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QUANTITATIVE HYDROCARBON EXTRACTION FROM DRILLING MUD ALLOWS ACCURATE EVALUATION OF FORMATION FLUID COMPOSITION

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Since the earliest days of oil and gas exploration and production, the monitoring of gas extracted from drilling mud has been used as a basic hydrocarbon indicator. Until recently gas extraction and analytical equipment was not accurate or efficient enough to provide either reliable phase identification or more importantly, prediction of fluid properties. In order to significantly improve the quality of mud gas data and thereby provide more powerful interpretational techniques the mud logging companies have made significant efforts to improve well site mud gas technology. This talk will discuss the analytical and interpretation advances asscociated with the Geoservices FLAIR mud gas system.

The Geoservices FLAIR mud gas system incorporates significant improvements to the gas extractor, sample handling and analytical devices. Successfully tested in different geological environments since 2001, results have shown a dramatic improvement in mud gas quality (Breviere et al., 2002). This new "gas chain" consists of an innovative compact analyzer that uses gas-phase chromatography linked to a mass spectrometer (FLAIR detector) fed via specialized, non-adsorbing gas sample lines connected to two heated volumetric gas extractors (FLEX). These extractors not only provide vastly superior sample quality in comparison to samples obtained from traditional gas traps, but also facilitate quantification of gas recycling by obtaining samples from both mud IN and OUT lines. The FLEX extractors provide consistent and reproducible sample quality for all drilling mud types over a range of mud temperatures. Some of the most important features of the FLEX extractor include:

- A specific sampling device which can be placed close to the bell nipple to reduce gas losses during surface circulation.
- Near total reduction of atmospheric gas contamination due to the full immersion of the mud extractor probe in the flowing drilling mud.
- A volumetric pump ensures a continuous mud flow to the degassing chamber, thereby avoiding variable sample quality related to fluctuating mud levels.
- A pre-extraction mud heating system is used to provide consistent extraction of heavy components up to C_8.

Controlled and reproducible gas extraction is one of the key factors that allow quantitative interpretation of gas in mud. Constant mud and air flow rates, stabilized high temperature and controlled agitation inside the degassing chamber ensure the extracted gas quantities for each component are fully representative of mud content. Standardized gas extraction efficiency calibrations performed at the well site with the actual mud system provide the correction factors necessary to identify the true hydrocarbon-in-mud composition.

To be able to detect and analyse aliphatic and aromatic hydrocarbons as well as non-hydrocarbon gas components at the ppm level a gas chromatographic-mass spectrometer is utlised. Such a device not only allows the differentiation of co-eluting peaks but also ensures very short analyzer cycle times, for example 60 seconds for a full chromatographic analysis to C7, including differentiation of several Cn isomers.

Linking these two technologies together, we are now able to provide an evaluation of bottomhole fluid composition in the range of C1-C5 together with a qualitative appraisal of heavier components up to C8. Results have already been compared and found to be very close to those obtained from downhole PVT quality reservoir fluid samples.

Such high quality mud gas data can be further interpreted using multidimensional analysis, providing rapid recognition of the presence and distribution of different fluid types (fluid facies) within the well. Each fluid facies is characterized by its average composition and/or specific component ratios The resulting synthetic fluid log can greatly assist the characterisation of petroleum systems by the identification of cap rock effectiveness, reservoir characterization, fluid contact identification, determination of in-reservoir fluid heterogeneities and presence of biodegradation. As the information provided is related to the actual fluid and no longer dependant on any specific drilling context, it can also be extensively used for correlation in the context of multi-well studies.

This paper focuses especially on technology and extraction improvements which, when linked with specific interpretation method based on clusterization, allow accurate fluid identification and characterization. Application, including case examples, is covered in a separate submission.

REFERENCES

Breviere, J., Herzhaft, B., Mueller N., 2002. Gas Chromatography - Mass Spectrometry (GCMS) - A New Wellsite Tool For Continuous C1-C8 Gas Measurement In Drilling Mud - Including Original Gas Extractor And Gas Line Concepts. First Results And Potential, SPWLA 43rd Annual Logging Symposium.