Rock Strength Determination from Well Logs: A Review

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Accurate knowledge of rock strength is essential for in situ stress and wellbore stability analysis and prediction of solid production. Quantitative data on rock strength can only be obtained from cores. However, in most cases the core strength database will be limited, discontinuous and often biased toward stronger reservoir intervals and rarely available in non-reservoir sections where most of instability problems occur. Consequently, rock strength evaluation is primarily based on log strength indicators, calibrated where possible against core measurements. There are many published log-core strength correlations that can be used to develop a rock strength model. These empirical relationships are developed for specific rock types and their application to other rocks needs to be verified before they are utilized.

Applicability of about 45 empirical rock strength models is summarized and compared with an extensive rock strength core database from hydrocarbon wells around the world including several wells from Australia and South East Asia region. While some equations work reasonably well, rock strength variations with individual rock property show considerable scatter, indicating that most of the empirical models are not sufficiently generic to fit all the data in the database. Although rock strength estimation can be improved by multi-variable analysis, this requires additional logs and petrophysical interpretation that may not always be available, particularly during exploration and appraisal stages.

Field examples illustrate the application of novel computing techniques, such as fuzzy logic and genetic algorithms, which optimise and improve the strength estimation, are compared to commonly used empirical rock strength models.