Mending the chronostratigraphic record

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Abstract

Fossil range data are crucial for assembling the chronostratigraphic record, but their fidelity is limited by gaps and biases caused by environmental and paleobiological factors. Environmental volatility during major ocean-atmosphere perturbations may create further bias in the fossil record. Importantly, linked swings in eustatic sea level generate unconformities with durations of tens of thousands to millions of years that distort chonostratigraphic taxon range data and impart a false impression of temporal continuity.

Process-oriented sequence stratigraphy integrating facies analysis, biostratigraphy, chemostratigraphy, and geochronology is designed to identify chronostratigraphic distortions and provide corrections. In particular, carbonate carbon isotope chemostratigraphy is a powerful tool for identifying and characterizing unconformities, especially those that occur between biozone boundaries or within fossil species ranges. Iterative sampling both parallel and perpendicular to depositional dip is a novel aspect of our chronostratigraphic approach. Data profiles generated along depositional dip document diachroneity and thus mend chronostratigraphic knowledge gaps while depositional strike transects provide insights for subtle refinement of basin morphology and delineate the geometry and age of incised valleys.

Fully characterizing the spatial distribution and duration of unconformities is vital for identifying bias and knowledge gaps in the chronostratigraphic record. Mending those gaps through documenting diachroneity allows reconstruction of a more complete temporal continuum of the events that shaped Earth throughout its history, revealing linkages between eustatic sea level oscillations, the carbon cycle, ocean geochemistry, and the evolution of marine organisms.

Keywords: sequence stratigraphy, carbon isotope chemostratigraphy, geochronology

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