The Wafra Field First Eocene Carbonate Reservoir Steamflood Pilots: Geology, Heterogeneity, Steam-Rock Interaction

Meddaugh, William *1; Osterloh, W. Terry 1; Gupta, Ipsita 1; Rowan, Dana 1; Champenoy, Nicole 1; Gonzalez, Gregorio 1; Toomey, Niall 1 (1) Chevron, Houston, TX.

The Paleocene/Eocene age First Eocene dolomite reservoir is a candidate for continuous steamflooding due to its large resource base and low estimated primary recovery. There are currently two steamflood pilot projects in operation to evaluate reservoir response to steam injection: a 1.25-acre, single pattern pilot (SST) and a 40-acre, 16 pattern pilot (LSP) are in progress. The densely sampled pilot’s provide a unique opportunity to assess reservoir heterogeneity and its impact on steamflooding. At the SST, an interval with abundant tidal flat cycle caps characterized by muddy, finely crystalline dolomites may be responsible for the observed vertical barrier to steam migration. Detailed studies, including micro-permeameter measurements, quantitative mineralogical studies, micro-CT scans were used to further characterize the permeability heterogeneity of this interval as have fine-scaled dynamic modeling. Geological data obtained from the LSP suggest that similar vertical barriers may exist in the pilot area. Early steamflooding results show multiple thermal “events” (most likely baffles rather than barriers) in the lowermost flooded zone. The early LSP data from this zone allows inferences to be made regarding the occurrence and distribution of lateral high permeability “connections” between injectors and producers. While the rapid temperature response observed in a few wells may reflect local fractures or karst zones, numerical simulation using very fine grids (1.25 m cell size) shows that some of the LSP wells will experience relatively short breakthrough times without the need for fracture or karst-like zones.

Over time, injection of high temperature, high pH fluids may complexly affect the fluid flow field, the thermal field, and the fluid/rock interactions near well, and in the reservoir. This in turn could affect storage capacity, production and injectivity. 2D reactive transport models (RTM) were run to simulate high pH, steam injection into the First Eocene dolomite reservoir for a continuous injection period of 6 months to a year, with the objective to understand changes in mineralogy, coupled with porosity change and potential scaling issues. Initial results predict precipitation of calcite and brucite, dissolution of dolomite, and conversion of gypsum to anhydrite. Sensitivity studies are currently ongoing involving steam quality, rock surface area, reaction rates, and mineralogy of evaporites.