Webinar Lunch & Learn technical session on

" CCUS in Mature Fields: How Core-to-Log Data Driven Analytics Enhances Mechanistic Models for the Purpose of Reservoir and Caprock Mineralogical Characterization"

Speaker : Marco Pirrone (ENI HQ)

Date : Friday, December 16, 2022

Time : 12:00 pm – 13:00 pm (UTC +01:00 Paris)

Admission : Free registration using the link below

https://register.gotowebinar.com/register/8316690987016438614

After registering, you will receive a confirmation email containing information about joining the webinar.

Contact : contact-us@spwla-france.fr

CCUS in Mature Fields: How Core-to-Log Data Driven Analytics Enhances Mechanistic Models for the Purpose of Reservoir and Caprock Mineralogical Characterization

Speaker : Marco Pirrone (ENI HQ)

Abstract: The work discusses how an integrated data-driven analytics (DDA), mechanistic petrophysical and mineralogical modeling can enhance the characterization of reservoirs selected for Carbon Capture, Utilization and Storage (CCUS) projects. The approach makes use of exhaustive core datasets to generate synthetic mineralogical curves at wells, hence expanding the available log information. This allows a robust and complete quantitative analysis of storage and sealing intervals through a DDA-informed physics-based methodology. The growth of interest around CCUS pushes towards in-depth analyses of reservoir layers, as well as of the sealing ones. In brown fields the available open-hole (OH) logs might not be enough for a detailed lithological and petrophysical characterization, which is mandatory to establish the storage capacity of the assets. Hence, the proposed methodology starts from X-Ray Powder Diffraction (XRD) core data representative of the field under investigation for both reservoir and non-reservoir sections.

Next, DDA is used to generate synthetic volumetric fractions of given minerals after an ensemble learning relating core mineralogy and selected logs. The DDA-based log mineralogy and the other available OH logs are then input for conventional mechanistic models to obtain final petrophysical and mineralogical properties. The added value is demonstrated through a real case study, where a CCUS project is ongoing for a mature field. From the mineralogical standpoint, experimental studies performed for several cored wells show a wide composition variety with different coexisting phases including carbonates, silicates, feldspars, micas and clays. The main criticality is represented by the OH log datasets that are often incomplete and ineffective to provide a straightforward formation evaluation consistent with the complexity highlighted by core analyses.

Therefore, after the calibration of the ensemble learner with hundreds of XRD data, high-frequency dielectric and reprocessed nuclear logs, the DDA steps have been successfully applied to about a hundred wells for obtaining synthetic mineralogical curves. These augment the information of the available measured logs and allow the definition of a physics-based interpretation model able to properly characterize both the reservoir and caprock layers. In addition, the most reactive facies to carbon dioxide are recognized and represent another significant step forward to evaluate the sealing efficiency and integrity over time at field scale.

The presented workflow is deemed able to provide a strong mineralogical and petrophysical characterization template in case of incomplete/not exhaustive wellbore dataset. The outcomes are fundamental for several aspects in CCUS projects, including reservoir modeling, geomechanics, geochemistry, monitoring phases and risk management.

About the Presenter :

Marco Pirrone is Production Petrophysics Team Leader at Eni HQ and he has been with the company since 2009. He specializes in dielectric dispersion log analysis, rock physics modeling, nuclear magnetic resonance in porous media, cased-hole formation evaluation, wellbore integrity, production logging and data-driven analytics for reservoir characterization. He is now a focal point for the definition of downhole monitoring activities in CCUS and UHS projects, as well as for the development of new approaches in energy transitions. Marco has authored or co-authored more than 40 technical papers and joined the 2016-2017, 2019-2020 and 2022-2023 SPWLA Distinguished Speaker programs. He holds a MSc degree in Physics and a PhD in Theoretical Physics from the University of Milano-Bicocca, Italy.