Basin Modelling Study of the Sabinas-Piedras Negras Basin: Thermal History, Hydrocarbon Generation and Overpressuring

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Thermal history, hydrocarbon generation and overpressuring are presently studied in the Sabinas-Piedras Negras basin (a Cretaceous age basin located in the north-eastern part of Mexico) using 1D and 2D models.

1D modelling was performed using PetroMod 1D (IES, GmbH) in order to determine thermal history, and is based on Vitrinite reflectance (Rᵥ) values determined for 14 wells. Among these 14 wells, 6 wells were more specifically studied for their great distribution of Rᵥ values along the depth profile. Several scenarios were tested to reconstruct the thermal history of this area. Results obtained seem to indicate that the scenario integrating a thermal event is the most correct to explain the Vitrinite reflectance profiles observed in the basin. This scenario is in agreement with petrographic observations, and is reliable to a regional heat flow enhancement associated with magmatic bodies of Tertiary age located in this area. Erosion amount determined by modelling indicate that eroded thicknesses of 1700 m in the northern part of the basin to 3500 m in the southern part of the basin have to be considered. Hydrocarbon generation modelling results indicate that the La Casita Formation (considered as the most important source rock) began to generate oil and gas in the early Cretaceous times, where as the La Peña and Eagle Ford Formations generate hydrocarbons later, i.e. during early Palaeocene.

2D modelling was performed using the BasinMod 2D software (PRA). 3 cross sections were constructed using seismic profiles, well data and results from the 1D study. These cross sections are presently used to study hydrocarbon migration and overpressure development. The obtained first results indicate that overpressure developed mainly in the La Virgen and La Gloria Formations. It appears also that faults do not behave as pressure drain-off, as the present day distribution of overpressure along the cross sections in the La Virgen Formation indicates that overpressure seems to decrease only close to the faults. This would be due to the low permeability value of this formation. It also appears that the La Virgen Formation, mainly composed of carbonates and evaporites, induce a control on hydrocarbon migration in the basin, limiting the vertical circulation of the hydrocarbon fluids generated by the La Casita Formation. It seems so that fracturing is an important factor to understand the present day distribution of oil and gas in this basin. However, in order to fully understand the movement of fluids in the basin, several hypotheses are getting tested.

All these results should lead to a better understanding of the whole parameters of the basin evolution.