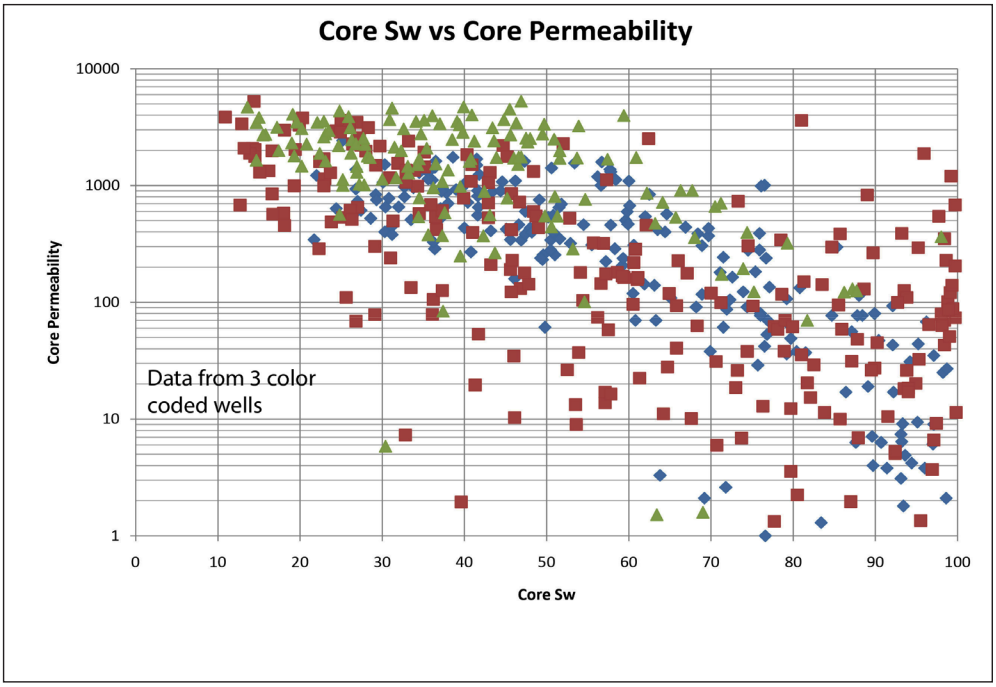
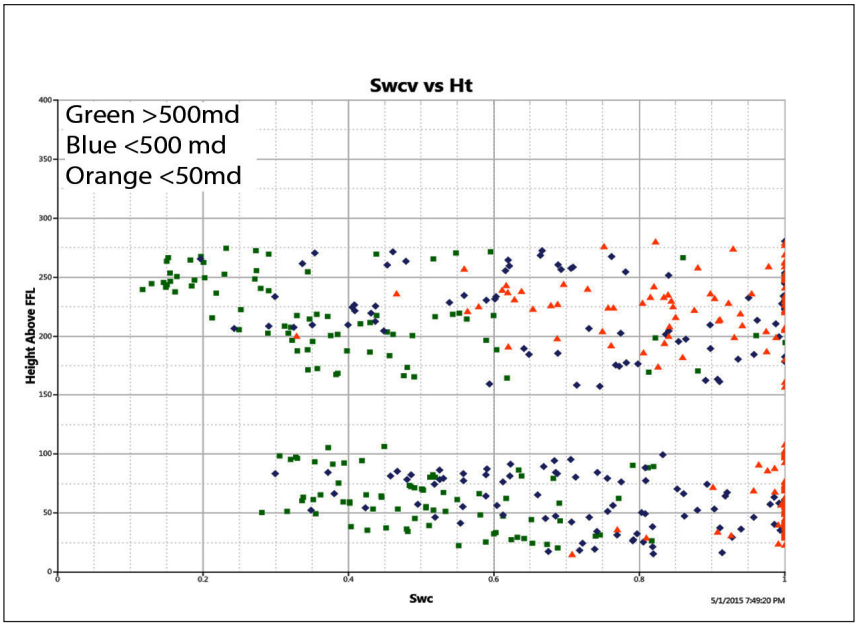
Deriving Pseudo-Capillary Pressure Curves From Standard Core Analysis Data in Heavy Oil Reservoirs

Original Sw is needed for OOIP estimates, but in many reservoirs cannot be calculated from the existing logs. Capillary pressure data can be used to calculate original Sw, but for many reservoirs Pc measurements are not available. We have developed a method for deriving pseudo-Pc curves from standard PKS core analysis data in heavy oil reservoirs. The oil's low mobility greatly reduces flushing and the measured saturations are close to reservoir values. This plot of core Sw vs core perm clearly shows that Sw increases as permeability decreases, just as expected from capillary pressure.





A plot of Sw vs K for two wells at different heights above the oil/water contact is shown with permeability ranges color-coded (left). High-perm rocks have lower Sw than low-perm rocks. The spread of data to the right indicates depletion in some samples. This dataset demonstrates the influence of capillary pressure on reservoir saturations.

