Lithologic Descriptions and Properties of Non-Reservoir Sediments in the Gulf of Mexico

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Non-reservoir sediments that occur within and as bounding lithologies to young Miocene to Pleistocene age reservoirs in the Gulf of Mexico are dominated by mudstones and claystones but there are also marls, volcanic ashes, carbonates, and cemented silts and sands present. The properties of these non-reservoir sediments, particularly the mudstones and claystones, are critical to understand as they are important to interpretations of 1) seal capacity, 2) fluid flow baffles and barriers, and 3) seismic interpretation.

Mudstones contain 1/3 to 2/3 silt-size particles and are the most common non-reservoir sediments that are found within and directly bounding reservoirs. They are part of the waning flow and suspension fallout; in deepwater deposits these are often referred to as the T_{et} turbidite facies. Claystones contain <1/3 silt-size particles. They often contain some forams and coccoliths but the percentage is low. The claystones represent final suspension fallout and hemi-pelagic "rain" of material; in deepwater sediments these represent the T_{et} to T_{ep} turbidite subdivisions. Marls contain >30% calcareous material (mostly microfossils) and the remainder is pelagic clay. Detrital carbonate is not present in marls but will be present in mudstones. Distinguishing the types of carbonate is important for depositional interpretations. Marls form in the basin during the transgressive to highstand systems tracts (condensed section deposits) and are often regional markers.

The properties of the non-reservoir sediments are quite variable depending on the silt, clay, and carbonate content as well as on the age, pressure, and temperature. Clay diagenesis is important, particularly the smectite to illite transition that starts occurring from 70 to 100°C, but it is not the only factor controlling the quality of the seals, baffles/barriers, and geophysical properties. Porosities of the mudrocks may range from a few percent to 20+% but the permeability, measured in stressed cells, is always in the micro- to mostly nano-darcy range. Where the mudstones and claystones are laterally continuous within the reservoir, they can be very effective transmissibility barriers. In addition to these petrophysical properties, we have used unstressed and

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stressed (up to 55,000 psi) mercury/air and stressed soltrol/brine capillary pressure measurements to obtain entry pressures in all of the types of mudrocks mentioned above. The soltrol/brine measurements are long tests (weeks to months) but are significant for comparison to and for standardization of the mercury/air measurements. True reservoir and fluid properties are used to interpret these seal capacity measurements with information on the interfacial tension and wettability important to proper interpretation. A variety of mudrock types are good capillary seals, with the capacity of holding significant hydrocarbon columns – up to 3000' (915 m) or more. Even though the sediments may be locally effective seals, it is critical to know both the lateral extent and quality of the mudrocks to evaluate the seal potential and trap integrity. The microscopic and field scale measurements are both important and seismic to laboratory measurements are made to evaluate the effectiveness of the sealing sediments. Representative bounding and intra-reservoir non-reservoir sediments from deltaic and deepwater settings, along with their lithologic, petrophysical, and seal capacity measurements, will be presented.