So Different, Yet So Similar: Comparing and Contrasting Siliciclastic and Carbonate Slopes and Predicting Mineralogy and Texture Ahead of Drill

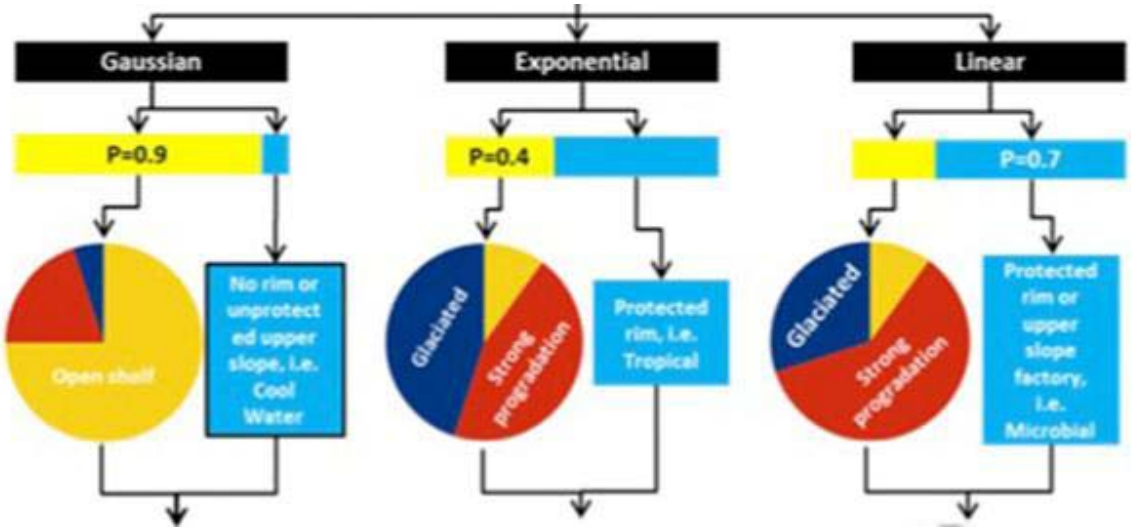
Jeroen Kenter
ConocoPhillips, Houston
kenter.jeroen@gmail.com

Abstract

Carbonate submarine slopes have a tendency to be steeper than their siliciclastic counterparts, an observation that is generally attributed to microbial binding and early cementation in carbonates. However, careful comparison of gross development, curvature, and angle of dip in similar settings shows surprising similarities between siliciclastic and carbonate slopes. For example, where deep shelves, low slope angles and usually sigmoidal slope profiles are typical, similarities between siliciclastic continental slopes and cool-water carbonate platforms are evident. Coarse-grained deltas compare with tropical carbonate platforms. Both have steep, exponential and linear, slope profiles, and coarse sediments originating from shallow water depths. Exponential profiles are common on rimmed platforms because reefs are resistant to erosion and the platform edge is therefore relatively stationary vertically forming a distinct platform-slope break. This also accounts for ice-covered margins because the grounding level of the ice limits vertical fluctuations.

Biotically induced carbonate precipitates stabilizing and building deep microbial “reefs” and taluses of rubble and sand present an exception to these observations. However, in-situ slope accretion and stabilization by itself does not necessarily explain the large-scale geometry of the platform flanks. It is more likely due to a slope factory that is insensitive to light and can therefore accrete during both lowstands and highstands. A direct comparison are coarse-grained fjord and Alpine lake deltas where the inherent fast prograding system, which is dominated by a mixture of coarse sand and rubble, results in comparable steep and planar slopes.

Clearly, while sediment properties vary greatly, striking similarities in gross development, curvature, and angle are observed in comparable settings. As a consequence, morphometric attributes captured from seismic data have to be put in the context of the entire depositional system and basin setting to fully comprehend and predict sediment properties and depositional process. This paper presents examples of the various systems from seismic and outcrop and proposes a workflow that facilitates more systematic and improved prediction of carbonate and siliciclastic depositional systems ahead of drill.


Gaussian
Exponential
Linear
P=0.9
P=0.4
P=0.7
Open shelf
No rim or unprotected upper slope, i.e. Cool Water
Glaciated
Strong progradation
Protected rim, i.e. Tropical
Glaciated
Strong progradation
Protected rim or upper slope factory, i.e. Microbial