# Atomic Force Microscopy (AFM) Study of Wettability Modification in Sandstones

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Atomic Force Microscopy (AFM) is a technique to characterise surfaces at length scales ranging from the microscale to the nanoscale. It has the potential to carry out 3D imaging of the surface topography and give information about interaction forces at mineral surfaces. In this study, the capabilities to investigate the mineral-water interface with AFM will be presented based on an example of mineral modification in Bandera Brown.

By utilizing an AFM tip functionalised with oil components, the wettability of a mineral surface can be ascertained from the adhesion forces between its pore surfaces and these oil components as the tip is scanned over the sample surface. This process is quite useful in Enhanced Oil Recovery (EOR) for determining conditions in the pores of reservoir rocks.

However, the difficulty lies within the fact that reservoir cores, particularly sandstones containing iron-bearing clay minerals, once brought to the surface, become oxidized, thus deviating from anaerobic, reducing conditions within the rock formation. Expectedly, experimental results obtained using these oxidised cores differ substantially from field tests, as wettability is observed to vary depending on the redox state.

In this work, AFM will be used to study the possibility for modifying the wettability of the mineral surfaces of a clay-containing outcrop sandstone, Bandera Brown, by measuring the interactions with both polar and non-polar oil components like $-NH_2$ and $-CH_3$ end groups, respectively. Conversion of surficial ferric ions to ferrous ions will be achieved using a reducing agent. The effect of this change in the redox state will be ascertained by drawing parallels with experiments performed on a pure iron-bearing mineral, Hematite.