Sequence Stratigraphy: Principles of Standardization

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Sequence stratigraphic principles offer theoretical guidelines of how the facies and time relationships are expected to be under specific circumstances such as subsidence patterns, sediment supply, topographic gradients, etc., but these circumstances may change significantly with the type of sedimentary basin, as each tectonic setting is unique in terms of subsidence mechanisms, sediment supply and dispersal patterns, physiography, etc. This is a main source for the conflicting ideas between the various models currently in use, as their proponents draw their conclusions from case studies derived from different tectonic settings. The study of similarities and differences between the sequence stratigraphic architectures of basins formed in different tectonic settings will help identify a broader platform of theoretical principles that should place all current ideas into a more general context. Such syntheses are still being formulated, and the incorporation of the variability imposed by changes in the tectonic setting to the sequence stratigraphic model represents a logical next step in the evolution of sequence stratigraphy (Catuneanu, 2006).

At least three different approaches to sequence stratigraphic analysis are currently promoted by different 'schools'. The inherent confusions caused by this variety of opinions have a negative impact on the communication of ideas and results between practitioners embracing alternative approaches to stratigraphic analysis, and also on the previous attempts to standardize sequence stratigraphic concepts in international stratigraphic codes. Despite this lack of cohesiveness in the field of sequence stratigraphy, common ground is bound to exist since all stratigraphers, regardless of their background and preferences, are essentially describing the same rocks, only using a different style for their conceptual packaging into sequences and systems tracts. The following basic principles represent the essence of sequence stratigraphy, and need to be considered irrespective of the model of choice (Catuneanu, 2006):

1) Sequence stratigraphic surfaces are surfaces that can serve, at least in part, as systems tract or sequence boundaries. A set of seven sequence stratigraphic surfaces are defined relative to the four main events of a reference base-level cycle. Their assigned degree of usefulness and/or importance may vary with the model.

2) As a function of subsidence patterns, the magnitude and timing of base-level changes may vary within a sedimentary basin, from one area to another. The reference curve relative to which sequence stratigraphic surfaces and systems tracts are defined describes changes in base level *at the shoreline*.

3) The four main events of the reference base-level cycle mark changes in the direction and/or type of shoreline shift (i.e., forced regressions, normal regressions, transgressions). These changes control the formation and timing of all sequence stratigraphic surfaces and systems tracts.

4) Recognition of sequence stratigraphic surfaces in the rock record is data-dependant. Inherent difficulties in recognizing any of the sequence stratigraphic surfaces, depending on case studies and the available data sets, do not negate their existence or validity. In most cases, this is just a reflection of the lack of sufficient data. Integration of outcrop, core, well-log and seismic data affords the most effective application of the sequence stratigraphic method.

5) Different genetic types of deposits (i.e., forced regressive, normal regressive, transgressive) need to be separated as distinct systems tracts, data permitting, as this is the key to the predictive aspect of sequence stratigraphy. Each such genetic wedge (systems tract) is characterized by different sediment dispersal patterns and petroleum plays.

6) Sequence stratigraphic surfaces that form independently of sedimentation (i.e., onset-of-fall and end-of-fall 'correlative conformities') are closer to time lines than surfaces that mark the end of regression and the end of transgression (i.e., maximum regressive and maximum flooding surfaces, respectively).

7) The highest-frequency (lowest-rank) cycles in the rock record reflect the *true changes* in depositional trends. All higher-rank cycles represent *overall trends*, which approximate the true facies shifts at different scales of observation. Lower-rank stratigraphic surfaces superimposed on higher-rank surfaces do not change the stratigraphic significance of the latter within the bigger-picture framework. A sequence stratigraphic framework constructed at a particular hierarchical level should consistently include sequence stratigraphic surfaces of equal rank.

8) Where two or more sequence stratigraphic surfaces are superimposed, always use the name of the youngest surface.

Reference

Catuneanu, O., 2006, Principles of Sequence Stratigraphy: Elsevier Science Ltd., Amsterdam, 375 pp.