South Atlantic Offshore Geologic Assessment for Carbon Storage in the Southeastern United States Based on Rock Physics and Seismic Analyses

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Rock physics analyses of laboratory measurements on targeted Jurassic/Cretaceous sandstones and carbonate rocks along the South Atlantic seaboard are interpreted as part of the Southeast Offshore Storage Resource Assessment (SOSRA) research project funded by the U.S. Department of Energy. These analyses have included integration of 2- and 3-D seismic surveys with core samples and geophysical well logs leading to a detailed stratigraphic, structural, petrophysical, and injection simulation model showing the heterogeneity and highly complex tectonic evolution of the target reservoirs of the Eastern North American Margin (ENAM). ENAM is a complex and regionally extensive, mature Mesozoic passive margin rift system encompassing: (1) a large volume and regional extent of related magmatism, (2) a complete stratigraphic column that records the post-rift evolution in several basins, (3) preserved lithospheric-scale pre-rift structures including Paleozoic sutures, and (4) a wide range of geological, geochemical, and geophysical studies both onshore and offshore. Using legacy industry 2-D seismic reflection and well data, this assessment is the first application of multiple seismic inversion techniques in this area. This work proves a reliable and replicable workflow of model-based inversion that provides the tools to discriminate lithology and predict porosity. The inversion results indicate that there are distinct porosity and permeability regimes within the Upper Cretaceous strata of the SGE. The impedance and porosity relationships show well-founded and reliable correlations. These

relationships reveal low seismic impedance to coincide with high porosity intervals identified on well logs and which are proposed as potential CO2 storage reservoirs. The acoustic impedance results show that the Upper Cretaceous strata have two main potential reservoirs that are overlain by a thick impermeable interval, mostly shale which has high seismic impedance, low porosity, and low permeability. The extracted values of porosity, ranging from 15 to 36 %, and permeability, ranging from 1 to 100 mD, are close to the measured values from the well core data at the Upper Cretaceous strata interval.

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