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A Deep Temporal Network Methodology for Logging While Drilling Optimisation for Natural Hydrogen Recovery Optimisation

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Abstract

Recently, natural hydrogen—a source of hydrogen derived from underground rocks—has received a lot of attention. Natural hydrogen is found in volcanic gases, hydrothermal systems, the oceanic and continental crust, and other geological environments. The development of natural hydrogen is subject to various complex processes. Natural hydrogen may be seen as both biogenic and abiotic, despite the fact that the bulk of its sources appear to be abiotic. Despite the fact that logging while drilling (LWD) technology is already widely used in this paper, an overview of recent Artificial Intelligence (AI) methodologies and a unique methodology for evaluating hydrogen ingress from logging during drilling observations is presented. The techniques rely on a deep temporal network that combines various time-series derived well log data, such as gamma ray, doppler-based flow measurements, optical and electrical sensors, bulk density, and neutron porosity logs, to estimate the presence of natural hydrogen and quantify the concentration. The technique not only quantifies the values from the LWD measurement data but also calculates the degree of uncertainty in the identification of hydrogen. In hydrocarbon reservoirs, further studies are required to analyze naturally occurring hydrogen logs and optimize the well path for optimal output. A new deep learning approach for real-time LWD hydrogen identification was tested on simulated natural hydrogen reserves close to Kimball, Nebraska. The Salina Basin, a mid-continental basin between eastern Nebraska and Kansas, is situated in Nebraska and most of the potential areas are in the northwest and southeast of Nebraska. While sediments from the Cambrian to the Quaternary are also recorded, sediments from the Ordovician through Pennsylvanian (Upper Carboniferous) and Mississippian (Lower Carboniferous) eras predominate. In the Salina Basin, a basement terrane made up of metasediments and crystalline rocks from the Pre-Cambrian period, natural hydrogen has been found in a number of locations. The hydrogen inflow into the wellbore from the formation and zonal interaction were determined using time-series gas influx detection in conjunction with gamma ray, bulk density, and neutron porosity LWD data. The results demonstrate that the formation is capable of detecting an adequate amount of hydrogen input to maximize geosteering for natural hydrogen reserves. Natural hydrogen, which may be obtained from subsurface rocks, is considered to be a vital supply of hydrogen. Geosteering and recovery optimization through optimum well paths are challenging undertakings due to the unavailability of highly specialized LWD equipment for hydrogen inflow monitoring. The method is an AI-driven mechanism to identify hydrogen influx in real-time in order to enable Geosteering and well location decisions. It was successfully tested on a simulated natural hydrogen reservoir in Nebraska.