DECONVOLUTION OF PETROLEUM SOURCES IN SOUTHEASTERN OFFSHORE BRAZILIAN BASINS USING STABLE CARBON ISOTOPE RATIOS OF *n*-ALKANES

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Introduction

The Southeastern offshore Brazilian Basins (SOBB), including Espírito Santo, Campos and Santos, is the most important petroleum province in Brazil. In those basins are found oils of different types accordingly to their respective sources. For an appropriate understanding of those petroleum systems, the discrimination of each oil type is crucial. In this context, carbon isotopic ratios ($\delta^{13}C$) are important subsidies for understanding and interpreting the origin, generation, and post accumulation changes in oils. Variations in $\delta^{13}C$ in petroleum and bitumen are related primarily to the organic matter type (O.M.). Thermal maturity levels and secondary alterations (e.g. biodegradation) can also alter the isotopic signature of petroleum in much less intensity. $\delta^{13}C$ is also an effective tool for geochemical correlation between petroleum and its respective source rock. Interpretations are strengthened if supported by other independent data, such as biomarker ratios.

Six post- and pre-salt oils from Southeastern offshore Brazilian basins used in this study (***Table 1***) were supplied by National Agency of Petroleum, Natural Gas, and Biofuels (ANP). The sample preparation follows the fractionation and urea adduct procedures. Gas chromatography-combustion-isotope ratio mass spectrometry (GC-C-IRMS) was applied to determine $\delta^{13}C$ of *n*-alkanes. Biomarker ratios were obtained by gas chromatography-mass spectrometry (GC-MS) and used as an additional result. Interpretation was integrated with geological information available in the literature.

Table 1 *Origin and API gravity of crude oil samples used in the study.*

Code	Basin	Source	°API
TAB-4G	Espírito Santo	Post-salt	44.8
TAB-0Q	Espírito Santo	Post-salt	29.6
TAB-6A	Campos	Post-salt	26.4
TAB-6J	Campos	Pre-salt	29.4
TAB-7L	Santos	Pre-salt	27.9
TAB-7S	Santos	Pre-salt	29.4

Results

$\delta^{13}C$ profiles for the *n*-alkanes of the studied oils are shown in ***Figure 1***. In all samples isotopic amplitudes are significant varying between 3.2 and 6.9‰, indicating a noteworthy diversity of O.M. sources. The samples have shown lacustrine characteristics in $\delta^{13}C$ of *n*-alkanes (characteristic asymmetrical "U" shape between *n*-C_{13} and *n*-C_{32} and relatively large isotopic amplitude) and biomarkers (***Table 2***), with exception of the TAB-4G. This sample has a marine biomarker signature and a depletion in $\delta^{13}C$ in *n*-$C25^{+}$ (significant contribution of terrestrial O.M., suggesting deltaic influence). This sample has also the highest API gravity, reflecting a great difference in relation to the other samples.

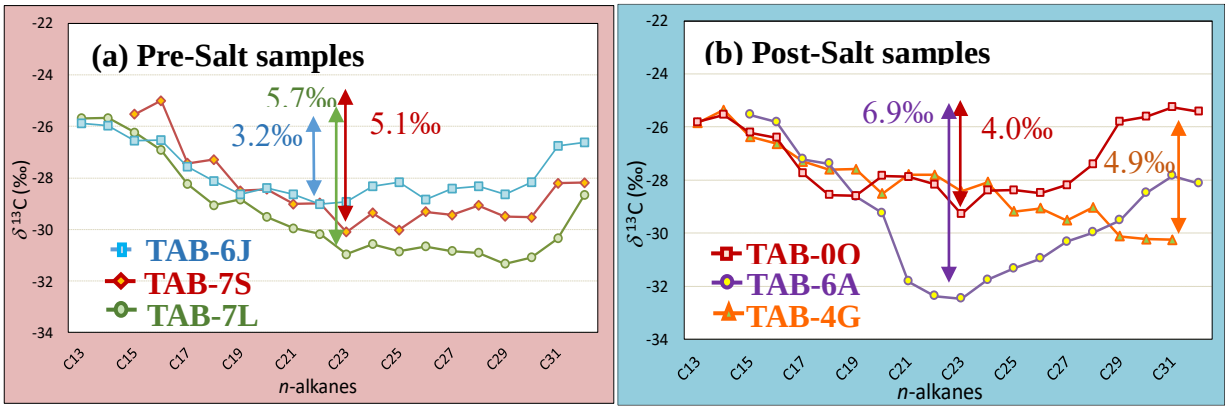

Figure 1 *n-Alkane carbon isotopic profiles of samples from: (a) pre-salt; (b) post-salt.*

Table 2 *Biomarker ratios obtained by GC-MS.*

Samples	H/ST	TPP/(TPP+DIA)	TS/TM	TS/(TS+TM)	G/H30
TAB-4G	1.71	0.34	1.86	0.65	0.26
TAB-0Q	11.80	0.73	0.68	0.40	0.26
TAB-6A	9.97	0.77	0.26	0.46	1.27
TAB-6J	8.46	0.71	0.50	0.33	0.29
TAB-7L	6.02	0.63	0.29	0.23	0.23
TAB-7S	5.82	0.66	0.33	0.25	0.23

Conclusions

The six oil samples from SOBB were geochemically characterized using carbon *n*-alkane isotope and saturated biomarkers. All samples analyzed have shown lacustrine characteristics in $\delta^{13}C$ of *n*-alkanes and in biomarkers, excepted for TAB-4G. The marine biomarker signature and the isotopic profile of n-alkanes suggesting terrestrial O.M. contribution in TAB-4G probably are related to a depositional environment of source represented by a transitional realm, e.g., delta.

References

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