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Chronostratigraphic calibration of shallow and deep marine bioevents by quantitative biostratigraphy across the last unratified system boundary of the Mesozoic: A synthesis from the Pontides Carbonate Platform

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The Late Jurassic–Early Cretaceous represents a time span characterized by several unstandardized stages and includes the only Mesozoic system boundary still lacking a formal GSSP—the Jurassic/Cretaceous (J/K) boundary. Recent research has concentrated largely on continuous deep-marine Tethyan successions, yielding major advances in the calibration of pelagic bioevents. However, correlating these pelagic zonation schemes with those derived from neritic settings remains challenging.

Biostratigraphic evidence from marginal carbonate successions that contain fossils from both platform and basinal facies offers a critical bridge between these contrasting depositional realms. Such Upper Jurassic–Lower Cretaceous carbonates are extensively exposed in the Pontides, where they occur in association with coeval shallow- and deep-marine deposits. This study synthesizes biostratigraphic data from 17 stratigraphic sections across the Pontides Carbonate Platform (PCP), incorporating fossils representing a range of environments, including benthic and planktonic foraminifera, calpionellids, algae, microencrusters, and crinoids, and documenting 139 bioevent datums.

To address facies-dependent local biohorizons and to integrate datums from unrelated lineages and biofacies, the dataset is analyzed using Graphic Correlation (GC) and Unitary Association (UA) techniques. These methods yield a Composite Standard Reference Section (CSRS) and a set of UA Zones. GC produces facies-independent tie lines and requires only a sufficient number of shared taxa to establish reliable correlations with the CSRS. In contrast, the UA approach relies on complete fossil assemblages to define unique UA Zones, substantially reducing the lateral continuity of its subdivisions. While GC evaluates the superpositional ordering of calibrated bioevents, UA identifies discrete “maximal fossil assemblages” without resolving the internal ordering of their biohorizons, making GC more compatible with contemporary GSSP protocols.

Correlation of the Pontides CSRS with the Geological Time Scale clarifies the relative stratigraphic positions of both shallow- and deep-marine bioevents with respect to the Oxfordian–Hauterivian stage boundaries. The Tithonian/Berriasian (T/B) and Berriasian/Valanginian (B/V) boundaries are

currently considered candidates for the J/K boundary and are distinguishable in pelagic sections through characteristic calpionellid bioevents. Equivalent synchronous bioevents in shallow-marine deposits, however, are lacking. The elevated origination rates during the Berriasian produce clusters of bioevents around the T/B boundary, providing stratigraphic brackets for both pelagic and neritic successions. In contrast, several last occurrences in neritic facies offer only weak constraints on the B/V boundary. Declining species richness from the mid-Berriasian onward reflects a broader trend of falling sea level from the Late Tithonian through the Valanginian, which suppressed shallow-marine carbonate production and contributed to widespread platform drowning during the Valanginian–Hauterivian in the northern Tethyan margin. This extinction-dominated interval further complicates identification of reliable origination datums within neritic environments.