

USE OF ASPHALTENES IN OIL-OIL AND OIL-SOURCE ROCK CORRELATION

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ABSTRACT

This work presents the use of the weight average (Mw) and number average (Mn) molecular weights of asphaltenes of bitumen and crude oils as correlation parameters, by using the ratio Mw/Mn denominated polydispersity, for rocks and oils from the Maracaibo, Eastern and Barinas Apure Venezuelan basins. For the asphaltenes of bitumen and oils, a graph of Mw vs. Mn indicates an acceptable correlation that allows to group oils and source-rock that have been correlated by means of conventional geochemical parameters. It also differentiates oils and rocks from the different basins of Venezuela. Therefore, these parameters measured in asphaltenes can be used as oil-oil and oil-source rock correlation parameters and in the definition of petroleum systems.

INTRODUCTION

The oil-oil and oil-source rock correlation is performed by the used of parameters determined in the saturate and aromatic fractions of bitumen or crude oils. For the asphaltenes, the oil fraction of highest molecular weight and structural complexity of oils and bitumens, the structural characteristics are too inherited from the organic matter source and the changes in the structure occur in response to thermal maturation. Changes in the asphaltenes fraction are due mainly to migration and thermal maturation processes, suggesting their use in correlation studies and as maturity indicators, and as a characterization tool for oils and bitumens. Previous work has shown that the molecular weights of asphaltenes are indicative of oil types in different basins of Venezuela (Sayago, 1999; Cumberbatch, 1999; González, 2000; García, 2003; Rojas, 2004; Lo Mónaco, 2005; Luque, 2006; González, 2006). Based on these results this work presents a compilation of the weight average molecular weight (Mw), the number average molecular weight (Mn) and the polydispersity (Mw/Mn) as correlation parameter.

EXPERIMENTAL

Samples of rock from Maracaibo (La Luna Formation) and Eastern (Querecual Formations) Venezuelan basins, and oils from Maracaibo, Eastern, and Barinas-Apure basins were treated for asphaltenes extraction and purification. Molecular weights were determined in a Perkin Elmer gel permeation chromatograph with a LC pump with isocratic gradient and a Waters detector at a 484 nm wavelength, with a PE Nelson 900 data acquisition system.

RESULTS Y DISCUSSION

The values of Mw and Mn represent the weight average (Mw) and number average (Mn) molecular weights, if some factor alters Mw it alters Mn too, but the ratio between them, the polydispersity (Mw/Mn), should remain constant. The values of Mn and Mw for asphaltenes of bitumen from La Luna Formation (creek Maraca, Santa Rosa, wells VLE, Totumos, ALP), Querecual Formation (Querecual river) and oil from the three main basins (Maracaibo, Eastern and Barinas-Apure) are presented in figure 1.

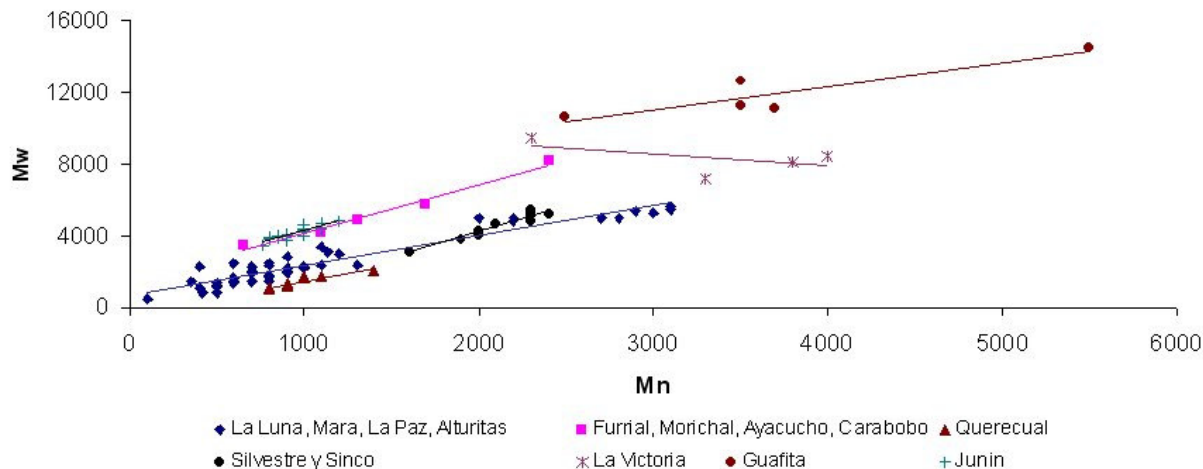


Figure 1 Weight average (Mw) vs. number average (Mn) molecular weights of asphaltenes in rock and oils of Venezuelan basins.

