

Enhancing Production Allocation Accuracy Using PVT-Derived Compositional Analysis

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Outline:

- Utilizes GC data from PVT studies to analyze fractions up to C36+ for better production allocation.

Outcome:

- Enhances allocation accuracy, reduces uncertainty, and improves reservoir management cost-effectively.

Requirement:

- One time BHS sampling
- Only monthly STO samples; applicable to heavy, biodegradable, and volatile oils.

Theoretical Description:

β^k : Production Allocation

r^C : Commingled sample - Average properties at Separator conditions

r^k : End Members - Average properties by Single Flash

wt_Ci^C : Commingled - wt% fractions up to C₂₀₊

wt_Ci^k : End Members - wt% fractions up to C₂₀₊

R_s^k : GOR measured for End Members by Single Flash

R_s^C : GOR measured for Commingled sample - Separator conditions

$$F(\beta^k) = r^C \times wt_Ci^C - \sum_{k=0}^n \beta^k \times r^k \times wt_Ci^k$$

$$r^C = \frac{1}{1 + \frac{R_s^C \gamma_g^C}{\rho_{ST}^C}} \quad r^k = \frac{1}{1 + \frac{R_s^k \gamma_g^k}{\rho_{ST}^k}}$$

Development of the Method

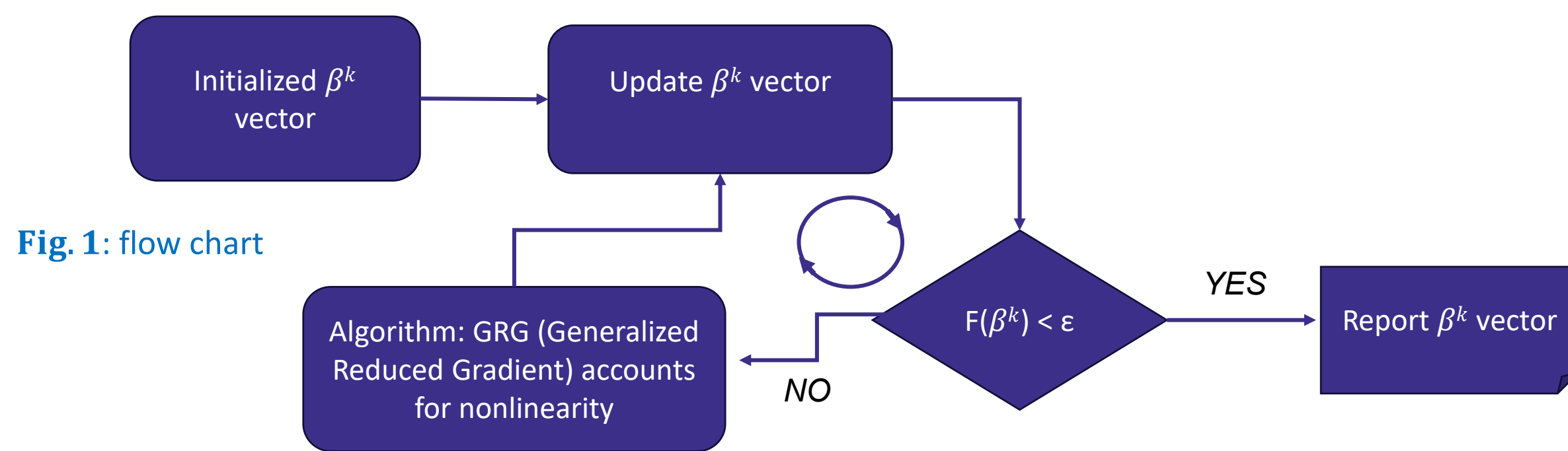


Fig. 1: flow chart

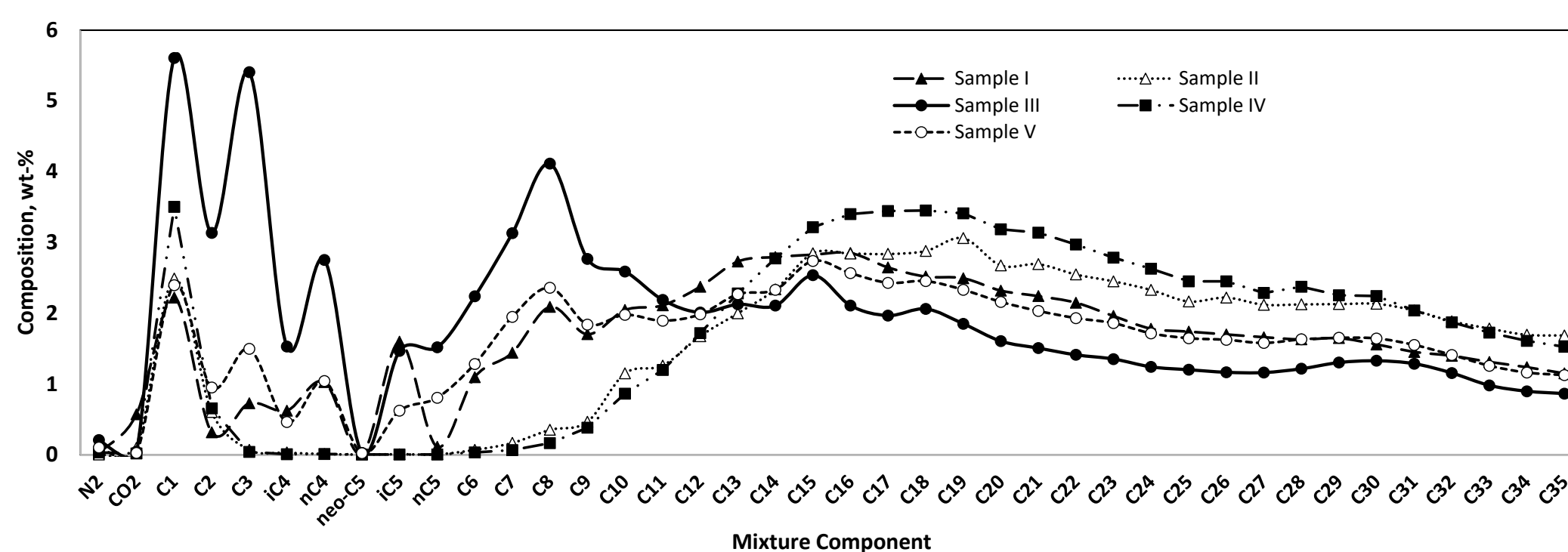


