



## Artificial delta growth

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### Abstract:

A deltaic sedimentary system has a point source; sediment is carried over the delta plain by distributary channels away from the point source and deposited at the delta front by distributary mouth bars. The established methods to describe such a sedimentary system are "bedding analysis", "facies analysis", and "basin analysis".

We shall call the ambient conditions "input" and the rock record "output". There exist a number of methods to deduce input from output, e.g. "Sequence stratigraphy" (a.o. Vail et al. 1977, Catuneanu et al. 2009), "Shoreline trajectory" (a.o. Helland-Hansen & Martinsen 1996, Helland-Hansen & Hampson 2009) on the one hand and the complex use of established techniques on the other (a.o. Miall & Miall 2001, Miall & Miall 2002). None of these deductive methods seems to be sufficient. I claim that the common errors in all these attempts are the following: (1) a sedimentary system is four-dimensional (3+1) and a lesser dimensional analysis is insufficient; (2) a sedimentary system is complex and any empirical/deductive analysis is non-unique.

The proper approach to the problem is therefore the theoretical/inductive analysis. To that end we performed six scenarios of a scaled version of a passive margin delta in a flume tank. The scenarios have identical stepwise tectonic subsidence and semi-cyclic sealevel, but different supply curves, i.e. supply is: constant, highly-frequent, proportional to sealevel, inversely proportional to sealevel, lagging to sealevel, ahead of sealevel. The preliminary results are indicative.

Lobe-switching occurs frequently and hence locally sedimentation occurs shortly and hiatuses are substantial; therefore events in 2D (+1) cross-sections don't correlate temporally. The number of sedimentary cycles disequals the number of sealevel cycles. Lobe-switching and stepwise tectonic subsidence cause onlap/transgression. Erosional unconformities are local diachronous events, whereas maximum flooding surfaces are regional synchronous events. The evolution of the different scenarios is significantly different. These results demonstrate that the complexity of the deltaic system merits the inductive approach.

### References:

Catuneanu, O. et al., 2009. Towards the standardization of sequence stratigraphy. *Earth-Science Reviews*, v. 92, p. 1-33.

Helland-Hansen, W., and Martinsen, O.J., 1996, Shoreline trajectories and sequences: description of variable depositional dip scenarios: *Journal of Sedimentary Research*, v. 66, p. 670-688.

Helland-Hansen, W. and Hampson, G.J., 2009, Trajectory analysis: concepts and applications. In: *Basin Research Special Publication* 21, p. 454-483.

Miall, A.D., Miall, C.E., 2001, Sequence stratigraphy as a scientific enterprise: the evolution and persistence of conflicting paradigms, *Earth Science Reviews*, v. 54, p. 321-348.

Miall, C.E., Miall, A.D., 2002, The Exxon Factor: the roles of corporate and academic science in the emergence and success of a new global model of sequence stratigraphy, *Sociological Quarterly*, v. 43-3, p. 307-334.

Vail, P.R., Mitchum Jr., R.M., Todd, R.G., Widmier, J.M., Thompson III, S., Sangree, J.B., Bubb, J.N., Hatlelid, W.G., 1977. Seismic stratigraphy and global changes of sea-level. In: Payton, C.E. (Ed.), *Seismic Stratigraphy—Applications to Hydrocarbon Exploration*. American Association of Petroleum Geologists Memoir, v. 26, p. 49–212.