# Improving Reserve Estimates in the Uteland Butte Play Via More Accurate Quantification of Mobile Oil Saturations

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## Abstract

This study was to improve reserve estimates and primary production forecasts of the Lower Green River Formation via more accurate quantification of mobile oil saturations. That zone contains some of the largest in-place oil volumes of any unconventional petroleum reservoir in the Uinta Basin. Traditional EUR calibrations to total oil and/or vaporizable oil may misrepresent primary depletion recovery in these reservoirs. A novel method of low temperature hydrous pyrolysis (EZ-LTHP) was used, in which 28 cuttings samples were heated in a closed reactor vessel in the presence of a liquid water phase to mobilize retained oil. The workflow was implemented to quantify "vaporizable oil", "mobile oil", "total oil", and "Enhanced Oil Recovery (EOR) oil" saturations using as-received, post-LTHP, and post-solvent extracted total organic carbon (TOC) and programmed pyrolysis data. Additionally, to evaluate the suitability of this method for production allocation of these waxy crudes, the mobile oil characteristics were assessed using High-Resolution Gas Chromatography (HRGC) fingerprints of select LTHP oils. In these Eocene unconventional reservoir samples, the traditional oil saturation methods yield very different results: total oil (avg. 116 bbl/a-ft) and vaporizable oil (avg. 41 bbl/a-ft). However, mobile oil saturations are intermediate (avg. 63 bbl/a-ft), highlighting how use of either total or vaporizable oil as a proxy for mobile oil is misleading for reserve estimates. The discrepancy between total oil and mobile oil is a component of non-mobile waxy oil, likely sorbed onto kerogen or illitic clay in marlstone intervals. In contrast, vaporizable oil underestimates mobile oil in most zones due to their non-volatile nature. HRGC fingerprints of LTHP mobile oil are characterized by good retention of light-end compounds suitable for production allocation and n-alkane envelopes that contain >C20 waxy alkanes which are common components in Uinta Basin production oils. This study provides a step-change by quantifying the mobile oil fraction and, when paired with reservoir volumetrics, allows for better reservoir model calibration and field management by using the novel EZ-LTHP workflow detailed herein. Other industry techniques, such as solvent extraction and vaporization, suffer from the same limitations as log-derived values which are illustrated in this study to be a poor proxy for mobile oil and potentially misleading for reserve estimates.