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Hydrocarbon Prospectivity within Interval "A" of the Villeta Formation in the Putumayo Foreland Basin

The Putumayo Sub-Basin, located in southwestern Colombia, is a key hydrocarbon exploration target within the Putumayo-Oriente-Marañón petroleum province, which extends into Ecuador and Peru. This region is one of the most prolific petroleum systems in South America, attracting continued academic and industry interest due to its proven reserves, active production, and ongoing exploration potential. The Upper Cretaceous Villeta Formation plays a fundamental role in this system, acting as a source rock, reservoir, and seal, making it critical for further hydrocarbon assessment.

This study evaluates the hydrocarbon potential of Interval "A", a carbonate-rich unit within the Villeta Formation, integrating well log analysis and 2D/3D seismic interpretation to assess its structural framework, accommodation geometry, and reservoir quality.

Interval "A" extends across three foreland basin zones: the wedge-top, foredeep, and forebulge. The wedge-top is structurally controlled by compressional tectonics, characterized by high-angle reverse faults. The foredeep exhibits extensional deformation, primarily associated with normal faulting, while the forebulge presents thinning of the interval and minor faulting. Depths of Interval "A" range from −1,220 ft in the foothills to −9,940 ft in the foredeep, with an average depth of −5,580 ft. Thickness varies between 16 and 178 ft, averaging 97 ft, with the greatest carbonate accumulation occurring in the south-central sub-basin.

Hydrocarbon prospectivity within Interval "A" is controlled by two structural trapping mechanisms. In the foothills, hydrocarbons are mainly trapped in faulted anticlines sealed by reverse faults; however, uncertainties remain regarding the timing of trap formation relative to Miocene hydrocarbon migration phases. Conversely, in the interior of the foreland basin, normal fault closures align with later migration phases, making them more viable exploration targets.

This study provides critical insights into the structural complexity of the Putumayo Basin, emphasizing the interplay between compressional and extensional tectonics in shaping hydrocarbon traps. These findings support the optimization of exploration strategies and future oil & gas development initiatives in this highly prospective region of South America.

References

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