AI Assisted Geoscience Workflows Applied in the Deepwater Brazil Pre-Salt

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Abstract

Advances in Artificial Intelligence (AI) and its implementation assists and compliments subsurface geoscientific evaluation of the pre-salt Brazil assets. AI provides increased efficiency/productivity, a creativity boost through new ways of working, and quicker data-guided insights. This presentation provides a high-level overview of different facets of the AI-enabled geoscience workflows and share some examples of these workflows. Our journey starts with the identification of suitable Artificial Intelligence (AI)/Machine Learning (ML) solutions complementing the traditional interpretation, geological concepts or physics-based assessments. The search starts from solutions available in the industry, available inside Shell global digitalization/ ML initiatives or developed through the Brazil University Levy projects. The work then moves to either testing, adopting or modifying solutions or develop them internally to cater to our subsurface needs. Our key subsurface challenges, how AI can help and what we are doing so far in that space: Data conditioning: Our challenges commonly start with data; whether it is a missing section of log data, seismic with high noise content or noise with patterns like inter-bed multiples. For rebuilding missing log data, AI enabled tool usage is now common. For seismic data clean-up and enhancements ML tools developed by the Shell processing and digitalization team can provide effective solutions. Container geometry definition: A complex overburden over pre-salt fields poses significant challenges in building velocity and anisotropy models to get the container geometry, depth and depth uncertainty correct but also importantly to get the image right. When building velocity anisotropy prior models or updating them during processing, quick mapping or geo-body isolation of different contrasting velocity/anisotropy units can be performed by ML/human assisted ML tools. When translation of seismic-depth to depth is more than a simple layered analytical model assessment, AI can help finding relationships between overburden attributes and velocity. Delineation of strati-structural building blocks like reservoir facies/non-reservoir/fault-fracture prone areas: Delineation of reservoir heterogeneities that controls the fluid-flow behaviour in pre-salt carbonate reservoirs can be tricky but important. These fine scale features often having broad-scale facies association expressed with distinct seismic character and/or different acoustic/elastic properties. Supervised training of various geometrical or quantitative seismic attributes using well data can help the process or by using InteractiveAI, interpreter assisted single/multi-volume geo-body delineation or quick generation of fault-networks. Static property prediction: In-house and industry (QEarth) ML tools complement traditional inversion and rock-physics guided products to generate data guided property volumes, like porosity. Often generating these products can be quicker, sometimes with increased details as well as demonstrating credible blind well tests. Dynamic (4D) interpretation: An in-house Deep Learning assisted 4D inversion tool helps the generation of a saturation response for matching 4D seismic signals. The main benefit of AI/ML guidance for generation of reservoir characterization ingredients involves the quick generation of multiple non-unique data-guided products to test diverse static/dynamic scenarios for our assets.