Fig. 2: Live oil composition

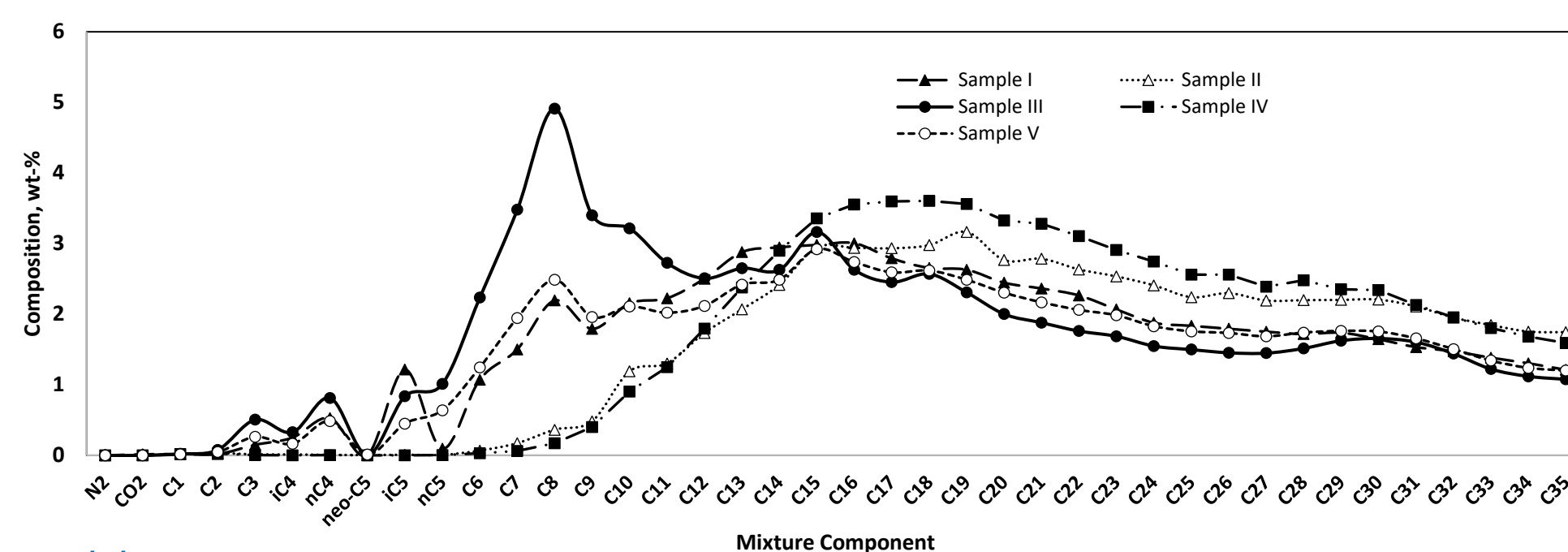


Fig. 3: STO Composition

Results and Discussion

Case 3: Five Commingled Reservoirs

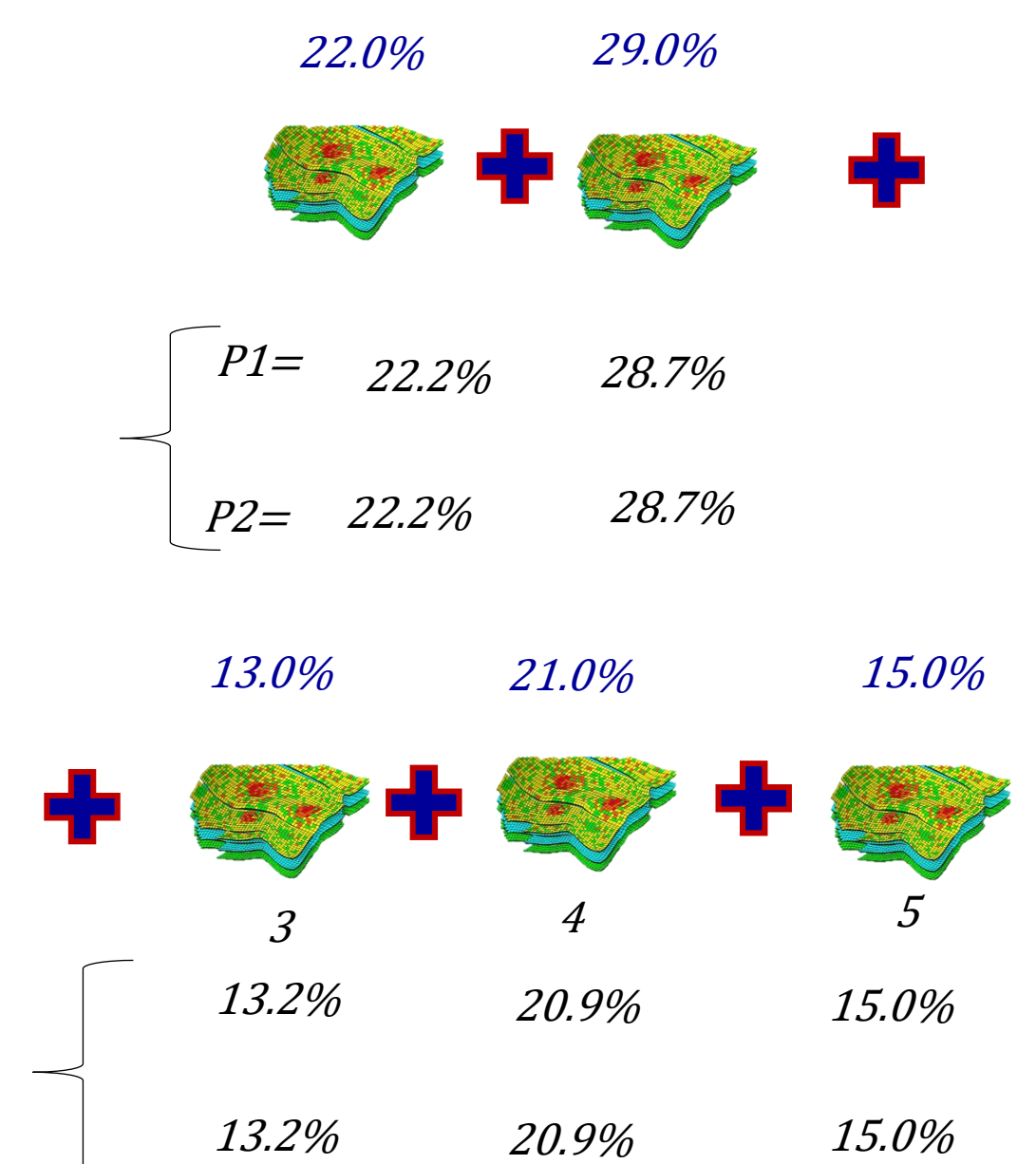


Fig. 6 Case 3

Fig. 7 illustrates the variation in allocation ratios for three reservoirs (Case 1) over ten years of production. The dashed lines show that the calculated ratios closely match across all streams, while the shut-in period of Reservoir 1 near the end of production is clearly captured by the proposed allocation

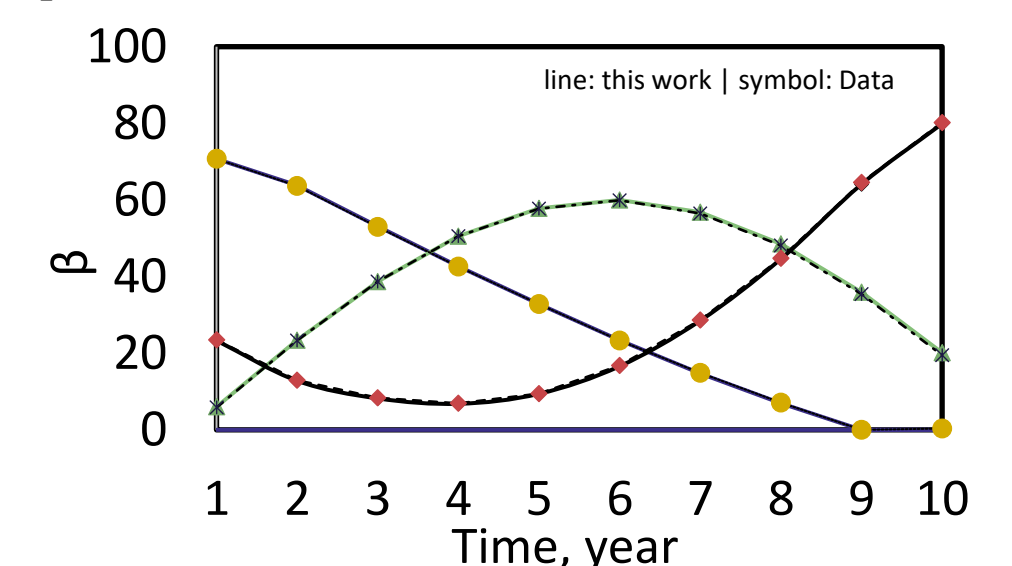


Fig. 7 Production Allocation Monitoring

Results and Discussion

- A commercial simulation model was employed to physically commingle production streams from multiple reservoirs based on defined production allocation ratios (Numerical data).
- The allocations obtained from the developed methodology were subsequently compared with the numerical data to assess its accuracy.
- Effect of complex surface process was also included (Table 1)

Table 1: surface process

Surface Process Conditions, P1		Surface Process Conditions, P2	
Pressure, bara	Temperature, °C	Pressure, bara	Temperature, °C
85.0	60.0	50.0	40.0
35.0	40.0	10.0	30.0
1.0	15.0	1.0	15.0

