SPWLA France & ASET SIG

2026 Semester 2 series:

“New Energies, New Molecules”

Webinar #1 about CO_2

"Advancing CCS Monitoring: Petrophysics, Geomechanics and Storage Performance"

Date: Monday September 7th, 2026

Timing: 2:30pm-4pm (Paris time)

Location: online

Subtitle: Insights from Pulsed-Neutron Logging and Integrated Petrophysics–Geomechanics–Rock Physics Workflows

Pulsed-Neutron Logs for CCS: Further Insights to Injectivity and Storage Performance

By Robert Laronga, SLB

Abstract:

Pulsed-neutron logs (PNL) are ubiquitous in measurement, monitoring, and verification (MMV) programs for carbon capture and sequestration (CCS) projects. As more projects mature, we continue to realize the uncertainties these logs can address beyond simple verification of containment. For example, initial injectivity is straightforward to evaluate, but it always evolves with time, usually for the worse. And the uncertain future CO2 saturation of the reservoir has critical implications for plume conformance. In this work, we examine how PNL interpretation addresses these risks. We show that in the complex CCS environment, standard interpretation of thermal neutron capture cross-section (sigma) often does not give representative saturation. Further, saturation at injection wells is most often not representative of saturation in the far field of the CO2 plume. We review current methods to predict saturation as a function of time and radial distance under partially miscible injection conditions and compare these to observations from PNL data on actively injecting projects. We also examine physicochemical processes in the near field of injection wells impacting injectivity and saturation, attempting to identify and quantify these phenomena via PNL interpretation. We find that dry-out, precipitation, halite banking, and capillary-driven backflow are all diagnosable, the latter two presaging loss of injectivity. Through time-lapse analysis of CO2-corrected porosity and sigma in a three-phase saturation model that incorporates time- and depth-variable brine salinity and solid halite precipitate, we can identify these conditions and monitor the change with time. Far-field saturation is readily determinable in monitoring wells, but requires breakthrough before it can be measured. Contrarily, saturation in injection wells can be measured almost immediately but is challenging to interpret accurately and is most likely not representative of the far field. We propose that under the right conditions, a careful injection well analysis that includes both sigma and CO2-corrected porosity using the three-phase model described above provides the basis to deduce, constrain, or quantify the far-field saturation. Advancing the timing and frequency of the earliest time-lapse acquisitions can help push this further. PNL time-lapse data are tremendously valuable to understanding storage and injectivity performance, though it is crucial to always use multiple PNL measurements and identify any limitations via careful comparison of the measurements. As only a handful of projects have reached the active injection phase, we are still learning. In the future, these insights may help design completions that gain injectivity over time instead of losing it.

Speaker

Robert LARONGA has 32 years of experience at SLB, working as an engineer, manager, geologist, integrated team lead, and a Petrophysicist both in the US and internationally. Rob currently supports the petrophysics domain for all of SLB's onshore operations in the U.S. and Canada. With the present wave of Carbon Capture, Usage, and Storage (CCUS) activity, Rob has participated in over 80 appraisals plus 8 MMV programs on actively injecting projects. He serves SPWLA Petrophysics journal as Associate Editor, Energy Transition, is Secretary of SPWLA's Alternative Subsurface-Energy Transition (ASET) SIG and has coauthored six SPWLA papers on CCS, receiving a 2023 Best Petrophysics Journal Paper Award, a 2024 Best of Symposium Award, and a 2024 Best Petrophysics Journal Paper Award.

CCS Petrophysics–Geomechanics–Rock Physics Integration: A Worked Field Example to Improve Monitoring Efforts

By Hendrik Rohler Independent

Abstract:

We present the subsurface evaluation of a real-world carbon capture and storage (CCS) project, highlighting an integrated petrophysics–geomechanics–rock physics workflow. A stochastic mineral solver combined with nuclear logs is used to estimate storage capacity and flow potential. Nuclear magnetic resonance (NMR) logs and special core analysis (SCAL) data provide key inputs for forecasting CO2 storage performance across different project phases. Full-waveform sonic logs, augmented with wireline formation tester data, mini-frac tests and laboratory rock-mechanics measurements, are incorporated into a geomechanical and wellbore stability model. This enables prediction of reservoir and rock mechanical properties under relevant effective stress conditions. Fluid substitution modelling is then applied to evaluate the impact of saturation changes on seismic responses. A novel stochastic workflow is introduced to quantify uncertainty in derived drained elastic moduli. The deliberate separation and redundancy of nuclear, NMR, and sonic datasets ensure internal consistency and support robust uncertainty assessment throughout the workflow. A key finding is that only a limited set of parameters exerts primary control on the results. This insight allows us to identify targeted actions to improve reservoir saturation monitoring and reduce uncertainty in CCS performance predictions.

Speaker

Hendrik ROHLER has over 30 years of experience in geophysics and petrophysics, spanning both service and operating companies across multiple continents. He holds an MSc in Geophysics and a PhD in Hydromechanics and has authored numerous publications on log and rock analysis. He currently works as an independent consultant, supporting geothermal and CCS development projects.