Regional Structural Styles of the Putumayo Basin, Colombia:

Their Effects On Trapping Styles and Migration Pathways

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Most of the commercial oil in the Putumayo Basin is trapped in compressional high-relief structures. Hence, understanding the structural geometry and association with migration pathways is fundamental for successful exploration strategies. We present four new structural transects, spanning the entire basin, from north to south and west to east, revealing the structural styles, their interaction with the sedimentary cover, and their relevance for migration pathways. The transects, built with MOVE 2012.1 software, are the product of the integration of regional 2D seismic (mid-1980s to 2011), well data, surface geology, digital elevation data and remote sensing data.

The transects reveal a wide variety of structural styles, including (a) evidence of a pre-Cretaceous rift-system, present even in distal parts of the basin, (b) Andean-inverted normal faults, related to partial inversion of the rift-system creating flexures in the overburden, (c) dextral transpressional wrench-systems with an important vertical component along the mountain front, and (d) thin-skinned low-angle thrusts detached in shaly parts of the Tertiary section along the southwestern mountain front. High-relief thick-skinned structures are observed only near the Andean mountain front, while subtly inverted thick-skinned structures are observed across the entire basin, as far away as 100 km from the mountain front. Thin-skinned structures are only observed in a 10-15km wide belt, along the western mountain front. They do not seem to be directly linked to the thick-skinned system and may represent an earlier thrusting event.

Grabens and half-grabens of the pre-Cretaceous rift-system are typically 10-15 km wide, N-S trending, and do not seem to have a preferred vergence. Often at least one bounding fault shows Andean rejuvenation, creating flexures in the overlying Cretaceous and Tertiary sections. These rift-faults seem to play an important role in the inversion history of some of the major accumulations, such as the Orito structure. The data indicates that the basement-steps, created by the inversion of these old faults, as well as the existence or non-existence of counter-dips in the Cretaceous section, have controlled oil migration at a prospect scale. Our assessment will help to better understand structural trapping mechanisms and migration pathways that has resulted from the discovery of Moqueta and Costayaco, two of the largest light-oil discoveries in Colombia in the last decade.