Case 2: Four Commingled Reservoirs

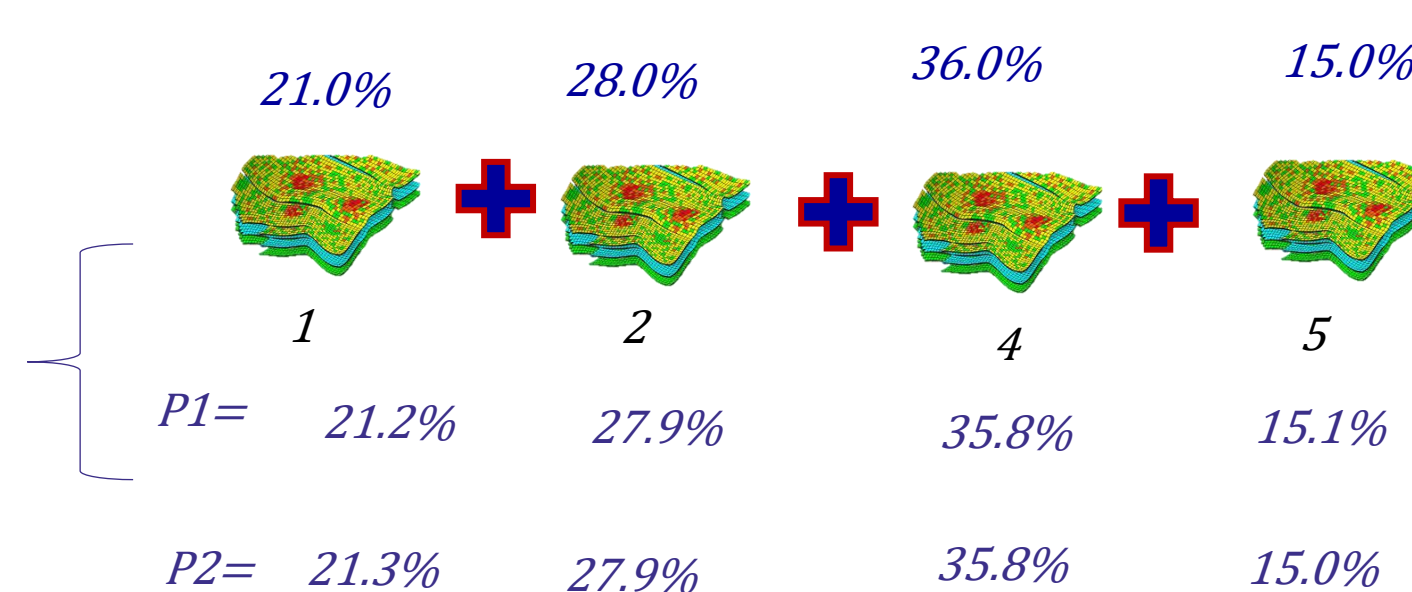


Fig. 5 Case 2

Case 1: Three Commingled Reservoirs

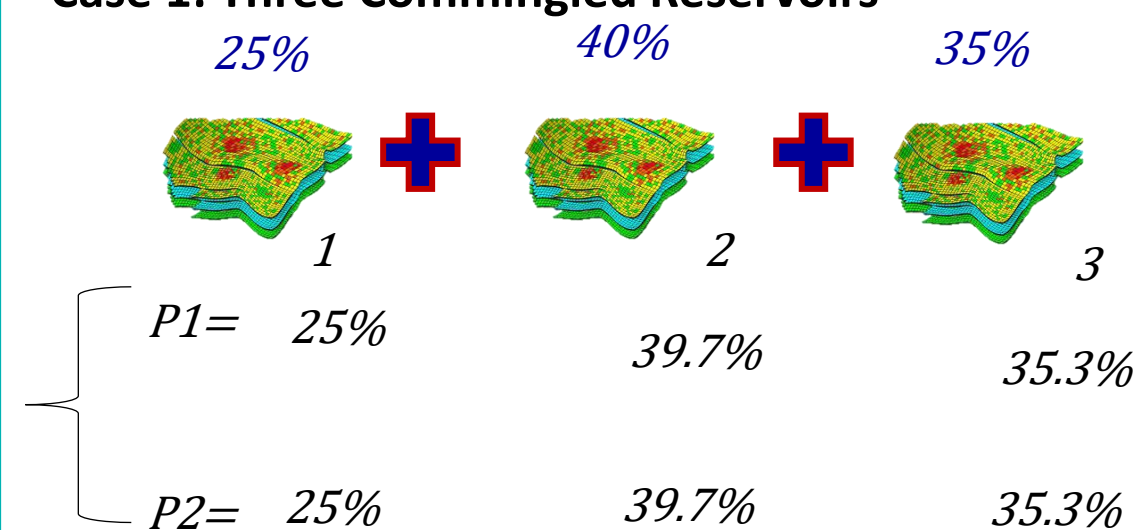


Fig. 4 Case 1

Concluding remarks

- The simplified PVT-GC method effectively quantifies production allocation for individual oil streams.
- Similar endmember compositions increase uncertainty; higher-resolution GC analysis is recommended (Geochemistry).
- Surface process conditions have minimal impact on production allocation results.
- Contaminated samples significantly affect accuracy; only clean or corrected compositions should be used.



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