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Li, Ming; Mokhtari, Rasoul; Afrough, Armin; Larsen, René Wugt; Feilberg, Karen Louise

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*Ming Li, Rasoul Mokhtari, Armin Afrough, René Wugt Larsen, Karen Louise Feilberg**

The degree and rate of oil displacement largely depends on interfacial properties of solid-oil-water systems, which are determined by physicochemical properties of oil, chemistry of water, and characteristics and wettability of the reservoir. Understanding the interfacial phenomena involved in petroleum production, such as oil recovery and oil-water emulsions, is critical for developing novel processes to improve oil production while reducing GHG emissions and other environmental impacts at a lower operating cost. Therefore chemical "surgery" was performed at the isolated interface between crude oil and chalk which governs the wetting properties. On the crude oil side, the ageing experiment was performed using pure $CaCO_3$ powder. The isolated layer is around 0.5 nm, which is calculated from AFM-IR data. These compounds were collected and analyzed by FTIR and XPS. The interface residues have more COOH and OH groups, and more N elements than the crude oils. The S element has also been found at interface, just at much lower concentrations. On the chalk reservoir side, cores from water flooding experiments were used in the measurement. The isolation at nm level is challenging, so the work was performed within a few microns depth via EDS analysis. The element Ca is relatively reduced after water flooding and other elements increase, including Si, Al, Mg, Sr, Ba and Na, some of these with correlation. The reasons for these increases are different for the individual elements but originate in the geochemical processes during water flooding.