

Geochemical Surveillance to Reach Full Reservoir Potential in Ecuador Fields

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Summary

Block 61 is one of the most prospective areas in Ecuador. It is subdivided into 17 fields, with seven main reservoirs. Due to government regulations, the reservoirs were being produced sequentially, opening a new one when the production became uneconomical. This limited the real potential of these fields. Multi-zone production had been evaluated and applied as Dual completions. However, the high costs and completion specifications disfavored their use. Hence, it was imperative to find a production alternative to accelerate recovery and increase return.

In this study, we use geochemical high-resolution fingerprinting and a dedicated software application to back-allocate commingled oils producing from up to four reservoirs. Currently, more than 30 existing commingled wells in the block are being monitored using geochemical fingerprinting, showing a significant production increase as direct results of the multi-zone production strategy, while optimizing cost. The surveillance of the wells also generates additional information to enhance reservoir management.

Workflow

Geochemical fingerprinting is a fast, cost-efficient, proven technology alternative to traditional approaches for production back-allocation (McCaffrey et al., 2011, Rojas et al., 2013). One of the challenges faced in the Block 61 study was the inability to collect selective oil samples from the various sands of interest in commingled wells. The workflow in this project involved evaluation of compositional variations across the field, and reservoir continuity aspects, to assess the use of oil from different wells as analogue endmembers, following a carefully designed sampling campaign.

A production allocation feasibility evaluation conducted with candidate analogue end-member oils confirmed the suitability of the methodology. Distribution factors for commingled production from up to four reservoirs were calculated using a dedicated geochemical production allocation software application, based on the distribution or errors of interparaffinic peak ratios. The used computation tackles issues related to changes in composition of endmembers during production and allows management of uncertainties (Nouvelle et al., 2012).

The geochemical allocation values were further validated with Production Logging Tool (PLT) results.

Results, Observations, Conclusions

The High-Resolution Gas Chromatography (HRGC) fingerprints of evaluated analogue end-member oils from five reservoirs indicate biodegradation to various levels, affecting normal and isoprenoid alkane distribution (Fig. 1). Lateral compositional changes are also observed.

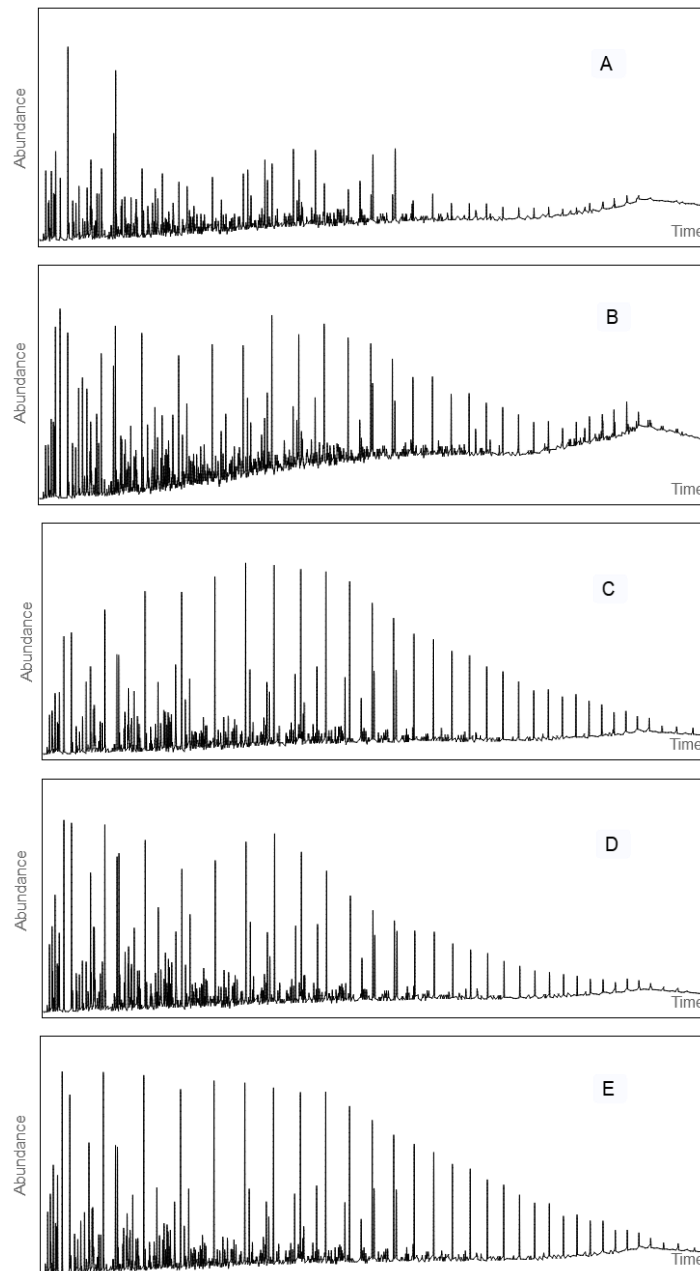


Figure 1: High-resolution gas chromatography (HRGC) fingerprint of samples from the four investigated reservoirs

Fig. 2 shows a chemical distance analysis comparing geochemical fingerprints of potential end-member oils from the four reservoirs for potential commingled production. Distances above the significant threshold, shaded in blue, correspond to samples with distinguishable fingerprints. The greater the distance, the higher the likelihood these oils will be differentiated in mixtures.

Laboratory mixtures, prepared for calibration and validation, corroborated the feasibility of multi-zone production back-allocation using geochemical fingerprinting. Table 1 shows examples of the results of this process using laboratory mixtures as unknowns. The reported interquartile range (IQR) is used as a parameter to assess end-member oils representativeness and its possible compositional variations through production time.

