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Crustal and lithospheric architecture of the Gulf of Mexico and its continental margins from ambient noise Rayleigh wave tomography

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The Gulf of Mexico formed as a result of continental breakup between the North and SouthAmerican plates and a short period of seafloor spreading in the Late Jurassic-Early Cretaceous. This small ocean basin offers an opportunity to further our understanding of continental rifting processes and the geologic evolution of continental margins during and after rifting. However, previous knowledge of lithospheric structure has been limited to crustal investigations. We constructed a 3D shear-wave velocity model for the Gulf of Mexico region using cross-correlations of the ambient noise field and measurement of vertical component Rayleigh wave phase velocities in the period band 15 to 95 s. We employed continuous data recorded by more than 500 stations in seismic networks in the US, Mexico and Cuba. Our model shows distinct variation in lithospheric structures that reliably identify and constrain the properties of extended continental and oceanic domains. We estimate the depth of the lithosphere-asthenosphere boundary to be in the range of 85-100 km with the thinnest lithosphere under the oceanic region. A low velocity zone is observed below the lithosphere centered at ~150 km depth with a minimum shear-wave velocity of ~4.45 km/s. Lithospheric mantle underlying the offshore Texas Gulf Coast between oceanic lithosphere and unextended continental lithosphere is characterized by reduced shear-wave velocity. This might indicate that extension resulted in permanent deformation of the continental lithosphere. The differential thinning between the crystalline crust and mantle lithosphere suggests that the extended continental lithosphere has cooled and thickened by approximately 30 km since breakup.