Contemporaneous and Mesozoic Low Gradient Shelf Deposition across Wide Continental Shelves

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ABSTRACT

Review of contemporaneous wide continental shelves characterized with drainage and fine-grained Holocene/highstand sediments reveal novel dynamics, a model applicable to Mesozoic-aged sea levels including Milankovitch oscillations. Marine stratigraphy can range down to virtually absent overlying submarine and subaerial riverine to beach desiccated sediments intermingled with channel-fill of all grain sizes. Increasing overpressure with depth can irregularly accumulate, changing subsurface geophysics. Organics gather non-uniformly from both pelagic and river-based erosion both submarine and subaerially and join clusters of clays, increasing the cluster's chemical strength. Slippage can be influenced/controlled by these clusters along with dewatering by compaction. With greater depth, organics can produce natural gas, again changing sediment structure and its geophysics. These complicated highstand units, with little internal cohesion, are unstable and subject to motion, often obliterating detailed structure.

Pertinent shelves can be along active and passive margins periodically jostled by earthquakes and oceanic winter and summer storms. Even with low gradients of 0.01 to 0.001% and beyond for a vertical range of 50 m over 200–400 km, weak hyperpycnal flows migrate downslope, unable to sculpt a definite channel, flow basinward along intermittent/marine braided streams and as sheet wash.

The major mechanical weakness of these largely clay and unconsolidated sediments implies continuous and discontinuous flowage downslope over a riverine system. This general weakness does not obviate rare massive floods that remove unconsolidated sediments to be then replaced.

Combination of stresses from growth of extensional breakages, regional to local in extent, to suites of polygonal faults, genetically restricted to fine-grained sediments, to gravity-driven mass-wasting along shelf faults, and basement-generated forces can deform the sediment wedge. Granting these highstand weak units intermittently stacked one over another form a fragile structure. On margin-wide subsidence, these units may act as a most malleable portion of the margin; similar sheet deposition over extensive and stable continental interiors as during Mesozoic do not behave similarly due to sustaining underlying basement. With unevenly subsiding margins, weak highstand units 'collapse' via ductile to increasingly brittle deformation. With depth, failure promotes individual units that may serve as individual hydrocarbon reservoirs. With slope gradients as low as here proposed, a sea level rise of circa 20 m would result in a transgression of 20 to 200 km, a lateral distance surely to be located in outcrop or subsurface.

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