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# BIODEGRADATION OF STERANES: A NEW CASE STUDY IN BRAZILIAN OILS

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Biodegradation of regular steranes has been observed only in heavily biodegraded oils after complete removal of the compounds like *n*-alkanes and isoprenoids. In many cases, steranes are more susceptible to biodegradation than hopanes (Wenger *et al.*, 2002; Peters & Moldowan, 1993). In general, the susceptibility of steranes to microbial degradation typically decreases with increasing carbon number ($C_{27}>C_{28}>C_{29}>C_{30}$), and compounds with the biological configuration are more prone to degradation than the other isomeric forms ($5\alpha,14\alpha,17\alpha(H),20R >> 5\alpha,14\beta,17\beta(H),20R \geq 5\alpha,14\beta,17\beta(H),20S \geq 5\alpha,14\alpha,17\alpha(H),20S$; Peters *et al.*, 2005).

The main goal of this work was to investigate the preferential biodegradation of regular steranes based on quantitative analytical techniques (MRM-GC-MS) and compare the observed results with the biodegradation scale proposed by Wenger *et al.* (2002).

Thirteen samples of lacustrine oils with moderate thermal evolution and submitted to different biodegradation degrees, collected in an oilfield in the Brazilian continental margin, were selected for the study. All these oils were generated from source rocks in the Barremian rift section, and were trapped in Upper Cretaceous-Tertiary reservoirs. Non-biodegraded oils have API gravities in the 28-30º range.

The saturated hydrocarbon fraction was quantitatively analyzed using gas-chromatography with mass spectrometry (metastable ratio monitoring or *MRM-GC-MS* with a Waters Autospec system). β-cholane (100 ppm in the saturated hydrocarbon fraction) was used as internal standard and compounds quantified in relation to it.

The biomarker concentrations were measured in the saturated hydrocarbon fraction and recalculated for the whole oils based on the percentage of saturates obtained by liquid chromatography (MPLC) considering the mass losses during the analysis.

The results show a relative increase of the steranes concentration for the oils as API gravity is reduced from 30 to 20º due to the preferential biodegradation of more liable compounds such as *n*-alkanes and isoprenoids. For oils submitted to even more intense degradation levels (API gravities below 20°), a remarkable decrease in the steranes

concentration was observed, suggesting that these compounds were probably also affected by the biodegradation process (Figure 1A).

In this study, differences in biodegradation susceptibility of steranes related to isomeric forms and the carbon number of the structure were noticed. Relative losses of steranes were calculated taking the sample with the highest concentrations (19.5º API) as a reference. Steranes losses of more than 70% were estimated for the most biodegraded oils. Under more severe levels of biodegradation, $C_{29}$-steranes were preferentially removed when compared to their $C_{27}$ and $C_{28}$ homologs (Figure 1B). Among the $C_{29}$-steranes, the 5α,14α,17α(H),20R configuration was apparently the least affected by biodegradation.

Furthermore, it is worth noting that in moderate stages of biodegradation (18ºAPI oils) hopanes are preferentially removed, whereas both hopanes and steranes are degraded in more severely biodegraded oils (9ºAPI oils).

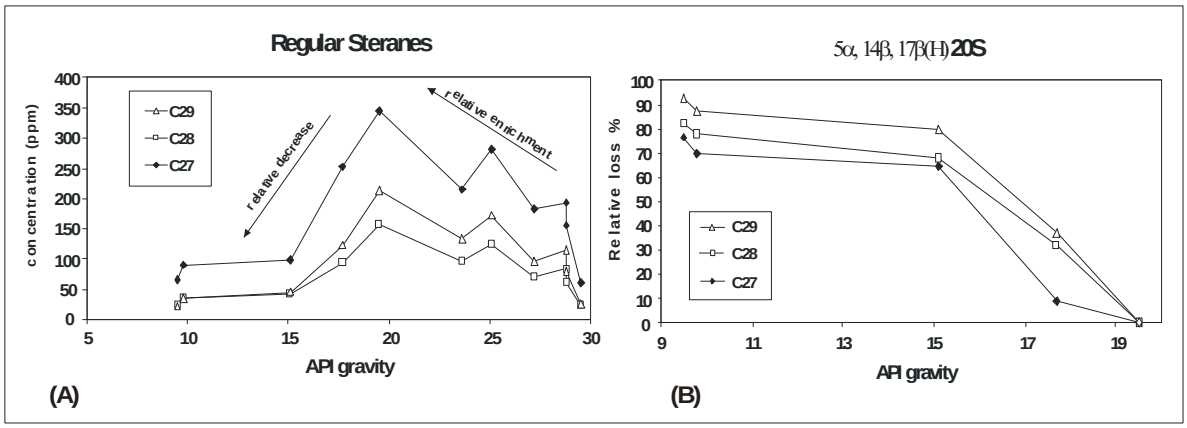


Figure 1. Variations of the concentrations of the $C_{27}$, $C_{28}$ and $C_{29}$ steranes in the whole oil as a function of API gravity (A). Relative losses (%) of the 5α,14β,17β(H),20S isomer of $C_{27}$, $C_{28}$ and $C_{29}$-steranes as a function of API gravity (B).

## REFERENCES

Peters, K. E., Moldowan, J. M., 1993. The Biomarker Guide: Interpreting Molecular Fossils in Petroleum and Ancient Sediments. Prentice Hall, Englewood Cliffs, New Jersey, 363p.

Peters, K. E., Walters, C. M., Moldowan, J. M., 2005. The Biomarker Guide. 2nd Edition, Part II: Biomarkers and Isotopes in the Environment and Human History. Cambridge University Press, 474p.

Wenger, L. M., Davis, C. L., Isaksen, G. H., 2002. Multiple controls on petroleum biodegradation and impact on oil quality. SPE Reservoir Evaluation and Engineering, 5, 375- 383.