

Breakout Session Day 2 How to Identify fingering before it happens.:

Fingering meant different things to different people. Once we identified all the definitions of fingering, then we looked at ways to predict where fingering would occur.

Fingering is water or gas out racing the oil to the perforations in the well causing production problems. Fingering is high permeability streaks within a sand. It is also water or gas channeling behind pipe. It could be due to karst limestone layers. Faults and fractures may move the water or gas to the well before the oil. Simple coning is a form of fingering or water encroachment at different rates in different areas of the reservoir.

The many different fingering possibilities brought about just as many ways to predict where and when they would occur. We lumped these predictions into modeling and measurements.

Measurements needed to predict fingering:

Well data from drilling (rop, gas chromatograph, kicks and losses) and from logging (open hole and cased hole). The well data could be used directly from the raw or processed data or could be used to provide the foundation for property modelling within a static or dynamic model.

Typically the interpretation of fingering prone areas would show up as anomalies. Sudden increase in the rate of penetration, changes in gas readings, kicks, losses are areas that might be where fingering would happen and would require close examination.

Gamma ray, resistivity, neutron, density, pulsed neutron, carbon oxygen, sonic and other anomalous open hole and cased hole measurements could pin point areas prone to fingering. Cross well tomography, time lapse logging, permanent gauges for temperature and pressure can give advanced warning about fingering of fluids. Interference testing within the well or well to well would help describe kv/kh and communication between zones and wells. Monitoring during logging of pressure from MDT and later timely monitoring of PBU, PGOR, Pulsed neutrons, plts give evidence as to where fingering is about to happen. CBL/Images of cement channels are predictive tools.

Reservoir models can predict fingering:

Static, dynamic, and geomechanical models can predict fingering. Flow unit definition by interrogating k/phi, Dykstra Parsons coefficient predict fingering. Structure, stratigraphic and diagenesis modeling predict fingering. Modelling of fluids can predict areas in the reservoir prone to fingering.

Best Practices to mitigate fingering:

Don't frac into the water zone. Limit production and produce using smart completions and chose the placement of injections zones to reduce fingering effects.

