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GIS-Assisted Exploration of Tectonic Settings through Sedimentary Sample Analysis: Implications for Earth's Early Dynamic History

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One of the key aspects of understanding Earth's early evolution is plate motion history. Full-plate reconstruction describes the evolution of continents and plate boundaries, yet traditional geophysical and paleomagnetic methods have led to diverse models.

Recent rapid accumulation of deep-time Earth data related to plate tectonics may resolve these controversies. Previous studies proposed a classification approach based on detrital zircon age spectra to determine sample deposition tectonic settings, crucial for understanding early crust and lithosphere evolution.

In this study, we use Geographic Information System (GIS) to restore sedimentary rock samples to their paleogeographic positions during sedimentation. By analyzing the relationship between sample classification and tectonic settings, we evaluate long-term plate reconstruction models. Our results show the reliability of this approach, distinguishing Pangea's peripheral and core regions, significant for earlier supercontinent reconstruction.

Although the scarcity of samples limits the approach as we go further back in time, the explosive growth of detrital zircon data, along with GIS-based data analysis, will facilitate plate reconstruction updates. This research integrates GIS, contributing to interdisciplinary understanding of Earth's early evolution to a habitable state.