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Evaluation of Fluid Communication Between Gas Caps and Oil Legs: Applications to Reservoir Characterization and Identifying Down Dip Oil

Although evaluating fluid communication between reservoired oils is an established gas chromatographic (GC) technique, defining fluid communication between a gas cap and oil leg is difficult because of partitioning and phase separation effects. Furthermore, formation evaluation techniques used to define compartmentalization may be limited by variations in reservoir facies and fluid type. However, fluid communication of gas-liquid phases can be effectively evaluated using GC fingerprints defined from gasoline range (C5 - C10) hydrocarbons, which display limited fractionation between equilibrated gas and liquid phases. Gas isotope fingerprints and fluid inclusion properties also assist in gas cap–oil leg correlations.

Gas cap studies and down dip oil predictions from different regions help identify applications and constraints of this integrated reservoir geochemical approach. In the Barrow Sub-basin (Western Australia), fluid communication between a Mardie Greensand gas cap and underlying oil in the Barrow Group was evaluated in two separate structures to predict down dip Mardie oil. In the first structure, gasoline range fingerprint differences are less than the expected partitioning effects between the equilibrated phases suggesting fluid communication. The indication of a commercial down dip Mardie oil leg was confirmed by a subsequent horizontal well. In a nearby structure, fingerprint differences are much larger than partitioning effects indicating permeability barriers between the two reservoirs; drilling results confirmed a Mardie gas accumulation.