Debate persists over basin/water depths (relative to global sea level, GSL) for sag/salt deposition in former evaporitic rift basins. Seismic data and isostatic balancing of observed thin crust suggest deep depressions prior to sag/salt deposition. For those who interpret deposition occurring within ~200m of GSL, synrift dynamic elevation must have supported the basin at non-isostatic levels prior to sag/salt deposition. Sag/salt may then accompany dissipation of dynamic support and early thermal subsidence to allow early rapid and thick sag/salt deposition. This dynamo-thermal subsidence model (Pindell and Heyn 2022) allows top-salt relief to be minimal near GSL and explains why salt deposition in the Gulf of Mexico (GoM) and surrounding neritic zones (onshore Mexico) was coeval. This contrasts with models invoking a Mediterranean (Med) analogue of a ~1500m air- and/or brine-filled basin (accommodation pre-dates sag/salt) and high top-salt relief. We argue the Afar–Red Sea (ARS) region provides the correct rift analogue, with shallow salt deposition during dynamically elevated magma-rich rifting and salt flow over shallow oceanic crust. We show the Jurassic GoM occurred above a hotspot like the ARS analogue, and that shallow water sag/salt deposition models near GSL are at least as viable as deeper water/basin models.

GoM stretching along the Paleozoic orogen began in the Carnian but thinning began amidst widespread CAMP magmatism and positive dynamic elevation. Magma-rich rifting flourished in the E Jurassic as N America departed from Gondwana. Breakup (split of continental crust, CC) occurred at the Houston/Campeche magnetic anomalies (volcanic rift-fill and underplated intrusives, adjacent in E Jurassic). Magmatic crust (MC, ~11 km avg.), onlapped by sag and salt (like Albian Santos basin), formed basinward of rifted CC, possibly stranding Gondwanan rafts under syn-rift volcanics. Sag/salt accumulated on rifted CC and MC as the GoM moved off the plume. Hyper-extension of MC occurred in outer marginal troughs (OMT) as magmatism weakened (Hudec et al., 2013 show extension of transitional crust under salt / cover also), while salt flowed basinward but before typical 7 km oceanic crust (OC) formed and salt necked into two halves. OC began forming slightly after marine strata began accumulating on salt. GoM U Jurassic supra-salt extension exceeds downdip compression and must be balanced by OMT extension plus salt flow over OC. The OMT between MC and OC widened by magmatic addition and faulting below salt. Extensional growth of supra-salt units from OMT extension persisted until Kimmeridgian in West/Central GoM. Most of the GoM moved NW off the residual Florida–Bahamas hotspot by Late Jurassic except the SE GoM where rifting persisted through Berriasian; the eastern end-rift unconformity corresponds to end of spreading in the west. Basin departure off the plume was recorded by sag/salt, with accommodation by dynamo-thermal subsidence. The fast combination of thermal and dissipation of dynamic elevation during plume departure explains thick sag–salt sections with deposition near GSL, without tectonic subsidence except in the OMTs.

Some use the Med as an analogue for rift settings such as the GoM. Roveri, Lugli, Konstantinou, others show Med salt precipitated from >750m brine (ultra-deep) in a basin >1000m (ultra-deep). However, direct evidence is lacking for such pre-salt depths in rift settings. That the pre-existing Med was deep does not mean all salt basins were deep. Rifts must be assessed independently, with reasonable values of dynamic elevation likely preventing them from ever becoming deep. Accordingly, we see the ARS as the correct analogue for GoM and Sau Paulo magma-rich rifts.

Some models for the GoM (Hudec & Norton, 2019; Rowan, 2022) have salt precipitation in 0.5–2 km brine during (±mantle exhumation w top salt relief) as the OMT formed but have mantle/oceanic crust at ~ 2.7 km. SDRs observed on seismic data suggest that syn-exhumation salt deposition was unlikely (exhumation occurs over cold mantle without abundant volcanic SDRs), and the ARS region shows OC forming at <1 km depth over a plume.

The ARS provides GoM depth proxies, and suggests salt precipitated near GSL (-200m). Post-salt subsidence and extension of the OMT caused deepening of top salt and supra-salt cover to -1 km (ARS: -0.2 to -1.2 km). Plume dissipation caused deepening to -0.9 to -2.7 km, when the salt/cover was split. OC formed below the top salt level of the OMT (but higher than base salt), allowing salt to flow over OC. Partially restricting connections with the Pacific were likely in Bajocian–Bathonian, hence the hyper-saline GoM.