Integrated Fracture Analysis in Complex Areas. Colombian Eastern Foothills

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Structural modeling of the central segment of eastern foothills of the Eastern Cordillera of Colombia allows the identification of the mechanism of fold growth of some major structures in the surface and correlate them with analogues in the subsurface. Kinematic analysis of outcropping folds using balanced cross sections shows that most of the foothill structures can be interpreted as detachment folds which grew by limb rotation. Based on these cross sections and the inferred kinematics of fold growth, numerical modeling of 2d finite strain distribution in the folded horizons was done using a new software developed by the ICP. Numerical modeling takes into account the folding mechanism and relates the change in axial ratio of initially circular markers. In order to compare the calculated deformations, fracture patterns from outcrops were characterized, using orientation and crosscutting relationships, and area methods in pavement maps. Most of the procedure was based on the new ESPARTFRAC software. A comparison of the strain measurements and the estimated parameters shows that it is possible to relate variation on fracture parameters with variation in estimated deformations. There is also a good correlation between folding mechanism and fracture patterns in the case of surface structures.

Similar geometries of analogue producing structures in the subsurface (Floreña, Pauto, Volcanera) together with a good correlation between fracture distribution and position in the folds, although with more limited data sets, allow to propose that the fracture orientation, intensity and distribution can be correlated with the surface analogues. From the fracture data sets it appears that the folding mechanism of the subsurface producing examples is similar to the surface analogues. Kinematic assumptions on the subsurface fracture data sets based on regional stress directions and stress magnitudes allowed to infer tensile and shear fractures. Correlation of fractures with production data showed which fracture sets were the most important for fluid circulation.

This approach defining the best surface analogues, using detailed fold characterization, strain calculations, refined acquisition of fracture parameters and kinematic inferences proved to be a more accurate description of naturally fractured reservoir in highly deformed thrustbelts.