Significance and Modeling of Fracture Corridors in Carbonate Reservoirs

John Cole [1] and Ismail Ozkaya [2]
[1]Reservoir Characterization, Saudi Aramco, Dhahran, Saudi Arabia.
[2]Consultant, Ozkaya Consulting, Manama, Bahrain.

Detailed reservoir characterization performed over the last decade in the major carbonate reservoirs of the Arabian Peninsula has consistently indicated one particular type of fracturing to be significant in defining reservoir behavior - sub-vertical swarms of fractures termed “Fracture Corridors.” Fracture corridors are mainly fault related fracture clusters that traverse the entire reservoir vertically and these clusters extend for several tens or hundreds of meters laterally. Most other fracture types (e.g. layer bound/bed bound joints, regional joints, and stylolite related fractures) do not appear to play a significant role in dynamic performance of the reservoir under production.

Most fracture corridors are below seismic resolution. A core may offer information relating to small scale fracturing, but it misses fracture corridors because of poor core recovery from such intensely fractured intervals. Borehole image logs from horizontal wells provide the best sampling of fracture corridors. Normally only a limited number of image logs are available. Therefore deterministic identification and characterization of fracture corridors require full integration of static and dynamic indicators mandating an interdisciplinary/multidisciplinary approach.

The first phase of the workflow starts with interpretation and data analysis from borehole images and proceeds to integrate open-hole and production logs with image logs. The second phase focuses on evaluation and integration of dynamic indicators interpreted from production and injection history data, Kh and PI maps. Reservoir simulation with multiple iterations between the simulator and the static model provide key feedback to tune the fracture corridor model in terms of orientation, length and conductivity. With all the available data only a certain fraction of fracture corridors can be captured with some degree of uncertainty. The deterministically mapped fracture corridors that emerge from this workflow are then reviewed in the context of the reservoir structure and tectonic evolution. The goal is to reduce uncertainties and provide conceptual drivers for further mapping and modeling.