

Fracture and Fault Analysis in Abra del Condor Anticline, Devonian Outcrops, Southern Subandean, Bolivia: Analogy with Well Data and Implication on Connectivity Between Reservoirs and Modeling Parameters

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Yet some 50 wells have drilled the feldspathic litharenite, very-low porosity, fractured reservoirs of the Huamampampa, Icla, and Santa Rosa formations, in the gas province of Southern Bolivia, well data alone have demonstrated not being sufficient to assess fracture parameters. To overcome this limitation we have studied outcrops of those reservoirs in Abra del Condor anticline and integrated outcomes with well data. Indirect assessment of vertical connectivity (either between formations or reservoir zones) was our main goal, to properly design suitable wells and postpone at maximum breakthrough/fingering of water.

One axis-subparallel and three axis-oblique fracture sets are common in both Abra del Condor and throughout the gasfields. Axis-oblique sets are dominantly made up of shear fractures, including among them brittle shear bands (BSBs), which show up as either shear-fracture swarms or brecciate-to-gouged minor tear-faults.

Shaly beds (i.e., shale and siltstones), as in conventional reservoirs, play the most important role on vertical connectivity between reservoirs. Although almost-always fractured, shaly beds have very low permeability at reservoir depth. Both fracture/fault properties and distributions in outcrops, as well as well-derived dynamic and production data, indicate that a 25 to 100m-thick shaly bed can impede communication between reservoirs.

Axis-oblique BSBs, interpreted as non-through-going features perpendicular to bedding, would play paramount role on lateral conduction of gas and water throughout anticline limbs, as well as on reservoir anisotropy. When water breakthrough/fingering occurs it is expected from edge rather than from bottom aquifers. Our analyses on distribution BSBs have suggested we'd better cut them with horizontal wells and count on positive effects of lowering pressure drawdown.
