



Shallow Aquifer Sampling for Carbon Capture and Storage – Development of a Low Toxicity Tracer to Enable Low Contamination Water Sampling in a Water Based Mud System

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Abstract:

Aquifer water samples are a key component of carbon capture and sequestration (CCS) site characterization and are required in many jurisdictions. Often, these formations must be drilled with a water-based mud (WBM) system due to the proximity to the sea or the potential for potable water. To obtain high-quality aquifer samples using a WBM, an environmentally acceptable mud system was developed with a tracer chemical to monitor the sample pumpout. This system was successfully deployed in a shallow aquifer sampling job using a wireline formation tester.

The Northern Endurance Partnership (NEP) project is planning to store CO₂ in the Bunter Sandstone aquifer in the Southern North Sea (SNS). As part of site characterization, a shallow aquifer sample (at approximately 200 m BML) was required to characterize the fluid properties in the wider Bunter Sandstone aquifer. As no fluid data existed in the area, the composition of the water was unknown. A jack-up rig was obtained to drill a short borehole into the aquifer to allow the collection of fluid samples on wireline. Due to the shallow depth, it was deemed likely that the Bunter Sandstone is in hydraulic communication with the sea at this location. Therefore, common techniques for monitoring sample cleanup, such as resistivity, could not be used with certainty. To obtain low-contamination samples a tracer would need to be deployed. Tracers typically used in deeper reservoir sections are not acceptable for use in hydraulic communication to the sea, so an environmentally friendly tracer was required to be developed. Several chemicals were tested for their ability to be successfully built into a WBM formulation while also being able to model their concentration accurately using an advanced downhole fluid analyzer through optical density and/or fluorescent properties. This allows the chemicals to act as a tracer to monitor the sample contamination in real time during the wireline job. Chemicals were made up and tested in the operator's laboratories before being sent to assess suitability through workshop tests with an advanced downhole fluid analyzer. The best-performing tracer chemical was added to the entire circulation system of the drilling rig and deployed in a water sampling job in a shallow borehole in the SNS. Low-contamination (< 3%) water samples were successfully acquired at four depths. These results were verified by comparison with a deuterium oxide tracer (which can be tested in the laboratory only), whole core water samples, formation pressure gradients, and wireline log analysis. The data were then used as part of the project's environmental statement submission (United Kingdom regulatory permit). The tracer deployment was highly successful, and the operator is expecting to deploy the chemical again in other projects.

Bio:



Michael Taplin is the Senior Petrophysicist in the Northern Endurance Partnership subsurface team, based in Sunbury, UK. Michael has worked for bp across the Middle East, West Africa and the UK in a variety of Petrophysics roles. Michael holds masters and bachelor's degrees in Natural sciences from the University of Cambridge