‘Deep-Water’ Deltas: Exploration Potential of Shelf/Margin Lowstand Prograding Wedges

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Shelf/margin deltas are one of the most prolific reservoir systems associated with ‘deep-water’ depositional settings and are a primary source for gravity-flow sand displaced further basinward. These deltaic sands are encased in outer neritic and upper bathyal claystones that provide both optimal sealing potential and a critical clue to their deposition at the shelf/margin. Shelf/margin deltas have four primary attributes that make them highly prospective exploration targets:

Shelf-edge deltas prograde into relatively deep water where wave energy is less attenuated than for similar shoreface environments inboard on the shelf. The high-energy wave dominated environment facilitates mechanical weathering of the sands resulting in reservoirs that retain producible porosity and permeability to depths of 6,200 meters (20,000 feet).

Following shelf/margin delta deposition the transgression is rapid across the relatively horizontal outer marine shelf and coastal plain. Coarse-clastic sediment is impounded
progressively farther landward resulting in deposition of clean organic-rich and ductile clays on the outer shelf and upper slope. These clays resist fracturing and provide fault-sealing gouge making ideal seal for the deltaic sands.

Shelf-edge growth faulting is most active during differential loading when the sand-rich rivers are supplying high volumes of sediment to the shelf/margin. The sediment supply in-fills the fault-generated accommodation space depositing thick multistoried sand packages in the hanging wall section. As the
fault continues growing the hanging wall is folded into a rollover anticline placing the deltaic sands into a trapping configuration. The syndepositional movement of the fault facilitates burial of potential reservoir facies below the zone of bioturbation enhancing preservation of primary reservoir quality.

During growth-fault movement there is relative extension of the fault zone allowing fluids to move upward along the fault plane. If the fault system taps into a hydrocarbon kitchen or pool of migrated hydrocarbons, the oil and gas can migrate up the fault into the trapping reservoirs sealed by the transgressive claystone.