A Data Processing Workflow for Borehole Enlargement Identification and Characterisation Using Petrophysical Logs

Caliper and image logs are customarily used to identify and characterise borehole enlargement zones; in particular, the breakouts. However, these methods are limited in their applications in many instances. In addition, good quality image logs are not available in many wells including old wells.

The possible influence of borehole enlargement on different petrophysical logs was investigated. While individual logs are unable to differentiate breakout from non-breakout zones, multi-variable analysis using a number of logs demonstrates an improvement in separating BO from nBO zones.

Different data processing techniques including wavelet, classifiers, and data fusion, were used for this purpose and also to generalise the results.

Separation of BO from nBO zones in a 3-D space using Caliper, NPHI and RHOB

Comparison of the model results (MV & OWA) and actual BO-nBO zones in a Carbonate reservoir shows a good agreement.

Analysis of field data shown correlations between breakout width and depth.

Elastic and elastoplastic finite element numerical models also showed how breakout width and depth could change due to a change in different rock properties. An MLP neural network was designed for predicting BO geometry using formation properties.

The models were verified by comparing the results of numerical analysis with real observations from field data.