Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33175

Linking 3D Cave Morphology and Event-Sequence Analysis to Paleoclimate Research

SAKONVAN CHAWCHAI[1], PANUPONG PHIWLUEANG[1], RAPHAEL BISSEN[2] AND MATTHEW J. JACOBSON[3]

[1]Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok

[2]Department of Mining and Petroleum Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok

[3]Swedish University of Agricultural Sciences, Uppsala

Robust speleothem-based palaeoclimate reconstruction depends on the suitability of the stalagmite's depositional environment—a factor rarely assessed systematically prior to sampling. Here, we present a non-destructive pre-sampling framework that combines Terrestrial Laser Scanning (TLS), 3D cave modeling, and event-sequence analysis to quantitatively characterize environmental processes that may bias or overprint climate signals. Applied to Sam Phung Cave, eastern Thailand, a multi-chamber tropical system with 47 m of vertical relief, this approach resolves how chamber-specific morphology regulates "chimney-effect" ventilation, detrital flux, biological activity, and physical stability. High-resolution 3D models quantify geometry and connectivity, while event-sequence reconstruction identifies dominant disturbance regimes in each chamber. Subsequent stratigraphic and fabric analysis of three stalagmites from contrasting environments demonstrates that cave-scale processes are directly archived at the speleothem scale: laminae continuity, detrital content, and fabric types correlate systematically with mapped ventilation intensity, sediment pathways, and hydrological stability. Our approach demonstrates that pre-sampling environmental screening is critical for identifying the most suitable stalagmites, particularly in complex tropical caves. By linking speleothem internal stratigraphy to quantifiable cave dynamics, we improve the selection of stalagmites that best preserve primary climate proxies, thereby strengthening the interpretation of $\delta^{18}O$, trace elements, and isotopic records in tropical speleothem studies.