

Stratigraphic Relationships of Pennsylvanian Cyclothems with Allostratigraphy and Sequence Stratigraphy

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The cyclothem of Harold Wanless and J. Marvin Weller was the first unconformity-bounded unit to be acknowledged, although not truly accepted, by the 1961 (and 1970) American Stratigraphic Code. Referred to as a "cyclical sedimentary sequence" in a remark on the nature of lithostratigraphic units, cyclothems were clearly disregarded as valid units of the lithostratigraphic classification because the criterion for designating cyclothem boundaries was not solely based on delimitation of lithologic characteristics. The more recent 1983 North American Stratigraphic Code also regarded cyclothems as informal units and continued to address the subject in remarks in the articles on lithostratigraphic units. Defined slightly more broadly as "cyclic or rhythmic sequences," cyclothems were apparently considered to be more akin to formational units and remarkably less related to the newly introduced allostratigraphic units—stratiform sedimentary rocks bounded by laterally traceable discontinuities.

This apparent failure to recognize the relationship between cyclothems and allostratigraphy is paradoxical. Wanless and Weller had defined the cyclothem as a "series of beds deposited during a single sedimentary cycle of the type that prevailed during the Pennsylvanian period." Stratigraphically, a cyclothem consists of a terrestrial-to-marine succession demarcated by a basal unconformity. The disconformable boundary separating cyclothems formed during relative sea level fall (low stand) and is recorded in strata ranging from incised valley-fills (sandstone channels) or laterally equivalent paleosols (underclays). This disconformity is considered to be the most chronostratigraphically significant unconformity within the succession. Thus, cyclothems are unconformity-bounded stratigraphic units, defined with criteria similar to those for defining "cratonic" sequences, and differing only in scale (as had been recognized by Sloss in 1988).

Cyclothems may be analogous to depositional sequences, which consist of a "relatively conformable succession of genetically related strata" bounded by unconformities. Comparison with "Exxonian" sequence stratigraphic units is less straightforward. Cyclothems are not parasequences (a conformable succession bounded by marine-flooding surfaces), but are more akin to the sequence, a conformable succession of genetically related strata (composed of parasequences and parasequence sets) bounded by unconformities. Such sequences, however, are often thicker and contain numerous marine-flooding surfaces between the unconformities. Because cyclothems were deposited in a sedimentological framework of alternating transgressions and regressions, each cyclothem contains a single marine-flooding (transgressive) surface. This characteristic results in a distinct vertical succession marked by alternating transgressive and lowstand disconformable surfaces.

Cyclothems are a type of allostratigraphic unit, regardless of the relationship between allostratigraphy and sequence stratigraphy. Amendment of the North American Stratigraphic Code should account for the fact that cyclothems are not lithostratigraphic units. The original definition of the cyclothem constrained its use to the specific transgressive-regressive cycles of the Upper Carboniferous. Use of the term is recommended only for Upper Carboniferous and for Permian strata, which were also deposited in similar cycles.