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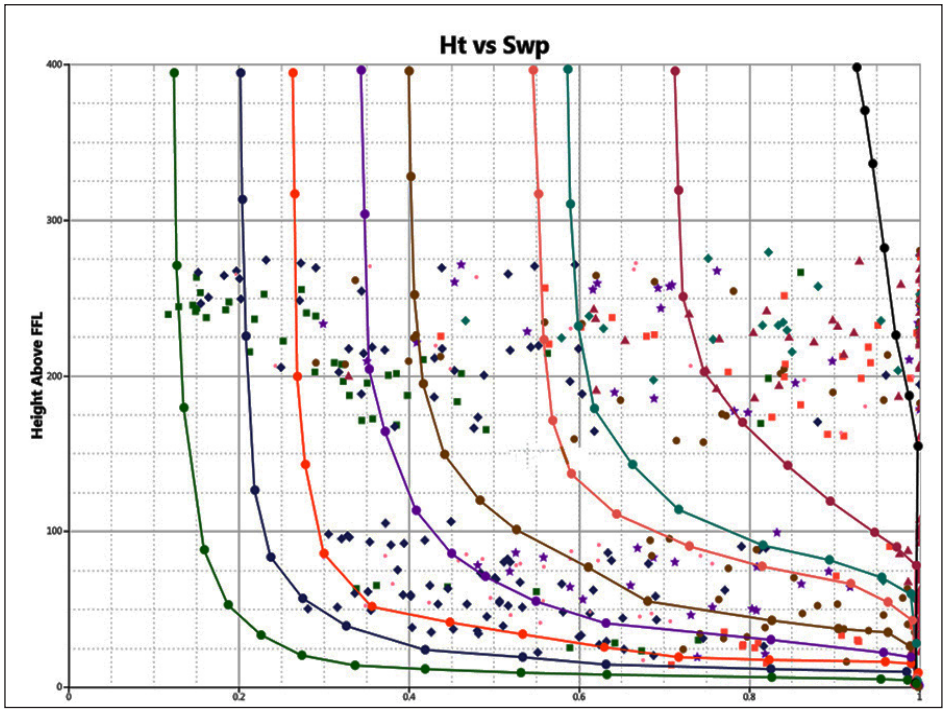
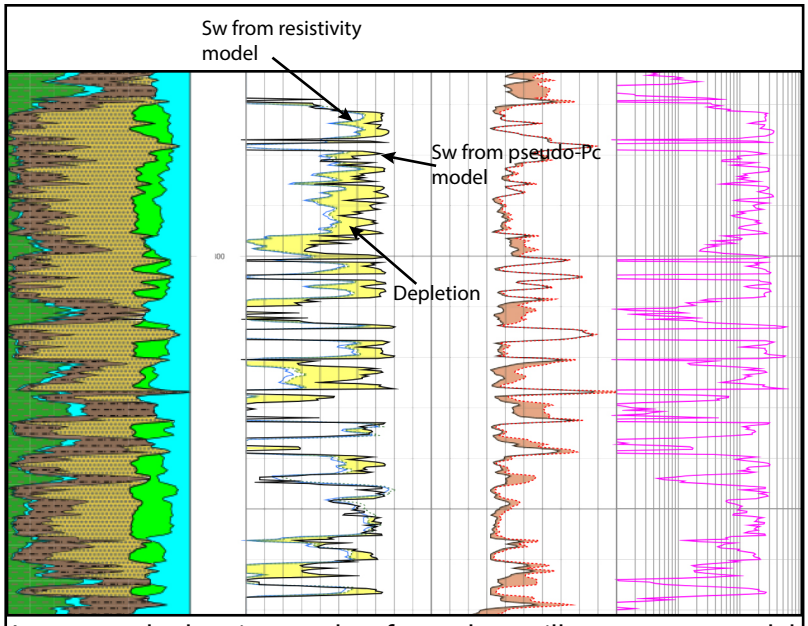
To apply this method, first explore the dataset to select the best permeability groupings for the available samples. Binning the data into appropriate groups is very important, and will require trial and error to find the best distribution for each dataset.



Then, fit a pseudo-capillary pressure curve to each group. Fit the curve to the low-Sw edge the dataset, and give it the characteristic shape of a capillary pressure curve. The plot (left) shows the full set of fitted curves color-coded to their permeability group. The log plot below illustrates the results of using the pseudo-Pc curves in a saturation model in the same way laboratory curves would be used.

In this example, the upper sand shows some depletion from production, as expected based on the history of the field, but the lower sand has little to no depletion. Even after decades of production, this analysis shows that the lower sand is still a good target for development.



Log example showing results of pseudo-capillary pressure model compared to resistivity-based Sw

Reference: Olson, Deborah M, and William R. Berry II, "Deriving Pseudo-Capillary Pressure Curves From Standard Core Analysis Data in Heavy Oil Reservoirs and Their use in Estimation of Original Sw", PSAAPG Meeting, May 3-5, 2015, Abstract