

# The 7th International Palaeontological Congress



## Bridging the molecular gap between life past and present

Proteins, lipids, and sugars are the fundamental building blocks of life as we know it. These biomolecules encode organismal relationships (phylogeny) and physiology in their molecular composition and are the primary target of the modern biosciences. Until recently, it had been assumed that molecular information cannot survive in deep time. Over the past five years, however, various independent groups confirmed the preservation potential of phylogenetically and physiologically informative heterogeneities in chemically altered, but not unrecognizable form. With an emerging consensus on the fate of biomolecules, molecular biosignatures integrable across extant and extinct life forms represent the current frontier of astrobiological, prebiotic, geobiological, paleobiological, and geochemical research and have been successfully analyzed for comparative data sets of Archean-to-Recent carbonaceous fossils, including prokaryotes, single-cellular eukaryotes, land plants, invertebrate and vertebrate animals. As a consequence of the growing interest in molecular aspects of macroevolution, the focus in our field is beginning to shift from methodological questions towards translational applications of mechanistic insights. This symposium highlights state-of-the-art molecular applications to macroevolutionary questions and introduces a suite of high-throughput instrumentation for chemical data acquisition alongside transformative statistical and machine-learning tools for data analysis. Featured applications range from the origin(s) of life to the drivers of skeletal evolution and the evolvability of warm-bloodedness in amniotes – and aim to engage our broader paleontological community in this exciting moment of rapid scientific advancement in Molecular Geo-, Astro-, and Paleobiology!

We believe that IPC 2025 in Cape Town is the ideal venue to host a symposium dedicated to the current developments in molecular applications to deep time questions, and propose a diverse slate of graduate student-to-tenured faculty speakers with expertise in a range of:

- **data acquisition platforms:** Fourier-Transform infrared spectroscopy (FT-IR); co-localized atomic force microscopy and UV, Vis, NIR-Raman spectroscopy (AFM-Raman); fluorescence microscopy; solid-state nuclear magnetic resonance (NMR); pyrolysis gas chromatography mass spectrometry (Py GC MS); liquid chromatography mass spectrometry (LC MS); Time-of-Flight secondary ion mass spectrometry (ToF SIMS); laser ablation inductively coupled plasma mass spectrometry (LA ICPMS).
- **data analysis tools:** Unsupervised – Regression, Principal Component Analysis (PCA), Non-linear Multidimensional Scaling (NMDS); Supervised – Linear Discriminant Analysis (LDA), Partial Least Squares

(PLS); Machine learning – Support Vector Machines (SVM); Neural Networks; Stochastic Gradient Descent; Random Forests.

- **and macroevolutionary applications:** origin(s) of life and prebiotic chemistry; hidden diversity of extinct single-cellular life forms; phylogenetic affinities of problematica; evolutionary drivers of the independent evolution of skeletons; evolvability of endothermy; metabolic and reproductive trade-offs; ontogenetically resolved metabolic strategies; homology assessments of fossil and modern features; conservation paleobiology; resurrection of extinct proteins and genetically engineered resilience.

Our symposium concludes with an open 30-minute discussion panel between the audience and all symposium presenters: this panel aims to catalyze new interdisciplinary cross-talk and collaborations between individual method experts and paleontologists interested in the use of different molecular tools.

## Conveners:

- Jasmina Wiemann (jasmina.wiemann@jhu.edu)
- Mariana Haase
- Pjotr Meyvisch

If you are interested in this symposium, please contact the conveners.