Beyond the sequence stratigraphy paradigm: learning to exploit high-resolution data

HENRY W. POSAMENTIER

Laporan (Report)

Henry W. Posamentier of Atlantic Richfield Indonesia Inc., gave the above talk to an audience of 25 on 7th December 1999 at the Geology Department, University of Malaya.

Abstrak (Abstract)

Sequence stratigraphy has proven to be a powerful vehicle for analyzing geological data ranging from sedimentological to biostratigraphic to geochemical data and developing robust geologic interpretations. Key to its success is that sequence stratigraphy embodies an approach rather than a set of models. And, as an approach, what originated as a somewhat simplistic model-based tool, has subsequently evolved into a sophisticated first-principles based tool.

Early development of sequence stratigraphy was based largely on relatively low-resolution 2D multichannel seismic observations. The basic framework of lowstand, transgressive, and highstand systems tracts comprising the sequence was developed initially on the basis of these observations. Initially, also, limited tectonic/physiographic settings were considered.

In the years since then, geologists and geophysicists have come to better understand the fundamental driving mechanisms behind the development of sequence architecture, namely, eustasy, sea floor motion (associated with tectonism, compaction, and thermal contraction), sediment flux, and physiography. Improved understanding of these driving mechanisms inevitably led to the conclusion that sequence stratigraphy was relevant not only to seismic data, but also to well log, core, outcrop, geochemical, and biostratigraphic data. As a consequence, there has been a pronounced shift to analysis of high-resolution geologic data, and with this shift came the challenge to learn how to exploit these data within a sequence stratigraphic context.

With these new high-resolution observations, it has become clear that many of the early concepts were lacking precision and ignorant of some significant variations on the general sequence stratigraphic theme. Such fundamental concepts as the expression of key surfaces (e.g., flooding surfaces, maximum flooding surfaces, and sequence boundaries) and the timing of formation and the physiographic settings of key physiographic elements (e.g., deepwater submarine fans, incised valley systems, shelf ridges, and shelf-edge deltas), have in some instances been profoundly influenced, refined, and modified by high-resolution observations. In particular, 3D seismic data, with its potential for imaging detailed three-dimensional views of subsurface paleogeography, when integrated with core sedimentology and detailed biostratigraphy have yielded compelling insights. This has led to awareness of significant variations on the general sequence stratigraphic theme and better prediction of temporal and spatial relationships between different depositional elements. Using these observations, the earth scientist can gain an understanding as never before of how a sedimentary basin fills. Examples of high-resolution data from the Gulf of Mexico and the Java Sea will be used to illustrate the relevancy of such data, with reference to the areas studied as well as to sequence stratigraphic principles in general.

Warta Geologi (Newsletter of the Geological Society of Malaysia), Vol. 25, No. 6, November-December 1999

H.W. POSAMENTIER