



Deep Crustal Structure Northeastern Gulf of Mexico

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The Gulf of Mexico is a small ocean basin between the US and Mexico that opened up soon after the breakup of Pangea. Although the area has been heavily surveyed with seismic reflection profiles, the deep structure of the region is poorly understood because of lack of penetration beneath the thick sediments and salt. We present the results of two wide-angle seismic refraction profiles in the northeastern Gulf of Mexico that constrain seismic velocities and thicknesses of the sediments and crust from the continental shelf to deep ocean basin. Profile GUMBO 3 extends 523 km from offshore Alabama south-southwest via the De Soto Canyon to the central Gulf of Mexico, while GUMBO 4 extends 507 km from the northwestern Florida peninsula across the Florida Escarpment to the central Gulf of Mexico. On both profiles, ocean bottom seismometers were positioned at 12-km spacing, and recorded air gun shots at offsets >100 km. We use a tomographic inversion of first-arrival and secondary travel time picks from these data to build a layered velocity model (water, sediments, crystalline crust, mantle) along each profile.

On GUMBO 3 and GUMBO 4 the thickness of crystalline crust from the continental shelf to the deep basin decreases from ~25 km to ~7 km (GUMBO 4) or ~8 km (GUMBO 3) over a horizontal distance of ~150 km. Velocities of 7-7.5 km/s are observed at the base of the crust along most of GUMBO 3, while velocities of 6.5-7 km/s are observed at similar depths along GUMBO 4. We suggest that higher lower crustal velocities, and thicker oceanic crust, on GUMBO 3 compared to GUMBO 4 may be explained by elevated syn-rift mantle temperatures in the vicinity of the De Soto Canyon and South Georgia Rift during rifting and continental breakup. We have integrated seismic refraction, seismic reflection, and well data to interpret sequence stratigraphic units along GUMBO 3 and GUMBO 4. We have constructed a geologic history of the late-Jurassic/early-Cretaceous, beginning first with Louann salt formation in the Callovian to early Oxfordian, Smackover/Norphlet deposition in the Late Oxfordian, and progressive downlap of Haynesville (Kimmeridgian) to Cotton Valley (Valanginian) siliciclastics and carbonate units onto newly formed oceanic crust from 154 to 137 ma.