EFFECTS OF MICROORGANISMS ON THE MECHANICAL AND TRANSPORT PROPERTIES OF MUDSTONES DURING EARLY DIAGENESIS

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ABSTRACT

This research investigates the influence of microbial activity on the mechanical and transport properties of mudstones during early diagenesis. Despite the proven presence of microbial communities in marine sediments to depths of >500 meters below sea floor, little is known about the interactions between microorganisms and sediments, especially during the early stages of diagenesis. To characterize and quantify the impact of microbial activity on mudstone properties, I compare natural mudstone samples treated with iron reducing bacteria Shewanella Oneidensis MR-1 to those without treatment. Two bulk mudstones are experimentally prepared using sediments from Integrated Ocean Drilling Program Sites U1319 and U1324 in the Brazos-Trinity and Ursa Basins, Gulf of Mexico. The obtained sediments are dried and ground to clay- and silt-sized particles and homogenized into two natural mudstone powders. These powders are used to make reproducible mudstone samples through a process called resedimentation, which replicates natural deposition and burial. Changes in microstructure, porosity, compressibility, and permeability are measured while the biotic (with bacteria) and abiotic (without bacteria) mudstones are being uniaxially compressed to a maximum stress of 100 kPa. I anticipate that biofilm growth in pore spaces will decrease porosity, permeability, and compressibility, and the resultant microstructural changes created by microorganisms will be evident in high-resolution scanning electron microscope (SEM) images. Recognition of the micro-scale processes that take place during the early stages of mudstone diagenesis, especially those mediated by microbial activity, and their long-term effects on mudstone properties can lead to better identification and increased production efficiency of unconventional reservoirs.

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