

Geovalidating Basin Models of Yo-Yo Tectonics – Example: Wadi El-Natron Basin, West Nile, Egypt

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Wadi El-Natron of the West Nile is a poorly explored basin located between the prolific hydrocarbon fields of the Nile Delta and the Egyptian Western Desert. Tectonic subsidence analysis of boreholes reveals a complex oscillating burial history (Yo-Yo Tectonics). Both the flank (T57-1) and the basin center (Natrun Gibli) exhibit pulses of tectonics which slowly increase in amplitude and then diminish, however the basin center continues its oscillations up to the present. As a first approximation, these tectonic pulses suggest rifting and shortening, with estimated crustal stretching betas up to 1.5 and shortening less than 0.85, the thermal modeled predicted kinetic vitrinite values exceed 2 Ro% units those observed in the borehole.

Geovalidation using observed vitrinite reflection values reveals a relatively time invariant heat flow, remarkable for the assumed multiple rifting pulses. Therefore, the changes which have occurred structurally are less likely the affects of lithospheric thinning and more likely the isothermal products of simple shear elastic deformation (wrenching) of the crust caused by alternations in transpression and transtension along changing stress fields of a strike slip fault system which migrated from the basin flank to the center.

The thermal impact upon hydrocarbon maturity of the Yo-Yo tectonics has been favorable for much of Wadi El-Natron. In contrast to coeval strata outside of the basin which are largely overcooked, intrabasinal sediments are only now beginning to enter the oil window. These results suggest the Wadi El-Natron Basin contains favorable petroleum system criticals (source rock, migration pathway, reservoir-seal, and timing) required for the existence of petroleum systems and that future hydrocarbon exploration is warranted.