PALAIOS, 2007, v. 22, p. 392–407
Research Article
DOI: 10.2110/palo.2006.p06-066r

Gradient ecology of a biotic invasion: Biofacies of the type Cincinnatian Series (Upper Ordovician), Cincinnati, Ohio Region, USA

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Keywords: paleoecology, migration, ordination, Richmondian stage, marine invertebrate

ABSTRACT

Recent studies have emphasized that faunal change is typically brief and most commonly occurs at sequence boundaries and major flooding surfaces. The Upper Ordovician of the Cincinnati, Ohio, region records a major biotic invasion in the Richmondian Stage, which offers an opportunity to test these generalizations and to understand how episodes of faunal change are reflected in the structure of ecological gradients. The early Cincinnatian (C1–early C4 depositional sequences) displays two relatively stable faunal gradients, with the primary gradient reflecting onshore-offshore setting and the secondary gradient reflecting substrate consistency. During the mid-C4 sequence, dominant taxa of the shallow subtidal are extirpated, while deep subtidal taxa expand into those habitats, leading to a loss of cross-shelf faunal differentiation. This faunal breakdown is accompanied into the mid-C5 by a series of ecological epiboles, indicating an ongoing flux in ecological associations. The onshore-offshore gradient is reestablished in the C5, albeit with new associations dominated by or containing immigrant taxa. Recognition of this gradient is hindered by widespread increased abundance of bryozoans and by the delayed appearance of at least seven common genera of brachiopods and corals. The Richmondian Invasion plays out over multiple sequences and is not confined to a brief interval at the beginning of a sequence. These faunal changes do not coincide with sequence boundaries or major flooding surfaces and therefore cannot be sequence stratigraphic artifacts, nor can they represent a geologically instantaneous faunal response to sea-level change.