Two Successive Phases of Triassic-Jurassic Gulf of Mexico Rifting Recorded in the Subsidence History of the Southeastern Gulf of Mexico

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ABSTRACT

Most workers now agree that the opening of the Gulf of Mexico (GOM) Basin began in a southeastward direction during the Triassic and early Jurassic and is recorded by continental rifting across a broad zone. These earlier phase 1 rifts, thought to be filled by coarse clastic fill of the Triassic Eagle Mills Formation, are deeply buried and rarely drilled or well imaged along most GOM margins. This early rifting of the continental crust generated a large, post-rift sag basin filled by a thick salt layer. A second phase of more north-south-directed rifting began in the late Jurassic and formed phase 2 rifts along with an arcuate area of oceanic crust that separated the salt into two parts: the Louann salt of the northern GOM in the USA and the Campeche salt in Mexico. In this study, we focused on testing the two-stage and two-direction rifting process in the southern GOM because: (1) two sets of orthogonal rifts are known from previous mapping that are consistent with both southeastward rifting and eastward rifting; and (2) rift structure and stratigraphy can be mapped in detail and dated from DSDP wells because the rifts are not buried by thick salt and clastic sedimentary rocks like the rifts are in the northern GOM. Five tectonostratigraphic sequences were mapped from seismic data and wells and include: (1) lower Paleozoic metamorphic and igneous basement; (2) pre-rift mid/upper Paleozoic dolomite; (3) syn-rift Jurassic arkosic sandstone, conglomerate, and shallow carbonate; (4) lower Cretaceous deep and shallow water platform carbonate; and (5) upper Cretaceous to Cenozoic pelagic carbonate, ooze, chalk, clay, and mud. Four seismic lines were backstripped and restored, with two of the lines in the phase 1 rift direction and two of the lines in the phase 2 rift and seafloor spreading direction. The result showed that total subsidence of the area exceeds the sum of the tectonic and sediment load subsidence; stretching factors range from 1.07 to 1.24 and are consistent with failed rifts in continental crust worldwide. To explain the discrepancy between the total subsidence, load subsidence, and tectonic subsidence seen for all of the lines, we propose that phase 1 rifting is a likely mechanism because structural restorations of phase 2 rifts show that significant phase 1, rift-related basement relief existed prior to the phase 2 rifts. Less likely mechanisms include lower crustal extension and regional effects related to the Cenozoic thrust deformation of Cuba.

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