

## A simple example of using geochemistry to determine contribution from different reservoirs to a produced oil from the Reçoncavo Basin, Brazil

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### Summary

A well in the Reçoncavo Basin of northeastern Brazil was thought to originally be producing from two reservoirs in the Agua Grande and Candeias formations. After a falloff in production, geochemistry was employed to determine if both formations were still contributing to the co-mingled oil. Geochemical data indicated that the co-mingled oil was almost entirely produced from the Agua Grande Fm. A subsequent workover of the well was then done to stimulate production from the Candeias Fm. Geochemical analyses of co-mingled produced oil samples taken after the workover indicate that the Candeias reservoir was still not contributing to production from this well.

### Workflow

The Reçoncavo Basin is located onshore in northeastern Brazil. This is a mature basin with regard to petroleum exploration which has been producing oil since 1939. The basin is an asymmetric graben filled with Upper Jurassic and Lower Cretaceous sediments. The principal hydrocarbon source rock is the Lower Cretaceous Goma Member of the Candeias Formation.

The well of interest for this study is situated in the central part of the basin. Production in this well had come from two zones, within the Agua Grande and Candeias formations. Prior to this study co-mingled production has “fallen off substantially” and the question to be answered was which reservoir was dominating production after the fall-off. The project undertaken had two parts. The first part was to determine if it was possible to distinguish between oils produced from the two contributing reservoirs and, if so, determine which reservoir was predominantly contributing to the produced co-mingled oils after the fall-off in production. The second part was to investigate if after a workover of the well, the relative contributions of the two formations had changed in the co-mingled produced oil.

To determine the contribution of the two reservoirs, oil samples were first analyzed by Whole Oil Gas Chromatography (WOGC). Oils were also fractionated, and the saturate and aromatic fractions were analyzed by Gas Chromatography-Mass Spectrometry (GC-MS) and isotopically.

### Results

The two oil samples collected from the Agua Grande and Candeias formations showed similar WOGCs but with some subtle differences. For the light hydrocarbons, these differences can be demonstrated by a star diagram of  $C_7$  parameters (Fig. 1). Also shown on Figure 1 is the co-mingled oil prior to workover (“Combined Production”) which plots essentially identical to the Agua Grande oil. This similarity between the Agua Grande formation oil and the co-mingled oil, along with consistent minor differences to the Candeias oil, was also shown by heavier hydrocarbons,

including biomarkers, as well as by isotopes. Hence it was concluded that the co-mingled production was almost entirely from the Agua Grande Formation.

Subsequently, the well was given a workover to see if this would stimulate a greater contribution from Candeias Formation reservoirs to the produced oil from this well. Three additional 'co-mingled' oil samples were collected at different times over a period of a month. These were subjected to the same analyses.

The star diagram of C7 parameters with these additional oils added shows that these samples are very similar to each other, to the original co-mingled oil and to the Agua Grande reservoir oil (Fig. 1). Again, other data such as that from biomarkers and isotopes also showed this. Hence it was concluded that the workover of the well had not been successful in stimulating production from the Candeias Formation.

## Acknowledgements

I wish to acknowledge Alvo Petro and especially Greg Soule for involving me in this project and Nanna Eliuk for encouraging me to present this (albeit some years ago). This work was done when I was an employee of APT Canada.

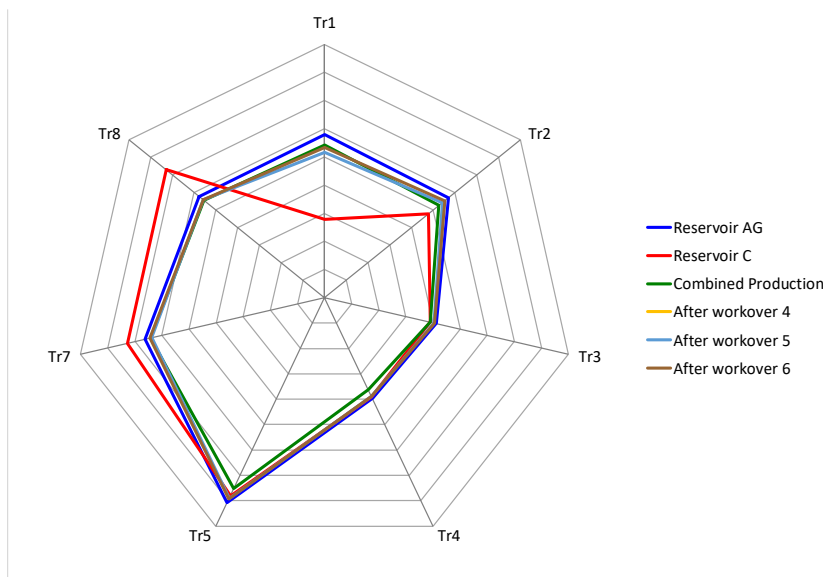


Figure 1. A star diagram of C<sub>7</sub> parameters of co-mingled produced oils before and after the workover of the well, compared to Agua Grande and Candeias reservoir oils. The Candeias oil shows differences to the other samples, suggesting that production is just from the Agua Grande Formation in this well.