Analysing Mulde Event Dynamics with Ultra-High-Resolution Ostracod Paleocommunity Analysis

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The Silurian period witnessed significant global extinction occurrences, including the Mulde/lundgreni Event (late Wenlock), which led to intricate and sudden alterations in the Earth's biota. Due to the short span of these events, conducting paleontological studies requires a high sampling resolution, which is rarely achieved. Ostracods, abundant and small, are ideal subjects for high-resolution studies. By combining existing data with new samples from the Gėluva-118 core, we have achieved a resolution of approximately 10 Ka years in analysing ostracod paleocommunities during the Mulde/lundgreni Event.

Our approach involved a custom-made binary recursive segmentation algorithm for the hierarchical subdivision of stratigraphically contiguous segments. This algorithm was applied to ostracod taxonomic compositional time-series data from the Gėluva-118 core (Lithuania). The results revealed significant changes in ostracod community composition, enabling us to delineate the event's stages. We employed a Bayesian Age-Depth model to assess the timing of these changes. The median and 95% Highest Density Interval (HDI) durations for each stage, as well as for the entire event, are as follows: Collapse – 50 Ka (11 – 171 Ka), Maximal Stress – 120 Ka (31 – 601 Ka), Recovery – 80 Ka (21 – 576 Ka), and the entire Mulde/lundgreni Event – 260 Ka (100 – 1,136 Ka). Our analysis of bootstrapped sample averages of diversity indices revealed that the Maximal Stress stage, marked by a severe scarcity of ostracods, signified a distinct shift in community diversity state. Prior to this stage, ostracod communities were less diverse, yet exhibited higher increases in evenness with growing diversity, indicating distinct community assembly and community structure patterns. Ostracod communities from the Collapse and Recovery stages resembled those adjacent to the Mulde/lundgreni Event interval but showed significantly reduced abundances, lower inverse Simpson index, and higher evenness. Furthermore, our findings suggest a nonlinear recovery stage, punctuated by setbacks and stabilisation phases.

These insights demonstrate the potential of high-resolution paleontological studies in deciphering the chronology and pace of intermittent global events.

Keywords: Silurian, recursive segmentation algorithm, Bayesian model.