

## **Relative Timing of Deformation Along the Western Margin of the Llanos Foreland Basin, Colombian Andes: Evidence from Growth Strata and Depositional Systems**

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Continued exploration and development of mature oil and gas fields in the northern Andes of Colombia will benefit from improved estimates of deformation timing along the western margin of Llanos foreland basin. This study focused on the eastern foothills of the Eastern Cordillera where we analyzed the surface and subsurface record of Oligocene to Pliocene sedimentation in an attempt to bracket the main phases of deformation along the Llanos-Eastern Cordillera margin, thus reducing exploratory risk in the region.

In order to accomplish this, we analyzed paleocurrent orientations at ~100 field localities, measured >2000 meters of stratigraphic section, and interpreted ~50 2D reflection seismic lines in the Nunchía syncline and the adjacent Llanos foreland basin.

The Oligocene to Pliocene succession is composed of the Carbonera, León and Guayabo Formations, which record the stratigraphic transition from a marginal marine environment to a braided fluvial system. Analyses of paleocurrent data in the lower Guayabo Formation help identify a temporal shift from a transverse, eastward flowing paleoriver to a younger drainage system flowing primarily to the south. This change in paleoflow direction is potentially related to surface uplift produced by the initial displacement along the Cusiana thrust, the modern deformation front of the fold and thrust belt.

Growth strata in surface and subsurface sections have been identified in the C8 - C7 members of the Carbonera Formation and in the lower to middle Guayabo Formation. According to the available depositional age constraints (mostly from pollen biostratigraphy), the lower members of the Carbonera Formation were deposited in the Oligocene and the lower Guayabo was deposited in the middle Miocene.

On the basis of the provenance data and growth stratal relationships, we suggest at least two episodes of deformation: the first occurring in the Oligocene and the second in the middle Miocene. The younger episode is recorded by the shift in paleoflow directions and the preservation of growth strata. The older one is supported by the presence of growth strata and a switch in provenance signatures identified in U-Pb detrital zircon age spectra. This older episode is particularly important because it would have implications for potentially older structural traps. Additional detrital zircon analyses and sandstone petrography will help constrain the timing and precise locations of the proposed deformation episodes in the area.