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A dynamic classification of clinoforms

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Clinoforms are fundamental elements in stratigraphic successions and form wherever sediments are building out in standing body of waters. They occur at scales from a few meters to a few thousand meters and record the lateral accretion of depositional slopes either through active deposition from nearby sources, accretionary clinoforms, or by passive hemipelagic or pelagic draping from distant sources, draping clinoforms. Clinoforms are "frozen" bathymetric profiles and give direct information about depositional processes and environments, water depths, bathymetry and gradients whereas successions of clinoforms, clinoform sets, record the interplay between sediment supply and relative sea-level changes. They also provide the key to better understand the transfer of sediment from shallow to deep water, and give important premises for how sedimentary units being laid down in standing water bodies should be correlated.

In this presentation we propose a hierarchical classification of siliciclastic clinoforms, consisting of four classes; shoreline clinoforms, delta-scale subaqueous clinoforms (together delta-scale clinoforms), shelf-edge clinoforms and continental margin clinoforms. Each of these are subdivided into accretionary and draping components; for the accretionary clinoforms a further breakdown into fine-grained and coarse-grained types can be made.

Where rivers debouches into standing waters shoreline clinoforms are formed as a response to the increase in accommodation and current-deceleration going from constrained to unconstrained flow conditions, with subsequent deposition and potential redistribution of sediment alongshore. Shoreline clinoform rollover depths are maximum at a few meters water depth, and clinoform reliefs from a few meters to a few tens of meters. For subaqueous delta clinoforms it is the deceleration associated with the transitioning from a high to a lower energy level when passing into deeper, and less agitated waters (e.g., fairweather wave base) that causes clinoform nucleation and growth. These clinoforms have rollover depths and reliefs in terms of tens of meters. Shelf-edge clinoforms are formed by the stratigraphic climb effectuated by the repeated transits of shoreline or subaqueous delta clinoforms through extended time-periods forming clinoforms hundreds of meters high. Finally, the kilometer- scale relief continental margin clinoforms are the result of sedimentary accretion of the continental margin slope, which, unlike the other clinoforms types, has a geodynamic origin, as exemplified by the change in water depth associated with the continental-oceanic crust transition.

All clinoform types may advance with an accretionary or draping style, depending on the proximity to the sediment source. Different clinoform classes can either be clearly separated along modern bathymetric transects or paleobathymetrically reconstructed profiles; compound clinoforms, or they may for periods of time have coincided and moved together as hybrid clinoforms.

A more systematic description and classification of clinoforms is important to better predict the paleoenvironmental conditions and the lithology of clinoform successions. The description of relief, slope angle, and clinoform set trajectory and the clinoform classification itself all give premises for how to better assess the reservoir potential of clinoform successions.