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# Evidence of a Volcanic Rifted Margin: a Velocity Model for the Gulf of Mexico Basin Opening Seismic Refraction Project

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The Gulf of Mexico Basin Opening marine seismic refraction project (GUMBO) is a study of the lithological composition and structural evolution of the Gulf of Mexico (GoM) that uses Ocean Bottom Seismometer (OBS) data from four transects in the Northern GoM. Our analysis focuses specifically on line 4, the easternmost transect which extends over ~500 km from the continental shelf near Gainesville across the Florida Escarpment to the deep water GoM. Shear-wave first arrivals are picked from eleven out of the 39 OBS shot records in order to perform a tomographic inversion. The resulting shear-wave velocity model is used in conjunction with a previously constructed P-wave model to plot Vs as a function of Vp. This graph is then compared with empirical velocities from the literature for the purpose of constraining lithological composition below the transect and to make an interpretation of the structural evolution of the eastern GoM.

The crust landward of the Florida Escarpment appears from our comparison with external data to be normal continental crust. Velocities plot within ~100 – 200 m/s of samples of felsic crystalline basement shown by Brocher, 2005 and Christeson, 1996 (Vp = 6.2 – 7.0 km/sec; Vs = 3.8 – 4.0 km/sec). Seaward of the escarpment, velocities in the oceanic crust are anomalously high (Vp = 6.5 – 7 km/sec; Vs = 4.0 – 4.6 km/sec). A possible explanation for this is that early-Jurassic basaltic sheet flows formed subaerially, reducing the vesicularity found in basalts that have cooled rapidly underwater. An increased magnesium and iron content could also account for these high velocities, and would suggest that the oceanic crust formed at higher temperatures than previously thought. Earlier studies of the eastern GoM have found what can be interpreted as seaward dipping reflectors (Imbert et al., 2001) which are evidence of a volcanic rifted margin. Geometrically, the transitional crust under line 4 is relatively narrow, moving from continental to oceanic crust within ~100 km, another indication of a volcanic origin for rifting (Menzies et al., 2002).

We propose that seafloor spreading in the eastern Gulf of Mexico may have been sub-aerial. Pillow basalts would not be produced without the presence of seawater, and the high seismic velocities at the seaward end of GUMBO line 4 suggest the absence of this type of lithology seaward of the Florida Escarpment.

**Keywords:** Gulf of Mexico, shear wave, velocity model, tomographic inversion, volcanic rifted margin, structural evolution, geologic history