Additionally, a fit-for-purpose sample distribution, and comparison through chemical distance analysis provided good understanding of lateral variations and continuity aspects, allowing the selection of the most representative end-member oils for each of the wells already under commingled production, as well as candidates for future multi-zone production.

This methodology currently enables routine production back-allocation and surveillance of more than 30 commingled wells, with a frequency defined by the production strategies (Mejia et al., 2024). A production increase has been observed since the campaign started in 2021, as direct result of the multi-zone production and adequate allocation.

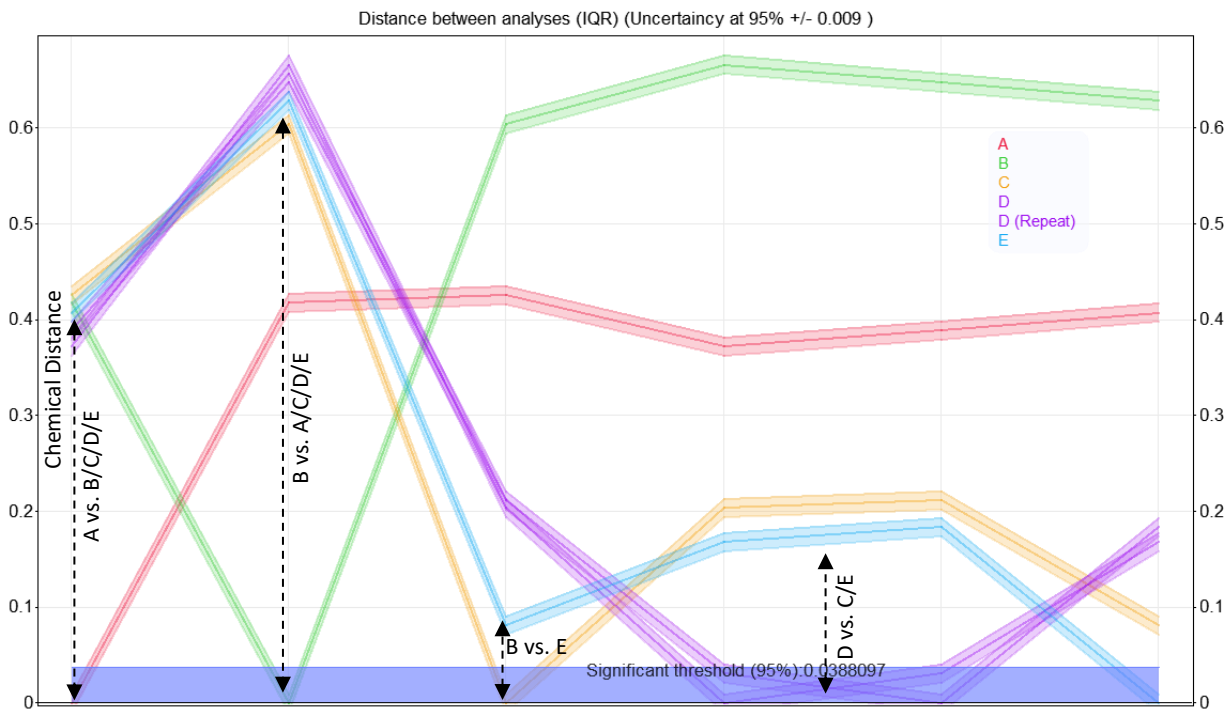


Figure 2: Chemical Distance Analysis comparing potential analogue end member oils

Table 1: Example of the results of validation of the production allocation computations using laboratory mixtures

Sample	Actual Proportions		Computed Proportions				IQR
	End-Member A (%)	End-Member C (%)	A (%)	±	C (%)	±	
Mix 1	90.5	9.5					
Mix 2	47.3	52.7					
Mix 3 (Validation)	8.3	91.7	7.4	1.3	92.6	1.3	2.7

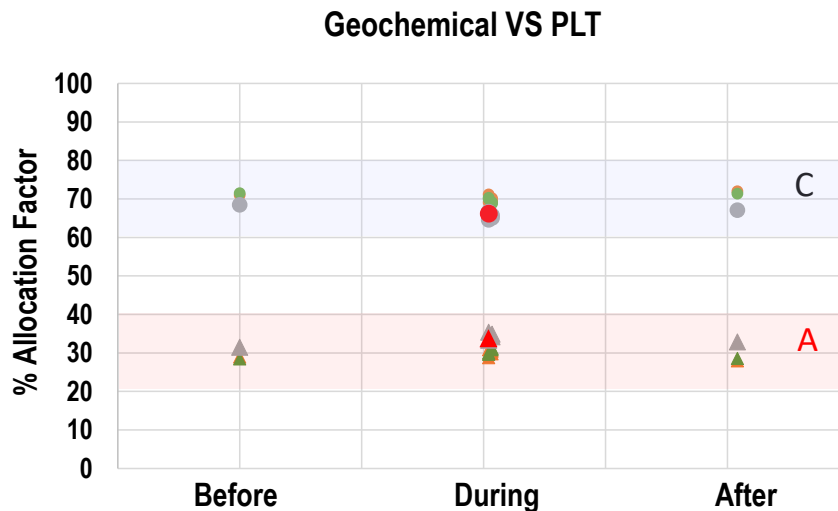


Figure 3: Comparison of PLT and geochemistry back-allocation results. Geochemical production allocation was conducted with samples collected before, during and after PLT measurement

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