AAPG Datapages/Search and Discovery Article #90254 ©2016, GEO-2016, 12th Middle East Geosciences Conference & Exhibition, Manama, Bahrain, March 7-10, 2016

Methodology to discriminate Natural vs. Drilling Induced Tensile Fractures using borehole images — critical for wellbore failure analysis and natural fracture characterization.

Tariq Mahmood[1]

[1]ETSD, Saudi Aramco, Dhahran, SAUDI ARABIA

ABSTRACT

Natural and drilling induced tensile fractures are routinely interpreted from borehole images; they provide a unique, high-resolution, wellbore centric indication of the density and orientation of fractures for use in reservoir characterization, fracture modelling, geomechanics and comprehensive stress analysis. Determination of in- situ stress direction is critical for geomechanical modeling and misinterpretation can lead to serious errors, not only in the stress analysis, but in the overall characterization and development of the reservoir.

Compressive and tensile wellbore failures are direct result of the stress concentration around the wellbore that results from drilling a well and borehole images are the best available tools to identify these wellbore failures.

Ideally, drilling induced tensile factures can be distinguished in a vertical well because they form a pair of borehole parallel symmetrical fracture tracks (180° apart), striking parallel to one of the principal stresses. Unfortunately, drilling enhanced natural fractures and drilling induced tensile fractures can have similar appearances on the borehole images, especially in deviated wells. This paper concentrates on demonstrating a number of criteria that can be used to differentiate natural from drilling induced fractures.

Seven basic criteria to distinguish between natural and drilling induced tensile fractures has been established and demonstrated in this paper. These basic criteria include:

1) Does a flexible sinusoid perfectly fit on a fracture plane?
2) Natural fractures appear as planar features on the borehole images.
3) Drilling induced tensile fractures appear as non-planar, asymmetrical features on the borehole images.
4) Drilling induced tensile fractures propagate parallel to the axis of one of the principal stresses direction.
5) Is there a good match between borehole image interpretation and forward geomechanical modeling?
6) Relationship of true dip magnitude and dip direction with respect to the principal stresses.
7) Distinguishing between drilling enhanced natural fractures and drilling induced tensile fractures. Criteria No. 1 is the most applicable.

With selected examples of borehole images from vertical, deviated and horizontal wells, the aim is to demonstrate that with careful application of the basic criteria, one can correctly distinguish natural from drilling induced fractures.