For the Maracaibo basin, the asphaltenes of bitumen from La Luna formation (Maraca and Santa Rosa creeks, and Totumo, Alpuf and VLE wells) and in the asphaltenes of the oils of this basin (Mara, Mara Oeste, La Paz, La Concepción), are grouped according to their molecular weights (Mn and MW). These results agree with those obtained by the interpretations of geochemical parameters; when based on biomarkers, V and Ni concentrations the results indicated that these

oils were generated by La Luna Formation (Talukdar et al., 1985; 1986). In this area of the graph, some of the asphaltenes of Barinas-Apure (Silvestre and Sinco fields) are located near the Maracaibo basin oils, but are separated from the one corresponding to other fields of this basin (La Victoria and Guafita fields). These results are in agreement with geochemical studies that demonstrate important differences between the crude oils from Silvestre and Sinco when compared to those of Victoria and Guafita fields (Lopez et al., 1998).

For the oils of the Eastern Venezuelan basin (Junin, Ayacucho, Carabobo, Furrial, Morichal), an acceptable correlation is obtained. In this case the zone that locates the asphaltenes of the crude oils does not coincide with that corresponding to the asphaltenes from bitumen of the Querecual Formation. These results are to be expected because this formation is in an over mature stage (metagenesis stage). In this case the molecular weights of asphaltenes of residual bitumen would have to be of low molecular weight as a result of the advanced thermal craking (González et al., 2007). This does not occur for the asphaltenes of bitumen from La Luna Formation because this formation is in a stage of less maturity (catagenesis stage). In this case, the asphaltenes of generated bitumen are similar in molecular weight to the asphaltenes of migrated oils.

CONCLUSIONS

The relation between Mw and Mn can be used as a new oil-oil and oil-source rock correlation parameter, and also allows differentiating the petroleum systems from the main Venezuelan basins.

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REFERENCES

Cumberbatch, T., 1999 Caracterización físicoquímica de extractos provenientes de núcleos de la Formación La Luna, (Cuenca de Maracaibo) con diferentes grados de madurez. Trabajo Especial de Grado. Escuela de Química-Instituto de Ciencias de la Tierra. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

García, J.A., 2003 Correlación entre parámetros físicoquímicos de asfaltenos y parámetros clásicos indicadores de madurez de la roca fuente: Formación La Luna sección Quebrada Maraca, Cuenca de Maracaibo. Trabajo Especial de Grado. Escuela de Química-Instituto de Ciencias de la Tierra. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

González, C., 2000 Estudio geoquímico de maduración de la materia orgánica contenida en la Formación La Luna, Cuenca del Lago de Maracaibo Trabajo Especial de Grado. Escuela de Química-Instituto de Ciencias de la Tierra. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

González, C., 2006 Estudio de las propiedades fisicoquímicas de asfaltenos en la localidad tipo de la Formación Querecual y su posible relación con los parámetros indicadores de madurez. Trabajo de Grado de Maestría Postgrado en Geoquímica. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

Lo Monaco G., 2005 Correlación de crudos de los campos La Victoria y Guafita (Edo. Apure) mediante parámetros fisicoquímicos de asfaltenos. Trabajo Especial de Grado. Instituto de Ciencias de la Tierra-Escuela de Química Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

López, L., Lo Mónaco, S., Richardson, M., 1998 Use of molecular parameters and trace elements in oil-oil correlation studies, Barinas sub-basin, Venezuela. *Advances in Organic Geochemistry* 29, 613-629.

Sergey Luque, S., 2006 Correlación de crudos de los campos Silvestre, y Sinco, en la subcuenca de Barinas, mediante la aplicación de parámetros fisicoquímicos de asfaltenos. Trabajo Especial de Grado. Instituto de Ciencias de la Tierra-Escuela de Química. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

Rojas, C., 2004 Correlación crudo-crudo mediante parámetros fisicoquímicos de asfaltenos. Trabajo Especial de Grado. Escuela de Química-Instituto de Ciencias de la Tierra. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

Sayago, A., 1999 Efecto del grado de madurez sobre las características fisicoquímicas de asfaltenos de crudos de Maracaibo. Trabajo Especial de Grado. Escuela de Química-Instituto de Ciencias de la Tierra. Facultad de Ciencias Universidad Central de Venezuela. Caracas, Venezuela.

Talukdar, S., Gallango, O., Ruggero A., 1985 Formaciones La Luna y Querecual de Venezuela. Rocas madres de petróleo. *Memorias VI Congreso Geológico Venezolano VI*, 3306-3342.

Talukdar, S., Gallango, O., Chin-A-Lien T., 1986 Generation and migration of hydrocarbons in the Maracaibo basin, Venezuela. *Advances in Organic Geochemistry*. 216-279.