PETROLEUM SYSTEM (S?) IN THE GUYANA-SURINAME BASIN: INSIGHTS FROM A GEOCHEMICAL STUDY ONSHORE SURINAME.

A.F Cedeño[1], S.E Ohm[1], A. Escalona[1], Eshita Narain[2]
[1]University of Stavanger, Stavanger-Norway. [2]Staatsolie, Paramaribo-Suriname

Introduction

The Guyana-Suriname basin is located along the passive margin of northeastern South America. It lies next to the Eastern Venezuela basin whose onshore accumulations of Turonian–Santonian oils extends toward the subsurface of the Orinoco delta and the Trinidad Columbus Basin. Recent discoveries by Exxon Mobile in the Stabroek block offshore Guyana confirm a working petroleum system therein. The presence of organic-rich source rocks of Upper Cretaceous age within the Guyana-Suriname basin is seemingly acknowledged, but the existence of Jurassic source rocks, put forward by Griffith (2017), is still not confirmed. This work revises the geochemical signature of 15 oils from onshore Suriname to improve the understanding of their age and facies, and to investigate the relationship between the Guyana-Suriname and the eastern Venezuela petroleum system.

Results

Twelve of the Suriname oils are interpreted to have been generated by Cretaceous, arguably Turonian–Santonian, marine shales containing dominantly algal organic matter (Group A petroleum). The remaining three samples are interpreted as generated from a Jurassic or Lower Cretaceous marly source containing dominantly terrestrial organic matter (Group B petroleum).

C_{26}/C_{25} tricyclic terpanes and the C_{31}/C_{30} hopanes suggest that the source rock generating the oils in the sample set was deposited in a marine environment (figure 1A). The C_{19}/C_{23} tricyclic ratio is less than 0.05 for samples in Group A, indicating a source rock containing predominantly algal and bacterial organic matter, while for samples in Group B the ratio is higher than 2, suggesting generation from a source rock containing high amounts of terrestrial-derived organic matter. High C_{24}/C_{23} and low C_{22}/C_{21} tricyclic terpane ratios (Peters et al., 2005) indicate that oils in Group A originated from a shale source, while the oils in Group B originated from a marine marl source (figure 1B).

The sterane distribution from the Suriname oils was used to constrain the age of their generating source rock. The C_{28}/C_{29} sterane ratios for Group A samples range from 1.0 to 1.15, which is within the range of 0.6 to 1.4 reported for Cretaceous aged rocks by Grantham and Wakefield (1988). The same ratio for oils in Group B is significantly lower and ranges from 0.40 to 0.43, suggesting a source rock of Late Paleozoic to Early Jurassic age. In addition, these oils have very low Extended Tricyclic Triterpanes (ETR) ratios (0.11-0.21), which hints on a Jurassic or younger source rock (Holba, 2001). In line with these observations, a Jurassic age is tentatively proposed for the source rock generating the crude oils in Group B.

Discussion

High ETR ratios (1.87-3.37) make oils in Group A (figure 1C) an oddball at first sight. While C_{28}/C_{29} sterane ratios are consistent with Cretaceous aged rocks, this ratio suggests a Triassic or older source (Holba, 2001). However, high ETR's are equally present in oils known to have been generated by Turonian–Santonian, La Luna-like source rocks onshore Colombia, Venezuela, and Trinidad (figure 1C). Holba links high ETR to areas of upwelling with subsequent diatom bloom. A depositional environment opening up for diatom bloom during the Upper Turonian has been described by Damste et. at (2004). Hence, elevated ETR ratios could provide a means of empirically discriminating Upper Cretaceous oils in northern South

America (figure 1D). This is also circumstantial evidence to suggest a correlation with the Upper Cretaceous petroleum system in the Eastern Venezuela basin. Thus, Upper Cretaceous source rocks in the Guyana-Suriname basin could represent the easternmost extension of organic rich sedimentation along the Cretaceous passive margin of northern South America.

The Jurassic age tentatively proposed for Group B petroleum is debatable. It can be argued whether or not the C_{28}/C_{29} ratio is biased by the high content of terrestrial organic matter determined for the source rock generating these oils. If correct, Lower Cretaceous emerges as an option that fits the low ETR ratios. Organic-matter rich sediments of Cenozoic age are discarded owing to their low maturity. Whether a Lower Cretaceous or a Jurassic source rock, this work highlights the possible presence of another active source in the basin.

