5.7 SIP DETECTION AND QUANTIFICATION OF IRON SULFIDE (FES) MATERIALS: A PATHWAY TO EARLY MONITORING

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ABSTRACT

The presence of iron sulfide (FeS) scale poses a substantial threat to oil and gas (O&G) production, with significant potential for operational disruption. Unfortunately, current monitoring approaches fail to detect the FeS scale at its early stages, rendering timely remediation impractical. Spectral Induced Polarization (SIP), an established geophysical technique widely employed in near-surface environmental contexts, emerges as a promising solution. Notably, SIP's unique attributes, which encompass sensitivity to both bulk and interfacial properties of materials, position it as a potential tool for characterization and monitoring purposes. SIP's heightened sensitivity to metallic targets, including FeS, holds profound implications for identifying, assessing, and quantifying the FeS scale. This study conducted a controlled column experiment involving varied concentrations of pyrite (FeS2), a prevalent form of FeS scale, embedded within calcite. The primary objective was to explore SIP's discernment capabilities and to establish correlations between SIP signals and the properties of FeS2. The research revealed that the concentration of FeS2 within the samples exerted a direct influence on the SIP signals; greater concentrations correlated with amplified SIP parameter magnitudes.

Notably, the SIP method exhibited remarkable efficacy by detecting the presence of FeS2 at concentrations as low as 0.25% within the sample's bulk volume. This pivotal finding underscores SIP's potential as a reliable FeS2 detection technique, signifying a significant stride toward proactive monitoring and intervention. Furthermore, the study sets the stage for subsequent investigations to harness SIP's inherent strengths as a robust and dependable method for characterizing and monitoring FeS scale. This research highlights the dire need for early detection and mitigation of FeS scale's detrimental impacts on O&G production. The study showcases SIP's proficiency in pinpointing FeS2 even at minute concentrations, substantiating its promise as an effective detection methodology. Moreover, the findings illuminate the path for future inquiries into employing SIP as a cornerstone for precise and steadfast characterization and monitoring of FeS scale. Ultimately, the study's outcomes contribute significantly to the drive for enhanced operational reliability and efficiency within the O&G industry.

KEY WORDS: spectral induced polarization, disulfides, pyrite