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From 2D Data to 4D Fracture Network Models: Structural Modelling of a Complex Thrust Trap, a Case Study from the Tarija Basin, Argentina

High gas production rates from the Santa Rosa Fm. in the Tarija basin, Argentina, indicate the presence of naturally fractured reservoirs. The reservoir's production potential is dominated by the properties of the fractures; i.e. the secondary porosity and permeability.

A consistent structural model and a good knowledge of the fracture systems is therefore of key importance in reducing risk in the exploration and development strategies of these complex geological structures.

The structural evolution of the Santa Rosa reservoir through time forms the basis of understanding the development of the 3D fracture system. A total of nine 2D balanced cross sections were used to build a 3D geological model of the two key structures. The fault blocks that compose the Santa Rosa Fm. reservoir were subsequently restored to their pre-deformation states using 3D structural modelling software.

Because the reservoirs are subject to spatial and temporal evolution of strain history, the kinematic restorations of the reservoir beds were used to calculate the strain tensors produced during the deformation. The resulting strain maps, combined with well data, were used to accurately predict the spatial location of fracturing and to estimate the orientations of fractures. This allowed the creation of several geologically realistic 3D discrete fracture networks.

This study showed that, even with very limited data sets, the use of structural validation tools and interactive fracture simulations allow risk analyses and production prognoses to be carried out on fractured reservoirs in an early stage of the development of a field.