EAGE

FP08

Characterisation of Fracture Corridors from Borehole Image Data

A. Subaie* (Saudi Aramco) & J. Cole (Saudi Aramco)

SUMMARY

Fracture corridors are swarms or clusters of tectonic fractures that can traverse an entire reservoir interval vertically and extend for several tens or hundreds of meters laterally. At reservoir scale they form subvertical tabular objects and they can combine linearly to provide significant flow conduits for several kilometers.

Most fracture corridors are below seismic resolution. A core may offer information relating to small scale fracturing, but vertical cores rarely intersect corridors; where they do the core is not usually very informative due to poor core recovery from what can be intensely fractured intervals.

Borehole image logs from horizontal wells provide the best sampling of fracture corridors. Horizontal wells are rarely cored, but are geometrically optimal for intersecting vertical fractures. Good quality image logs provide valuable statistical and descriptive information of fracturing and the relationship to other aspects of the geology of the reservoir, allowing fracture corridors to be identified and differentiated from other types and sets of fractures.

Corridors are not specific to particular lithologies or units within the reservoir, whereas layerbound fractures terminate at bed or lithological boundaries and show good correlation with stratigraphy, suggesting that they are related to mechanical layer characteristics. A primary diagnostic statistical characteristic of fracture corridors is provided by a high degree of clustering (coefficient of variation Cv 1.5 to 2.5) in contrast to layerbound fracture systems ("joints") which although they may have high density, demonstrate Cv < 1.0 due to a more even spacing. Another important diagnostic feature of corridors is the occurrence within them of fractures with large apparent apertures ("megafractures" 1cm apparent width at 1/20 scale borehole image view). Sometimes breccias and evidence of solution enhancement can also be seen in these larger fractures, which always occur in association with a statistical cluster, representing a corridor.

Since both fracture permeability (Witherspoon et al., 1979, Dicman, 2004)) and fracture length (Johnston, 1997, and Massart et al, 2010), are proportional to fracture aperture, we can infer that the megafractures will represent longer and more permeable fractures. Thus their presence within corridor systems will tend to improve the connectivity and thus transmissivity of these systems, enhancing the role of fracture corridors as significant permeability pathways in the reservoir.

References:

Massart, B., Paillet, M., Henrion, V., Sausse, J., Dezayes, C., Genter, A., and Bisset, A.: Fracture Characterization and Stochastic Modeling of the Granitic Basement in the HDR Soultz Project (France). Proc World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010, (2010), 1-7

Johnston, J.D., and McCaffrey, K.: Fractal geometries of vein systems and the variation of scaling relationships with mechanism, Journal of Structural Geology, 18 (1996), 349-358.

Witherspoon, P.A., Wang, J.S.Y., Iwai, K., and Gale, J.E.: Validity of Cubic Law for Fluid Flow in a Deformable Rock Fracture, Water Resources Research, 16, No 6, (1980) 1016- 1024.

Dicman, A., Putra, E., and Schechter, D.S.: Modeling Fluid Flow through Single Fractures Using Experimental, Stochastic, and Simulation Approaches, SPE 89442 Presented at SPE/DOE Fourteenth Symposium on Improved Oil Recovery, Tulsa, Oklahoma, USA, (2004) 1-20.