A Critical Analysis of Different Structural Models of the Eastern Cordillera, Colombia

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Five published cross sections through the Eastern Cordillera show net shortening values that range from 68 km to 230 km for essentially the same transect through the area of Tunja. Each is compatible with surface exposures and geometrically balanced, but the subsurface structural styles are strikingly different. Low shortening values result from thick-skinned interpretations of an inverted rift basin, medium values are derived from thin-skinned interpretations dominated by fault-bend folds, and the highest value is from an interpretation showing overthrusting of basement-involved nappes.

These various models are evaluated based on structural geometries seen on both surface and seismic data along a transect that crosses the Eastern Cordillera 65 km to the southwest, just north of Bogotá. We highlight several observations. First, stratigraphic and structural relationships around the northeastern plunge of the Quetame basement massif are most compatible with inversion of pre-existing normal faults. Movement on steep, basement-involved faults neither predated nor postdated thin-skinned deformation, but was physically and temporally linked to deformation on ramp-flat thrust faults. Similarly, seismic and stratigraphic evidence suggest that the Villetta anticline is an inverted half-graben in the hanging wall of a basement fault block. Finally, fold styles in the intervening Sabana de Bogotá are characteristic of detachment and break-thrust folding above a ductile layer rather than fault-bend or fault-propagation folding. This is compatible with the predominence of incompetent lithologies (shales and locally some salt) in the central part of the Eastern Cordillera, and may have resulted from buckling of strata during inversion of a rift basin bounded on both sides by basement highs.

We argue that the primary control on Tertiary contractional tectonics was the prior history of Mesozoic rifting. Stratigraphy varied considerably between deep graben and footwall highs, and the inherited structural architecture exerted a profound influence on subsequent deformation. The data are most compatible with simple inversion of a rift basin, and net shortening was probably at the low end of the published values.