Stratigraphic Completeness of Carbonate-Dominated Records from Cratonic Interiors versus Continental Margins: Stratigraphic Thinning Occurs via Condensation and Truncation at Multiple Scales

Mara E. Brady

The University of Chicago, Department of Geophysical Sciences, 5734 South Ellis Avenue, Chicago, IL 60637, marabrady@uchicago.edu

Over Phanerozoic time scales, stratigraphic records from the cratonic interior are generally assumed to be relatively incomplete, with more numerous and longer-duration hiatuses, compared to records from the continental margin. However, this assumption may not hold true for the shorter time scales (i.e. several 10^6 years) over which accumulation of the preserved stratigraphic record on the craton actually takes place.

In particular, this study examines Middle-Upper Devonian carbonate-dominated deposits in Iowa (cratonic interior) and Nevada (continental margin) that developed at equivalent paleolatitudes, preserve a comparable range of depositional environments, and were connected via a continuous epicontinental seaway. The stratigraphic record in Nevada is up to eight times thicker than the coeval record in Iowa. However, these two records appear to be equally complete at the limits of any sequence stratigraphic, biostratigraphic, and chemostratigraphic resolution (approximately 10^6-year resolution). This study compares the two records at finer stratigraphic scales to determine whether, and at which scale, the record in Iowa is (1) condensed but equally complete, (2) truncated, but comparable where preserved, or (3) truncated beyond recognition of equivalent stratigraphic elements compared to that of Nevada.

First, the facies compositions and thicknesses were documented in the two field areas in the context of measured stratigraphic sections. Next, I determined how these facies stack to form meter-scale cycles, defined as gradational facies transitions interrupted by discontinuities that reflect non-deposition and/or erosion. Finally, I compared the thicknesses and total numbers of stratigraphic elements preserved in these two records.

The results of this analysis indicate that meter-scale cycles in Iowa are on average half as thick and half as numerous compared to Nevada. Moreover, the thinnest meter-scale cycles in both Iowa and Nevada tend to have fewer numbers of facies preserved within them, and Iowa contains a higher proportion of those thinner, facies-poor cycles. However, the majority of the discrepancy in thickness of meter-scale cycles can be accounted for by differences in the thickness of individual facies – facies in Nevada are on average 1.5 times thicker than those in Iowa.

These findings demonstrate that major truncation of entire meter-scale cycles does occur in Iowa, but truncation of facies within the preserved meter-scale cycles appears to be minimal. A major portion of the discrepancy in overall thickness of meter-scale cycles can be accounted for

by condensation, or miniaturization, of individual facies in Iowa relative to Nevada. These results have implications for the ability of stratigraphers and paleobiologists to compare records across distinct basins for the purpose of documenting relative sea level changes, variations in meter-scale cycle stacking patterns, and evolutionary and paleoecological dynamics through time. This study suggests that, where preserved, the record of carbonate-dominated systems from the cratonic interior is qualitatively comparable, though relatively condensed, compared to that of the continental margin. The majority of truncation of cratonic carbonate records likely occurs at major depositional sequence boundaries and other recognizable discontinuities.