Production Contribution Analysis by Data Driven Fingerprinting for Unconventional Wells

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Abstract

Horizontal drilling of unconventional resources can involve penetrating thin layers and different formations with well production characteristics further complicated by fracking. Sampling produced oil along the wellbore at specific intervals for hydrocarbon characterization in a lateral production well would be impractical and expensive. Molecular fingerprinting of rock cuttings collected during drilling can be a cost-effective way to provide a better understanding of hydrocarbon composition and production contribution within a lateral well. Molecular fingerprinting is a well-established tool for identifying sources of oil spills and contamination. Additional studies have shown that statistical techniques can use the molecular fingerprint of a commingled sample to identify the end member contribution from different wells. Thus far, molecular fingerprinting for single well applications is relatively unexplored. Molecular fingerprinting by data driven methods utilizes principal component analysis (PCA) to extract a subset of peaks with maximum diversity and independency from gas chromatography mass spectrometry (GCMS) data. Peak assignment from GCMS measurements was used to train the machine learning model to extract diagnostic peak ratio features. A system of machine learning methods is used to evaluate each feature's ability to discriminate samples and determine representative features showing variation between different formations or sublayers. Star diagrams of these representative features provide a distinct pattern for each formation. Deep learning regression methods are used to quantify end member contributions to the commingled produced oil. This case study presents a thorough analysis of rock cuttings gathered at various depths along a single wellbore. The wellbore was drilled with water-based mud and samples were bottled

with fresh water. An integrated analysis of headspace gas, extracts from water, and extracts from the rock chips was conducted for each sample. Molecular fingerprinting of sublayers and formations within a single well using machine learning and data driven methods has the potential to provide valuable information of production contribution and tools for monitoring and evaluating lateral well production. Periodic measurements during production can show changes in production contribution over time and detect unexpected contributions such as invaded fluids into the well.

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