Contribution ID: **2** Type: **not specified**

# Shoreline length-series from virtual, artificial, natural deltas

The most used tool for a sedimentologist is a one-dimensional vertical log through sedimentary layers. The log provides a detailed record of the sedimentary system, but lack of time control frustrates correlation between logs one the one hand and between log and signal on the other, e.g. correlation between shoreline length-series and sealevel time-series. The objective of this study is to test whether shore line correlates to base level for alluvial shallow deltas. The fundamental question is whether one can infer sea level time-series from sea level length-series.

In order to infer paleo base level in the rock record one needs a base level proxy. A commonly used proxy is clinoform brink point; the position of which indicates shore level. If all else steady and deposition continuous then shore line correlates to sea level. Here we test if shore line is indeed valid proxy for sea level by growing a miniature delta in a flume tank under steady tectonic subsidence, periodic water (sea) level fluctuation and two periodic discharge fluctuation scenarios: in- and out-of-phase with sea level. We took photographs every 10 minutes and digital elevation models every 3.5 hours. At the end of the experiment we made 4 radial cross-sections.

We then convert length-series to time-series. We measure the shore line in a cross-section for each lamina subsequently, i.e. distance of shore line to delta apex, lamina for lamina, from oldest to youngest. Thus we obtain shore line "length-series" for the cross-section. We then obtain depositional event times from the photographs. Thus we obtain shore line "time-series" for the same cross-section. We convert the time-series to length-series by omitting hiatus and match the two. We then convert the length-series to time-series and hence obtain shore line time-series.

Our results show that first order shore line cycles mimic sea level cycles, but higher order shore line cycles deviate from the trend. Regional supply fluctuations affect amplitude of shore line shifts; supply change in-phase with sea level attenuates fluctuations, out-of-phase amplifies them. Local supply fluctuations caused by lobe switches or other autogenic responses generate shore line cycles similar to higher order sea level cycles. In the out-of-phase scenario lobe switches are rare and generate second order cycles; in the in-phase scenarios switches are frequent and generate third order cycles.

In conclusion, the results show that deposition events are adequate samples to capture the lower order base level cycles accurately from shore line cycles, but two phenomena create significant misfit between the two: (1) Irregular local deposition causes a varying phase shift between sea level and shore line cycles similar to varying sea level cycle period; (2) Autogenic phenomena create additional shore line cycles similar to higher order sea level cycles. It is evident that one can not infer sea level time-series from shore line length-series.

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**Track Classification:** Oral Presentation