8th International Symposium
on Andean Geodynamics
(ISAG)

Maturity, hydrocarbon generation and migration in North Peruvian Forearc System – Insights from an unstructured petroleum system modeling

A. Lemgruber-Traby[1, 2], N. Espurt[2], C. Souque[1], Y. Calderon[3]

[1]IFP Energies Nouvelles (IFPEN), France

[2]Centre européen de recherche et d'enseignement de géosciences de l'environnement (CEREGE), France

[3]Perupetro, Pérou

Even though the presence of hydrocarbon in the North Peruvian forearc system is well known and explored for many centuries, its petroleum systems dynamics is still poorly understood and the source rock responsible for the 1,500 MMBbl of discovered oil in the Talara basin remains debated. Lower Cretaceous potential source rocks are widely exposed in the Lancones depocenter and identified from exploration wells south of Mancora where they present enough thermal maturity to have generated hydrocarbon. But geochemical studies indicate a high concentration of oleanene in the oils, suggesting a Cenozoic source rock such as Mogollon, Talara or Heath Formations (Fildani et al., 2005). Nevertheless, the only identified potential Cenozoic source rock (Heath Fm) is located in the offshore Tumbes depocenter, where it is mainly immature even at great depths and at more than 100 km from Talara's oil fields.

The offshore domain remains poorly explored and is considered as a frontier area with hydrocarbon potential. In the Tumbes depocenter this potential is strongly dependent to presence and maturity of the Cenozoic Heath source rock. In this study we investigate the hydrocarbon migration within and across the different depocenters (Lancones, Talara and Tumbes) making use of the 213 km-long balanced and restored cross section of Espurt et al. (2018). The thermal cooling associated with the subduction is integrated to an unstructured petroleum system modeling. The timing of hydrocarbon generation, migration and trap formation are modeled and analyzed together. Primary and secondary biogenic gas generation are also analyzed.

The first results highlight the differences between the Lancones, Talara and Tumbes depocenters. The Heath tertiary source rock reaches the oil generation window only in the deepest parts of Tumbes depocenter, at burial depths exceeding 10km. Whereas it is reached at surface in Lancones and with up to 2km burial at Talara depocenter. These differences are mainly due to the presence or absence of the continental crust. When present bellow the depocenter, the continental crust act as a thermal insulator, keeping the sedimentary basin partially preserved from the subduction cooling. Erosion and fluid circulation are also factors controlling the thermal regime.