PREDICTING THE OIL GAS RATIO WHILE DRILLING USING ADVANCED MUDGAS DATA

M. Niemann[1], T. Yang[1], I.H. Arief[1], M. Houbiers[1]

[1] Equinor ASA, Norway

The Gas Oil ratio (GOR) is normally established with the collection of physical downhole samples and PVT analysis. This approach is extremely expensive and time consuming; data are not available for several months. In unconventional HC systems, the situation is even more challenging due to the fact that no downhole samples can be collected. The only way to establish the GOR in such systems is to collect production samples, which will require the completion of the well and the stimulation of the target formations. Furthermore, due to processes introduced by the production itself and production over a depth interval, no direct in-situ GOR values can be established. On the other side however, GOR is a key parameter for the evaluation of fluid type, value, economy and producibility of the formation fluid.

In the past, several methods were developed to predict the GOR and to have these data available much earlier, ideally during the drilling process, in order to utilize them in the decision-making process. However, these models suffer from large error ranges, which basically make them unreliable and unusable. Our approach is focusing on the combination of advanced mud gas (AMG) data with our in-house PVT database. The evaluation of AMG data over the years has shown that these data, in terms of chemical composition, are comparable with the recombined fluid of PVT samples normalized to the range C_1-C_5, which makes their composition representative of the actual formation fluid. Furthermore, when utilizing the latest AMG technology, these data are available in real-time while drilling.

For our approach we train a machine learning model using our reservoir fluid database with more than 2000 PVT samples. Following a thorough evaluation of compositional similarities between PVT samples and AMG data, we apply the model derived from the PVT samples to our AMG data. The outputs are GOR predictions along the entire logged section, providing not only GOR values for specific depths, but also variations within the same formation or across different formations. In order to evaluate the outcome and accuracy of this process, the predicted GOR values from AMG data are compared with GOR measurements from corresponding PVT samples. Results from 22 wells, with both AMG and corresponding PVT data, show a good agreement between prediction and measurement. The accuracy of our model is significantly improved compared to previous methods reported in the literature. Alongside the model, a quality check (QC) metric was developed in order to efficiently flag low-quality AMG data, which provides a vital elevated confidence level for the GOR prediction based on AMG data when PVT samples are not available.

Our study shows that good quality AMG data can be used to quantitatively predict reservoir fluid properties while drilling. This information is available at an early stage, continuously for all logged sections and at relatively low costs. The method can be used to optimize wireline operations, and in some cases, it provides the unique opportunity to obtain reservoir fluid data when conventional fluid sampling or the use of wireline tools is not possible.