Rosenfeld and Pindell, 2002, Gulf drawdown hypothesis, cont...

Discussion

Our hypothesis provides a unifying mechanism for periods of:

- Exposure of circum-Gulf continental shelves/upper slopes
- Severe canyon incision into shelves
- Massive slumping of clastic continental shelf/slope sections
- Deep caving of exposed carbonates
- Sediment bypass and progradation into the deep Gulf.

We do not define the number or duration of times the Gulf was isolated from the world ocean. Multiple cycles of rapid drawdown and flooding of varying magnitude may have occurred, depending on Late Paleocene-Late Eocene kinematics and dynamics of the Cuban orogen, and the orogen's level relative to eustasy on its southeast side.

This assumes episodic blockage of the Florida Straits, but alternatively the Gulf may have remained isolated for the entire Late Paleocene- Late Eocene interval, such that cyclical climatic cycles in the Gulf s catchment area controlled relative water level. In either case, the Gulf is unsatisfactory for calibrating eustasy at this time. A one-km drop (and subsequent rise) in the Gulf's water level would have raised (and lowered) global sea level by a modest two meters (W. Pitman, pers. comm.).

Drawdown of base level by ~3,000 ft would have produced moderately hypersaline conditions in the remaining Gulf. However, no Eocene evaporites are known and we assume for now that they either were not deposited or were dissolved upon reflooding. But it may be presumptuous to assume that all salt is Jurassic.

The isostatic response of lithosphere to water drawdown and flooding is potentially important. For every kilometer of water removed/added from/to the Gulf by evaporation/flooding, the lithosphere (and the remaining water in the Gulf) will rebound/subside by about 300 m. Rebound/subsidence will be progressively less within the flexural half-wavelength (~200 km) in the landward direction at the margins, where original water depths were less than 1 km. Rivers would cut into the rising area to reach the Gulf, and areas such as Florida would become better sea barriers by this process.

These considerations would reverse upon re-flooding: once flooding began, added water would load the Gulf floor and margins and cause them to subside, renewing marine deposition across the formerly subaerial and progradational shelves/upper slopes. The Big Shale and Upper Chicontepec formations would be one such interval; others could be the Yoakum, Reklaw, Weches, Cook Mountain, and Moodys Branch formations (Galloway et al., 2000).

Implications

Our hypothesis carries the following implications for hydrocarbons:

(1) one or more ubiquitous circum-Gulf unconformities that correspond to time(s) of lowered water level;

(2) extensive exposure/karsting of carbonate platforms (Florida, Yucatán, Córdoba, Tuxpan);

(3) silty/fine-grained turbidite filled canyons with stratigraphic trapping potential;

(4) slumping and landsliding of exposed canyon walls and poorly consolidated upper slope deposits;

(5) fluvial thalweg deposits (braided channels and fluvial sandbars) on the floors of subaerially eroded canyons during lowered water level;

(6) sandy low-stand deltas and basin slope and floor fans basinward of the canyon systems providing important reservoirs and migration pathways: the Chicontepec Formation is saturated with hydrocarbons (Bitter, 1993), possibly due to physical contact with Upper Jurassic source rocks at the canyon base. Recently discovered sands in the deepwater Perdido Belt (e.g. Unocal's Trident well) may be a specific example.

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