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Lateral variations of carbonate platform facies and cycles: The Dachstein Limestone (Late Triassic, Northern Calcareous Alps, Austria)

Elias Samankassou (1) and Paul Enos (2)

(1) University of Geneva, Department of Earth Sciences, Geneva, Switzerland (elias.samankassou@unige.ch), (2) University of Kansas, Department of Geology, Lawrence, Kansas, USA

The driving mechanisms of cyclic patterns in shallow-water platform carbonates remain controversial. The focus of the present paper is to quantify lateral facies variations for a long stratigraphic record in an extensive, continuous, well-exposed cliff of the Dachstein platform that is composed, as many other Phanerozoic carbonate platforms, of peritidal deposits. We noted the lateral continuity of the beds to the degree permitted by the outcrop, generally a few tens or hundreds of meters; exceptionally up to 1.7 km. The study demonstrates the importance of quantification to evaluate origins of sedimentary cycles.

The upper 885 m of the Triassic Dachstein platform limestone at Steinernes Meer, Saalfelden, Austria, includes 241 peritidal cycles overlain by 275 m of subtidal, non-cyclic and weakly cyclic limestone. Of 558 subtidal and intertidal beds measured, 121 (21.7%) disappear laterally. An additional 74 beds (13.3%) show significant (>10%) lateral variations in thickness. Mean thickness variation is 50%. Both lateral variations and discontinuities appear to lack a spatial vector. Disappearances toward the inferred platform interior (west), total 10.4% of the beds. East toward the inferred platform margin 11.3% of the beds disappear. Thickness changes occur in 6.6% of beds in each direction.

The lack of lateral continuity of beds is consistent with a non-eustatic component to stratification. Erosion of intertidal intervals is the process that can be most readily documented. Erosion, transport, and non-uniform distribution of sediments, superposed on stratigraphic sequences driven by eustacy, are the likely processes which produced the complex, randomly recorded cycle patterns.

Cycle duration may not be exclusively determined by Milankovitch processes, as suggested by the discrepancies in the cycle duration and interpretation among stratigraphers of the Dachstein, as well as other Phanerozoic carbonate platforms. Signals deduced from linearly measured sections likely represent composite inherent and extrabasinal factors; they should not be automatically interpreted as exclusive records of eustatic orbital forcing.

Lateral discontinuities and thickness variations could also present problems in spectral analysis of thickness patterns, typically conducted in search of “Milankovich frequencies”, as well as in construction of “Fischer plots,” to analyze long-period oscillations in relative sea level. Any section subjected to cycle analysis should be examined for lateral changes, to the extent permitted by the exposures, in order to produce the most complete (composite) section possible.