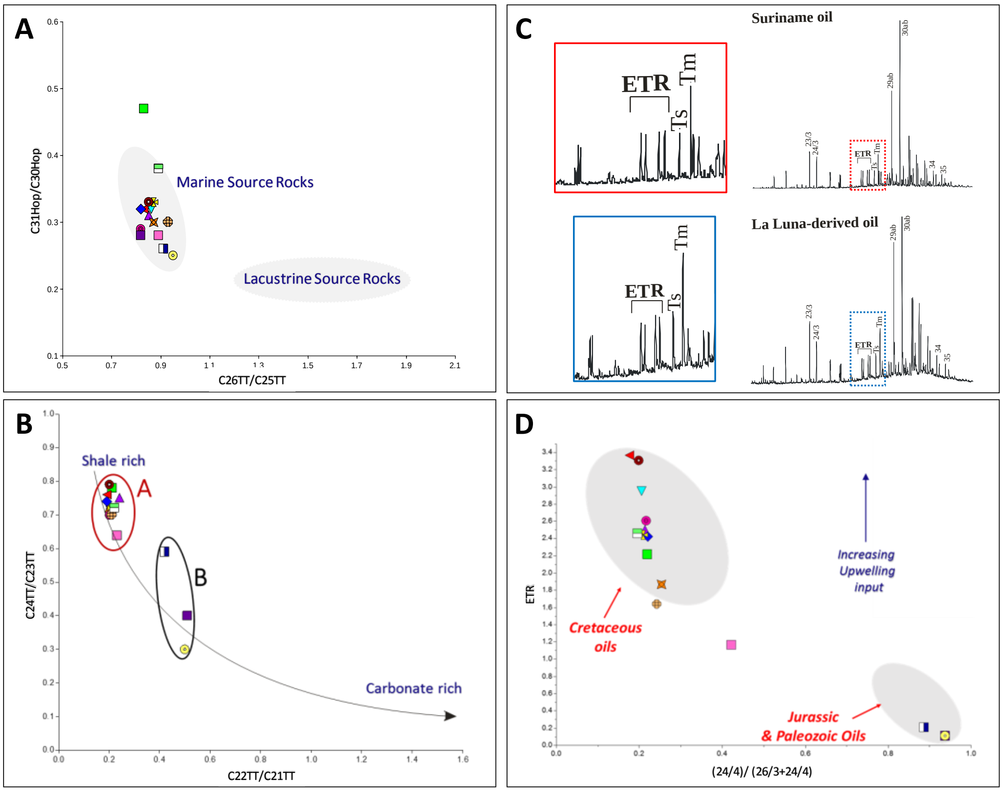

Figure 1. A. *26/25TT versus C31/C30Hop cross-plot;* ***B.*** *22/21TT versus 2423TT cross-plot;* ***C.*** *ETR for a Surinamese and a La Luna-derived oil;* ***D*** *(24/4)/(26/3+24/4)versus ETR plot.*

References

Damsté, J.S.S., Muyzer, G., Abbas, B., Rampen, S.W., Massé, G., Allard, W.G., Belt, S.T., Robert, J.M., Rowland, S.J., Moldowan, J.M. and Barbanti, S.M., 2004. The rise of the rhizosolenid diatoms. Science, 304(5670), pp.584-587.

Grantham, P. J., and L. L. Wakefield, 1988, Variations in the sterane carbon number distributions of marine source rock derived crude oils through geological time: Organic Geochemistry, v. 12, p. 61–73.

Griffith, C.P, 2017, Hydrocarbon Potential of Jurassic Source Rock in the Guiana-Suriname Basin: AAPG 2017 Annual Convention and Exhibition, Houston, Texas.

Holba, A. G., L. Ellis, I. L. Dzou, A. Hallam, W. D. Masterson, J. Francu, and A. L. Fincannon, 2001, Extended tricyclic terpanes as age discriminators between Triassic, Early Jurassic, and Middle–Late Jurassic oils (abs.): 20th International Meeting on Organic Geochemistry, September 10–14, 2001, Nancy, France, v. 1, p. 464.

Peters, K.E., Walters, C.C., Moldowan, J.M., 2005. The Biomarker Guide, second ed. Cambridge University Press, Cambridge, UK.