

WHAT HAPPENED TO SEQUENCE STRATIGRAPHY?

Gregor P. Eberli and Mark Grasmueck

RATIONALE FOR PRESENTATION

When sequence stratigraphy was introduced, it had a major impact on seismic interpretation due to its predictability. Yet, fifty years later it seems to wither or even be discarded as an analytical method for two main reasons. First, because of inadequate new stratigraphic methods and second because of advances in interpretation tools. We explore this development and try to grasp the implication for this trend.

STRENGTH OF SEQUENCE STRATIGRAPHY

Sequence stratigraphy is the only stratigraphic method with a predictable capability. This prediction success is based on the assumptions in sequence stratigraphy. The first and for a longtime controversial assumption is that seismic reflections are timelines and basically depositional surfaces. Once this was accepted it was implemented into interpretation packages starting with autotrack and more recently with relative geologic time models in Paleoscan. This has made highly detailed interpretations possible (Fig. 1).

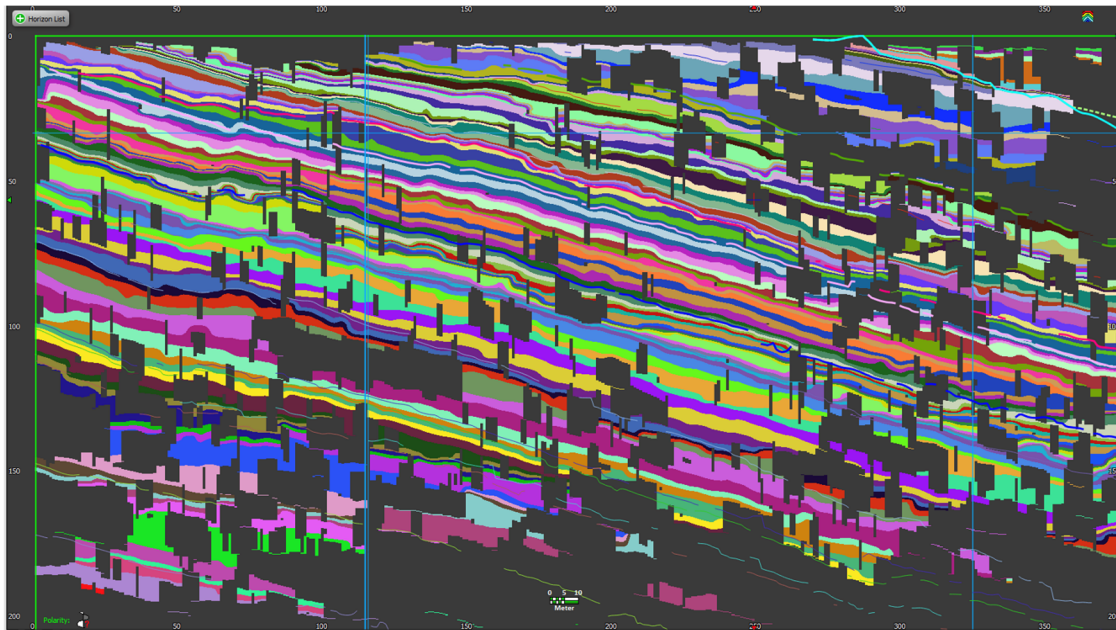


Figure 1: Example of Relative Geological Time (RGT) Model Preview in Paleoscan.

A second assumption is that stratigraphic sequences are related to changes in sea level and that these changes are recorded in the sedimentary succession. By recognizing that changing sea level partition the facies into highstand and lowstand packages with characteristic facies packages, predicting the correct facies from the geometry displayed on seismic data was possible. An early and very successful application of this principle was the exploration of deep-water turbidite fans.

HEADWINDS AGAINST SEQUENCE STRATIGRAPHY

Sequence stratigraphers themselves started to question the concept and methodology. The original unconformity-based sequence stratigraphy has a terminology, which is confusing for some people. In addition, the notion that only sea level falls can produce sequence boundaries was questioned by carbonate geologists who included drowning unconformities as sequence boundaries. However, more important were the appearance of two new sequence stratigraphic methods, in which varying rates of coastal accommodation increase and decrease (δA) relative to the rate of sediment flux (δS) are considered the main criteria to identify depositional sequences (Neal & Abreu 2009, Catuneanu et al. 2009). Both methods assume that the shoreline trajectory is in concert with the shelf edge trajectory, completely ignoring that currents on the shelf and shelf edge can alter the trajectory. In addition, because the method relies on the siliciclastic shoreline as a reference, both methods cannot be transported into the carbonate system. Yet, both methods are regularly taught and applied because the interpretation software is designed for picking conformable horizons that can be implemented into modeling.

SEQUENCE STRATIGRAPHY IN 3D

Modern seismic data is three-dimensional and seismic interpretation packages have adopted to this. Paleoscan where every reflection in a 3D data set is evaluated for its connectivity and automatically placed into a 3D model is capable of doing sequence stratigraphic analysis with very attractive output. Paleoscan uses unconformity-based subdivision, yet the interpreter still needs to have the skill to break out the sequences. In short, if an interpreter has the basic skills the new technology is major advance in sequence stratigraphy.

REFERENCES

- Catuneanu, O., and 27 others, 2009, Towards the standardization of sequence stratigraphy: Earth-Science Reviews, v. 92, p. 1–33
- Neal, J., and Abreu, V., 2009. Sequence stratigraphy hierarchy and the accommodation succession method. *Geology*, v. 39, p.779-782. Vacchi, M., Shaw, T.A., Anthony, E.J., Spada, G., Melini, D., Li, T., Cahill, N., and Horton, B.P., 2025, Sea level since the Last Glacial Maximum from the Atlantic coast of Africa. *Nature Communications* 16, 1486. <https://doi.org/10.1038/s41467-025-56721-0>