

## DISTRIBUTION OF ORGANIC MATTER THERMAL MATURITY THROUGH THE OLIGOCENE-MIOCENE CENTRAL BASIN OF FALCON, NORTHWESTERN VENEZUELA

Jean C. MONTERO<sup>1,2,\*</sup>, Manuel MARTÍNEZ<sup>2</sup>, José V. GUTIÉRREZ<sup>2</sup>, Armelle RIBOULLEAU<sup>1</sup> and Nicolas TRIBOVILLARD<sup>1</sup>

1. Université Lille 1, Sciences de la Terre, UMR 8110 and FR1818, bâtiment SN5, F-59655 Villeneuve d'Ascq cedex, France. \* e-mail: jc.motero-serrano@ed.univ-lille1.fr

2. Universidad Central de Venezuela, Instituto de Ciencias de la Tierra, Facultad de Ciencias, Apartado Postal 3895, Caracas 1010 A, Venezuela.

The Falcon Basin is located to the northeast of the Maracaibo Basin in northwestern Venezuela. This is a Tertiary basin, with a geographic extension approximately of 36.000 km<sup>2</sup> and a sediments volume of ca. 161.000 of km<sup>3</sup> (González de Juana et al., 1980). Among the petroliferous basins of Venezuela, the Falcon Basin is the one with the smallest reserves of liquid hydrocarbons, but it presents significant gas reserves and coal deposits. In the Central Falcon Basin, several stratigraphic units contain organic matter (Boesi and Goddard, 1991), but few works reported hitherto on the state of thermal maturity of the organic matter. In this work we present new data of the maximal temperature of hydrocarbon generation ( $T_{\max}$  index derived from Rock Eval pyrolysis) and vitrinite reflectance (% $R_o$ ) measured on the various organic matter-rich formations of the Central Falcon Basin: coals, shales, marls and limestones, as well as maturity parameters derived from molecular biomarkers analysis. The data were compared to what is reported in the literature.

The results are shown in Figure 1. Largely, the values of  $T_{\max}$  and % $R_o$  increase with the burial depth, from the thermally immature Urumaco and Socorro formations, to the mature Cerro Pelado and Agua Clara formations (base of the oil window), and finally to over-mature Pedregoso, Pecaya and El Paríso formations (catagenesis stage). In this stage, the pre-existing crude oil was expelled and the remaining organic matter is only capable to generate humid gas (Fig. 1A).

Using % $R_o$  data and assuming a normal geothermal gradient of 30°C/km for the Central Falcon Basin (Fig. 1B), an estimation of the maximal burial depth and the rank can be given following the model of Suggate (1998). The paleotemperatures thus estimated are between 50-65°C for the Cerro Pelado and Agua Clara, and  $\geq 120^\circ\text{C}$  for the other formations, placing organic matter in the early and late catagenesis stages, respectively (Fig. 1B). If we compare the estimated depths of burial with the sum of the thickness of the various formations present in the Central Falcon Basin (reported from the literature), a great difference appears, which can be caused by: (1) a smaller geothermal gradient (~18-15°C/km

instead of 30°C/km), or (2) the fact that the reported stratigraphic thicknesses of the Central Falcon Basin formations were over-estimated. The first cause is discarded due to the geodynamic context: the interaction of the Caribbean Plate with the north of South America must have raised rather than lowered the geothermal gradient. Therefore our results indicate that the thicknesses of the lithological column in the Central Falcon Basin must be reevaluated.

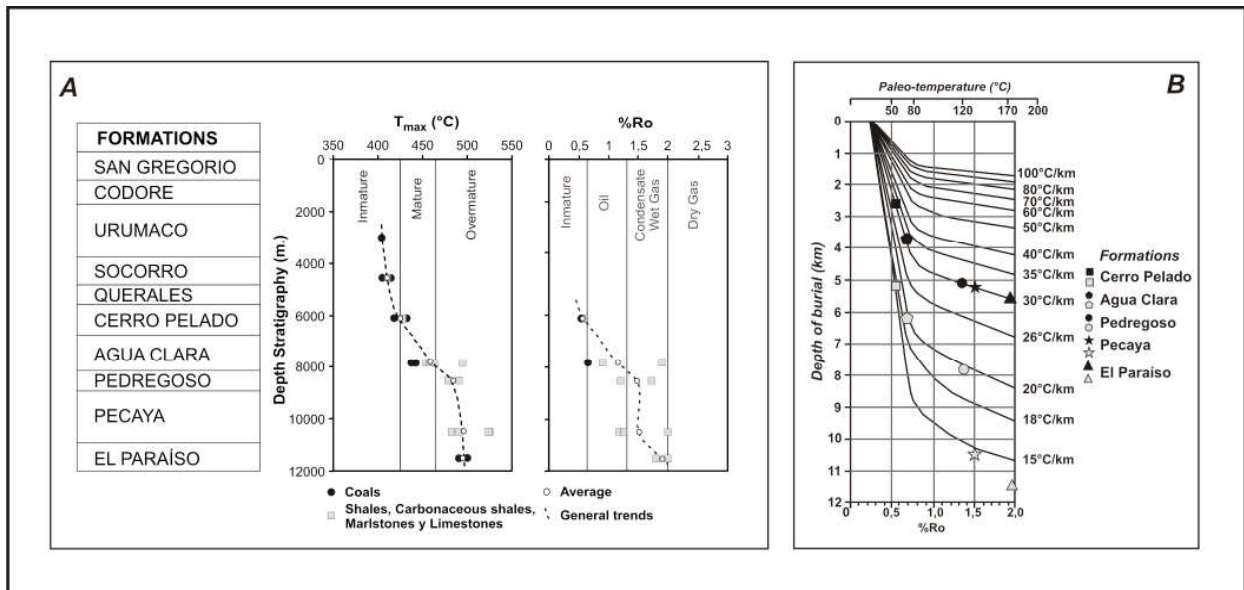


Figure 1. (A) Vertical distribution of  $T_{max}$  and %Ro values in the Central Falcon Basin; (B) Estimation of the depth of burial and paleotemperature (Suggate, 1998). The black symbols represent the values considered in this study and the gray symbols the values reported in the literature.

## REFERENCES

- Boesi T. and Goddard D. (1991) A new geology model related to the distribution of hydrocarbon source rocks in the Falcón Basin, Northwestern Venezuela. *American Association of Petroleum Geology Memoirs*, **52**, 303-319.
- González de Juana C., Arozena J. y Picard C. (1980) Geología de Venezuela y sus cuencas petrolíferas. Ediciones Fonvises, Caracas. Tomo I y II, 1031 p.
- Suggate, R. (1998) Relations between depth of burial, vitrinite reflectance and geothermal gradient. *Journal of Petroleum Geology*, **22**(1), 5-32.