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Application Of Fuzzy Logic And Mineral Modelling For Source Rock Evaluation Using Basic Well Log Data

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ABSTRACT

The exploration process requires best possible understanding of the source rock maturation, expulsion and migration. The source rock data may not be recorded in all the drilled wells. The wells which are drilled up to the basement are likely to encounter the source rock provided the well is drilled within the confinement of source area. The present study aims to evaluate the maturity, type of kerogen and type of hydrocarbon generated in the source rock using basic well log data. The part of source area, which the well has encountered, will contain different volume percentage of fluids, kerogen and matrix depending upon the maturity level of source rock. Therefore, the well log response will differ for different volume percentage of each of them.

In geoscience, uncertainty is inherent due to various limitations associated with recording & processing of data i.e. the data is never completely free of the error. Moreover, interpretation of the same set of data involves subjectivity. Therefore, a unique solution for a given geo-scientific problem is hard to establish. However, out of all the possible solutions of a given geo-scientific problem, there are solutions that are more likely than others are. This is the essence of fuzzy logic. The same logic is extended to present study in the sense that a particular set of log response can be received by any combination of volume percentage of various minerals and fluids but there are combinations that are more likely than others are, based on certain discretions (e.g. Source rock maturity will increase with increasing depth).

In the present study, single well data has been utilized which has encountered around 250m of source rock. Only the basic logs (GR, NPHI, RHOB & DT) are present for the study. Multiple models (total six) of source rock interval were generated by taking different minerals and fluids and varying their end-point values. All models expect model-1 show total error which are within acceptable range (<10%). This produced the ambiguity that all models from 2 to 6 are equally likely. Subsequently, available ditch cutting samples information was used to match the mineral models with rocks reported in the samples. Out of all models, the best match is obtained for model 6. Finally, by collating all available information the best-suited model is selected as the most likely solution.