Characterization of Asphaltene Precipitation and Wettability Alteration Effect on Residual CO_2 Trapping in Carbonate Oil Reservoirs

ALI AL-MENHALI[*,1,2], SAM KREVOR[1,2]

[1]Department of Earth Science and Engineering, Imperial College London
[2]Qatar Carbonates and Carbon Storage Research Centre, Imperial College London
([*]correspondence: a.al-menhali12@imperial.ac.uk)

Observations and modelling have shown how residual trapping leads to the immobilization of CO_2 in saline aquifers, limiting the extent of the CO_2 plume migration, enhancing the security and capacity of CO_2 storage. Most major carbon storage projects currently in operation, however, are located in oil fields due to the potential for enhanced oil recovery. Unlike the water-wet saline aquifers, carbonate oil reservoirs are characterized by a mixed-wet state. There are, however, no observations characterizing the extent of capillary trapping that will take place with CO_2 in mixed-wet rocks. Residual saturations were measured on a single limestone sample before and after wettability alteration with crude oil. A characterization of the asphaltene precipitation of the crude oil aided in the design of the wettability alteration process. Here we show that residual CO_2 trapping in mixed-wet carbonate rocks characteristic of oil reservoirs is significantly less than trapping in water-wet systems characteristic of saline aquifers. Our results show that one of the key processes for maximizing CO_2 storage capacity and security is significantly weakened in oil reservoirs relative to saline aquifers. We anticipate this work to highlight a key issue for the early deployment of carbon storage – that those sites which are economically most appealing as initial project opportunities are the very locations in which the contribution of capillary trapping to storage security will be minimized.