Early Identification of Variable Fluid Compositions in Complex, Multilayered Gas Condensate Field

FLAIR quantitative analysis of mud gas data while drilling optimizes operator’s development plan

**CHALLENGE**
Identify formation fluid compositions while drilling through complex reservoirs, with a range of mud weights and additives used across different sections.

**SOLUTION**
Determine the C1–C5 composition of reservoir fluids quantitatively through FLAIR* fluid logging and analysis in real time.

**RESULTS**
Provided accurate characterization of reservoir fluids while drilling, consistent with offset PVT data, enabling early refinement of reservoir model and optimization of subsequent development program.

**Multilayered field with range of fluids**
An offshore gas condensate field in Asia is a complex asset consisting of more than one hundred layers of sand with varying fluid compositions. An early analysis of reservoir fluid distribution was required to optimize the development program. Formation porosity also varied, necessitating mud with changing rheology and relative densities ranging from 1.2 to 2.1. The different additives posed an additional challenge to formation fluid characterization.

**FLAIR quantitative analysis of formation fluid compositions**
FLAIR fluid logging and analysis in real time was used to continuously analyze gas extracted from hydrocarbons in the drilling mud returns at surface. Unlike conventional mud gas results, the FLAIR service provides a unique quantitative analysis of C1–C5 and qualitative information on the C6–C8 components (including methylcyclohexane) and light aromatics. Calibration of the extraction efficiency, paired with a correction for recycled gas, makes the C1–C5 fluid composition analogous to the composition of the downhole reservoir fluid.

FLAIR analysis clearly differentiates the C1–C5 composition of various formation fluids. Three fluid facies can be seen between X040 m and X340 m.
**Accurate fluid facies log while drilling**

FLAIR analysis clearly differentiated the C1–C5 compositions of the various formation fluids ranging from wet gas to condensate to light oil; a fluid facies log was delivered daily. Calibration of the extraction efficiency at the end of each drilling section effectively compensated for the varying impact of the different additives used to adjust mud weight on the efficiency of the gas extractor. The C1–C5 composition could thus be determined accurately. The results showed consistent, close correlation with offset PVT data. A linear relationship was established between FLAIR fluid compositions and GOR. Gas data was integrated into the reservoir model while drilling, enhancing production forecasts and development plans and significantly improving the downhole formation evaluation program.

**Representative chart of data from the FLAIR fluid analysis.** Molecular weights of the various reservoir fluids were determined from quantitative FLAIR gas data in the C1–C5 range and showed a linear correlation with GOR (determined through PVT analysis). Once the correlation was established, GOR could be determined in this field through FLAIR measurements, without additional downhole sampling.