changes, and physical trauma. Recent high-impact studies of fossil hominins and extinct apes have documented variable elemental bands in sectioned teeth with laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), reaching contradictory conclusions about early-life stress and extinction risk. Here I review the elemental and histological evidence for such inferences in the enamel and dentine of captive primates with known medical histories, as well as in wild primates and recent humans. Although captive primates may show accentuated lines and elevated metals during periods of acute illness, such associations are variable. This is also the case with the neonatal line formed at birth, which is often accompanied by changes in zinc and/or barium, but such patterns vary amongst individuals of the same species and across primates more broadly. While trace element distributions offer a tool for understanding ancient behaviour and health, caution is warranted in interpretations of discrete bands as retrospective stress indicators, particularly without developmental, dietary, or environmental contexts. Additional research on the bioavailability of nonessential metals in food items, as well as the pairing of complementary isotopic systems, could help to resolve some of the pitfalls of inferring ecological stress, illnesses, and seasonal behaviours in the past.

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Variation and Error in the Assessment of Dental Long-Period Line Timing: A Cautionary Tale

Smith TM[1,2*], Ferrell RJ[3], Reid DJ[4]

[*]tanya.smith@griffith.edu.au

[1]Australian Research Centre for Human Evolution, Griffith University, Brisbane, Australia
[2]Griffith Centre for Social and Cultural Research, Griffith University, Gold Coast, Australia
[3]National Science Foundation, Virginia, USA
[4]Department of Anthropology, George Washington University, Washington, DC, USA

Recent studies have suggested that the supra-daily (long-period) rhythm in tooth formation may vary within an individual's dentition. If substantiated, this would require the reassessment of numerous histological studies over the past several decades. Here we explore long-period line timing (periodicity) in 56 medieval human individuals' canine and molar teeth, which were independently assessed by one experienced histologist. Two experienced histologists also blindly assessed molar periodicities in 30 of these individuals. Periodicities were identical in 95% of canine-molar pairs (n = 53/56 individuals), suggesting that deviations from uniformity are most likely due to intra-observer error rather than actual variation in concurrent biological rhythms. Inter-observer error in molar periodicities was high; differences were found in 22 of 30 cases, although one observer had far fewer molar tooth sections available for examination. Suggested intra-individual periodicity variation may be due to geometric differences between anterior and posterior teeth; subtle obliquity in the bisection of curved planes may lead to the appearance of artificially lower periodicity values in some instances. Inter-observer error is also a real concern; observations from multiple histological sections of each tooth, as well as different tooth types, are likely to improve accuracy. Further cross-checks include the use of juvenile material of known age at death, individuals given biomarkers during crown formation, and comparisons to long-period line numbers (negatively correlated with periodicities within tooth types). Irrespective of these suggestions to improve accuracy, caution is warranted in making meaning of small differences in long-period line periodicities amongst fossil hominins or non-human primates.

The growth pattern in long bones of Triassic pseudosuchians—is there even a pattern of growth?

Teschner EM

eteschner@uni.opole.pl

Institute of Biology, University of Opole, Opole Poland

The Triassic period was the time of great transitions in terms of climatic and environmental conditions which favoured a faunal turnover. Aetosaurs and phytosaurs are important faunal representatives, however, the Polish Triassic bears also enigmatic taxa like *Smok wawelski*. In pseudosuchians, generally there are two main bone complexes: lamellar-zonal bone (LZB) and fibro-lamellar bone (FLB). They differ at the tissue level, LZB is built by a mix of well-organised lamellar bone and parallel-fibered bone, whereas FLB possesses disorganised woven fibres. Further, they differ in vascularisation pattern, LZB is low to moderately vascularised by various types and generations of vascular canals, whereas FLB is highly vascularised by primary osteons. Lastly, the bone deposition speed is crucial, LZB shows alternating growth in form of annuli (indicating unfavourable conditions) and zones (indicating favourable conditions) deposited at an overall low rate, whereas in FLB the bone deposition is continuous at a fast depositional speed. Previously it was assumed that (the majority of) pseudosuchians grew with FLB, e.g., aetosaurs, ´rauisuchians´. Newer studies show that there are groups which show deposition of both, FLB and LZB, e.g., phytosaurs. The herein studied humerus of *Smok* shows a unique growth pattern resembling a pseudo-FLB complex. It mimics the architecture of FLB but does not deposit woven bone on the tissue level. This study aims to track the phylogenetic origin of FLB on the pseudosuchian lineage. Furthermore, the goal is to answer whether the deposition of FLB might be connected to environmental conditions or could be limited to palaeogeographic distribution.

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Using histotaphonomy to determine wet and dry diagenesis across subfossil and fossil bones from underwater caves.

Walker MM[1,2*], Miszkiewicz JJ[3,4], Price G[5], Reed E[6], Jacobsen G[7], Kumar S[7], Levchenko V[7], Fallon S[8], Esmay R[8], Monks J[1,2], Louys J[1,2]

[*]meg.walker@griffithuni.edu.au

[1] Australian Research Centre for Human Evolution, Brisbane, Griffith University
[2]Cave Divers Association Australia
[3]School of Social Science, University of Queensland, St Lucia, Queensland, Australia
[4]Vertebrate Evolution, Development and Ecology, Naturalis Biodiversity Center, Leiden, The Netherlands
[5]School of the Environment, University of Queensland, Brisbane, Australia
[6]School of Biological Sciences, University of Adelaide, Adelaide, Australia
[7]Australian Nuclear Science and Technology Organisation
[8]Research School of Earth Sciences, Australian National University, Canberra, Australia

It has been suggested that early stages of bone diagenesis in aquatic environments are linked with bone microscopic changes, which can be used to reconstruct hydrological contexts of archaeological and palaeontological assemblages. Here, for the first time, we apply this principle to diagenesis in underwater caves that shift from saturated to dry depending on the glacial/interglacial cycle. We analysed bone histology from various animal bones in historic (N=24) and Pleistocene (N=28) assemblages from underwater caves in Mount Gambier, South Australia to unravel how submerged cave landscapes changed through time. Diagenetic signatures from historic bones, with known hydrological conditions, set a benchmark to analyse the fossils. Bone degradation was evaluated using bSEM and optical microscopy by recording levels of microtunnelling associated with bacteria, cyanobacteria and fungi, general bone quality, microcracking, and collagen preservation. Within the historic samples, wet bones (N=14) were better preserved than those from dry settings (N=10). They showed peripheral microtunnelling linked to cyanobacteria, but no localised radial microcracking across secondary osteon cement lines previously linked to early aquatic decay. The Pleistocene fossils grouped into either well-preserved or completely degraded microstructure, suggesting deposition through glacial and interglacial periods. Our study shows that analysing histotaphonomy from fossil deposits in underwater caves can support reconstructing local burial conditions and palaeoenvironments.