

Utilization of a cuttings based advanced Ai, image and elemental analysis workflow to improve subsurface knowledge and regional geological definition: an example from the Devonian section, Awali Field, onshore Bahrain

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Abstract

Drill cuttings are an invaluable source of quality geological data and yet are often underutilized in our industry. Hundreds of thousands of drill cuttings samples are collected and stored in warehouses and repositories across the globe. With the onset of new AI-based technologies, these data can be quickly and consistently analyzed and interpreted to provide greater insight and to help better understand subsurface characterization and support key regional surfaces definition.

This study utilized 240 drill cuttings samples from two wells covering the Devonian Jauf and Jubah Formations across the Awali Field, on-shore Bahrain. Other log and core data were made available for review. The objective of the study was to utilize advanced AI image analysis of cuttings data together with elemental and other supporting data in order to generate a consistently measured, high resolution lithotype model applicable for the entire field. Lithotype definition would assist with cyclicity interpretation and ultimately regional sequence stratigraphic marker identification.

The drill cuttings samples were prepared and analyzed using portable custom-made benchtop equipment and interpreted for color extraction using various AI-based image analysis algorithms together with collected elemental data (32 elements and various key elemental ratios). The data was cross-checked against the MWD Gamma Ray measurement, and depth matched as required. This rapid and consistently measured analytical process together with supporting log and core analysis data enabled the construction of a robust lithotype model applicable to the Devonian section. Each sample was systematically classified in terms of the lithotype scheme, resulting in the generation of improved subsurface understanding.

Eight detailed lithotypes S1 to S8 grouped into three lithotype associations (S1-S2, S3-S5 and S6-S8) were identified, based on changes in color (a derivative known as Brightness) together with key elemental ratio data such as average Al (%), Mg (%), average Zr/Nb, Ti/Si and average Th/K. This was used to identify small to medium scale cyclicity (Brightening upwards cycles) which allowed for a further classification into regional Sequences SQ55 – SQ70.

With this generated information, it was possible to accurately compare these cycles and sequences well-to-well and identify key correlative surfaces and regional trends. For example, regional variations in Ti/Si per sequence suggest local changes in Si source from detrital to authigenic which may have consequences on drilling ROP. In addition, an increase in Mg and other elements coupled with a dominance of lithotypes S6-S8 during the late TST of Sequence SQ60, suggests the development of a more restricted bay environment at this time. These findings indicate complex changes in depositional environment and/or sediment sourcing across the field which could have implications for spatial changes in reservoir quality.

Utilizing an AI-driven drill cuttings-based approach to better understand subsurface Plays, typically requires a substantial initial investment and long analyses times. However, the workflow presented here offers increased efficiencies by providing a cost-effective and rapid method to collect, analyze, define, and predict key reservoir drivers. The ability to identify specific lithotypes from fresh and legacy drill cuttings will allow operators to better predict spatial reservoir definition and understanding across the field, thus improving subsurface model build and overall field development.