Geophysical, Geomechanical, and Computed Tomography Characterization of Potential Reservoirs and Seals for Carbon Storage, Offshore Southeastern U.S.

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Abstract

Geologic carbon sequestration is emerging as a viable method to curb anthropogenic CO2 emissions. With 40% of the United States' total CO2 emissions originating in the Southeast, proximal geologic storage sites are being characterized to reduce the region's carbon footprint. Funded by the Department of Energy, this multi-study project aims to estimate the CO2 storage potential for the Southeast United States Atlantic Continental Margin. Previous studies in this geologic region generated a velocity model, interpreted 2D seismic and wireline data, recommended prospective reservoirs and seals, and quantified between 16 Gt to 175 Gt of storage potential within the Upper and Lower Cretaceous formations of the Southeastern Atlantic Continental Margin. This research project will serve to ground-truth previous findings using drill core from the COST GE-1 well to characterize prospective reservoirs and seals, determine CO2 storage suitability, and refine previous estimates of storage potential using experimental rock physics, computed tomography (CT) scanning, and high-resolution core logging. Eight depth intervals of ¾-slabbed COST GE-1 drill core were selected within recommended seal and reservoir intervals. Non-destructive medical CT scans of 0.35-0.55 millimeter resolution were conducted and utilized as a proxy for rock density. The core was then logged using a high-resolution, non-destructive Multi-Sensor Core Logger (MSCL) to measure P-wave velocity, gamma density, fractional porosity values, and

X-ray fluorescence (XRF). These CT and MSCL results were used to identify zones of interest and select precise depths to extract seven competent 1 inch x 2 inch core plugs from the predominant lithology. Non-destructive industrial CT scans of 30-42 micrometer resolution were performed on each core plug to highlight the presence of fractures, pore space, and unique mineralogy. From these scans, 3D models of porosity and fracture networks were generated using ImageJ. Following the non-destructive analyses, the seven core plugs underwent physical property testing in a Helium porosimeter and pulse-decay permeameter and destructive mechanical testing in the AutoLab 1500 to measure permeability, P-wave, S-wave, resistivity, Young’s Modulus, and Poisson’s Ratio. Following the experiments, suitability of the recommended reservoir and seal intervals were revisited and the total volume for CO_2 storage was refined.

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