Using O-containing acidic polar compounds of biodegraded petroleum as biomarker of biodegradation

Célio Fernando Figueiredo Angolinia, Ramsés Capillab, Anita Jocelyne Marsaiolia

a State University of Campinas, Chemistry institute, P.O. Box 6154, CEP 13083-970, Campinas-SP. B) Organic Geochemistry / CENPES Petrobrás

anita@iqm.unicamp.br

Introduction

Microorganisms degrade petroleum following different biological pathways (Widdel and Rabus, 2001; Prince et al., 2002) at rates that strongly depend on the availability of inorganic and organic electron acceptors (Head et al., 2003; Larter et al., 2003). These biological transformations lead to the systematic alteration of the crude oil chemical and physical properties e.g., degraded oils have higher specific gravity, viscosity and heteroatom-containing compounds are more abundant (Kim et al., 2005), which are more resistant to microbial catabolism than pure hydrocarbons. In particular, the carboxylic acids which are produced during the biodegradation have a correlation with this process, prompting us to use them as marker of biodegradation extension in petroleum samples.

Experimental

In this work we used four oil samples obtained in July 2005 from a Pampo Sul Oilfield production platform in the Campos Basin. These samples showed distinct biodegradation levels (Figure 1), and were previously studied by Vasconcellos et al. (2009) and Cruz et al. (2011). The acidic fractions all oil samples were extracted with silica / KOH (25g KOH for 200g of silica) in a soxhlet apparatus.

Results and Discussion

The relationship between the carboxylic acids and biodegradation has been a topic of research in our lab for the last 15 years, and the access to fast analyses like petroleomics (Rodger et al., 2005) has widened the range of analyzed compounds. Here we selected four different oil samples sharing the same source rock and of similar maturity level, of different biodegradation levels (Figure 1)

In non-biodegraded samples there is a predominance of linear carboxylic acids (DBE 1), but in our samples of biodegradation level equal 2, the aliphatic carboxylic acids were not so abundant. Additionally we observed that their depletion increased at higher biodegradation levels as these compounds are in turn biodegraded after the hydrocarbons In general, each DBE class abundance increase at the beginning of the biodegradation process followed by an abundance decrease at higher biodegradation levels (Figure 2). Those oscillations synchronize with those observed in the analyses of the corresponding hydrocarbon

Conclusions

Similar to the biodegradation of the hydrocarbons we understand that biodegradation of O-containing compounds occurs in a sequential way, with biodegradation of less complex structure (lower DBE) over more complex structure (higher DBE). Also the O-containing classes are more recalcitrant than their corresponding hydrocarbons, but they are quickly biodegraded when their precursors are depleted. These classes were pointed out biodegradation biomarkers.
Acknowledgements
CNPq; ANP (Brazilian Petroleum Agency), FAPESP

References
Cruz, G.F.; Angolini, C.F.F.; Dellagnezze, B.M.; Garcia, I.N.S.; Oliveira, W.M.; Santos Neto, E.V.; Marsaioli, A.J. 2011, Could petroleum biodegradation be a joint achievement of aerobic and anaerobic microorganisms in deep sea reservoirs? AMB Express 1, 47.


