Expanding XRF XRD Applications in Deep Water Projects


Abstract

Objectives/Scope: In the rapidly evolving field of offshore drilling, the use of X-Ray Diffraction (XRD) and X-Ray Fluorescence (XRF) in mud logging has seen significant advancements. Originally utilized solely for formation evaluation, these techniques have found broader applications over the last decade. This paper aims to further explore these developments, specifically proposing these methods as effective diagnostic tools for identifying and addressing challenges encountered in deep water drilling operations offshore Brazil.

Methods, Procedures, Process: This research outlines two distinct applications of XRF and XRD in analyzing drilling fluid samples and additives. We investigated an unexpected increase in Gamma Ray (GR) Logging-While-Drilling (LWD) response, using XRF/XRD to analyze mud cake samples from varying depths and the barite in water-based drilling fluids. In addition, we applied XRF/XRD to identify contaminations in barite additives, prior to being mixed to the drilling fluid. These cases highlight the potential of XRF/XRD to build synergy in the combination of drilling technologies and drilling fluids.

Results, Observations, Conclusions: To understand the response of the GR sensor, we analyzed three mud cake and two barite samples. The XRF qualitative analysis revealed the presence of Potassium (K) and Thorium (Th) in the fluid samples. Both Gamma Ray sensors in the LWD tool displayed identical responses, indicating their proper functioning. The unexpected sensor response was traced to contamination in the barite additive used to increase mud weight. Observed Th concentrations increase in samples from deeper sections, explaining the correlation between the rise in Gamma readings and the increase in mud weight.

In addition, we collected barite samples from the onshore fluid’s facility to quality control the additives prior to mix it to the fluid. We identified iron (Fe) and Calcium (Ca) in concentrations higher than expected, besides the presence of Thorium (Th) already found in the mud samples from the field analysis.

In the field, the XRF/XRD analysis confirmed the operational status of downhole tools. In the lab, XRF/XRD helped to identify barite contamination that initiated a discussion with the provider regarding the quality of the chemical consumables.

The results from the qualitative XRF analysis supported a better LWD data interpretation and a better comprehension of the Barite quality utilized for the drilling fluids fabrication. Moreover, XRF and XRD together can be used to trace back the source of contamination and determine potential mineral impurities not visible in standard mud reports. This highlights the potential path to be followed for the XRF and XRD equipment employed offshore Brazil.

Novel/Additive Information: In different offshore projects in Brazil, we applied the same methodology to both validate LWD data and to certify the quality of fluid additives, boosting the synergies between two different product lines. This paper presents these findings, demonstrating the potential of XRF/XRD analysis as a novel tool for integrated projects in offshore well construction operations.