



Seminar

Carbon Capture and Sequestration: A New World of Petrophysical Applications

Date: Friday 22nd March 2024

Location : Société Géologique de France (SGF), Paris.

Start time	End time	Presenter	Title	Company
09:45	10:00		Welcome and introduction	SPWLA France
10:00	10:30	Andrew Mangeon-Fairweather	Exploration CCS screening	TotalEnergies
10:30	11:30	Vincenzo De Gennaro	Dynamic coupled flow and geomechanical modelling	SLB
11:30	11:50		BREAK	
11:50	12:20	Kateryna Voronetska	Experimental and numerical approaches to assess well integrity	IFP-EN
12:20	14:00		LUNCH	
14:00	14:30	Sylvain Thibeau	CO2 storage technical challenges	TotalEnergies
14:30	15:00	Sylvain Thibeau	CO2 storage resources evaluation in saline aquifer	TotalEnergies
15:00	15:30		BREAK	
15:30	16:10	Benoît Dechelette	CO2 Injection into depleted gas fields, some well performance challenges – ARAMIS Phase 1 example	TotalEnergies
16:10	16:40	Kamal Jansen	Monitoring, Measurement and Verification (MMV) Technology – How fiber optic gains popularity in subsurface CO2 Storage monitoring	SLB

The seminar is free to attend and registration is required. The abstracts of the presentations can be seen in the website <https://spwla-france.fr/>

SPWLA FRANCE, CCS One Day Event

Friday, March 22nd, 9.45am – 5.20pm



Exploration CCS screening by Andrew Mangeon Fairweather (TotalEnergies)

Climate and energy policy around the world has identified carbon storage as a critical technology to achieve net-zero ambitions. For targets to be achieved, carbon storage in both saline aquifers and depleted fields will be necessary. This presentation provides an overview of the initial exploration screening phase of potential carbon storage aquifers as well as an introduction to how they are evaluated and risked.



Andrew Fairweather, originally from the United Kingdom, embarked on his professional journey as a hydrocarbon exploration geoscientist at TotalEnergies in 2010. Over the years, Andrew has had the privilege of working in diverse locations, including France, Libya, Malta, and Denmark. In 2021, he made a transition to focus on carbon storage exploration within Europe. Currently, Andrew resides in the south of France with his young family where they enjoy easy access to the Pyrenees in winter and the idyllic beaches of the Côte d'Argent in summer!

Dynamic coupled flow and geomechanical modelling applied to CCS.



Vincenzo De Gennaro (Domain Head CCS Subsurface Modelling | Geomechanics Advisor)

Subsurface modelling is crucial in CO₂ sequestration risk management to assess potential exposure to emissions, such as groundwater contamination or atmospheric release. It is widely acknowledged that various risks associated with CO₂ sequestration, such as fault reactivation, cap rock failure, and well integrity, can be mitigated through coupled dynamic flow and geomechanics analysis. Underground re-pressurization via CO₂ injection involves pressure and temperature changes as well as rock-fluid interaction (geochemical changes). This is also known as Thermo-Hydro-Mechanical-Chemical (THMC) coupling. The consequences of pressure and temperature changes will depend on the interacting components (fluids, rocks, completion materials), the initial conditions, the operating conditions. The lecture will discuss aspects associated to THMC coupled modelling applied to CO₂ storage performance assessment, with particular emphasis on uncertainty evaluation and risk assessment.

Vincenzo has thirty years' experience in theoretical and applied geomechanics, including eighteen years' experience in O&G industry related projects. He graduated as Civil and Geomechanical Engineer at University of Rome (1992). He holds a Master of Science degree in Mechanics of Solids and Poromechanics (1994) from University of Paris 6 and Ecole Polytechnique (France), a PhD in Geomechanics (1999) from Ecole Nationale des Ponts et Chaussées - ParisTech (Paris, France) and he's Habilitated Research Director at Ecole Nationale des Ponts et Chaussées - ParisTech (Paris, France) since 2009. He joined SLB in 2009 as Geomechanics and Unconventional Gas Specialist. Starting from 2011 he embraced the larger spectrum of geomechanical applications related to energy. He's currently Domain Head for CCS Subsurface Modelling and Geomechanics Advisor. His activities encompass exploration, appraisal and production related projects, onshore and offshore drilling integrity studies, coupled reservoir geomechanics analysis, geomechanics for unconventional (completion quality evaluation and hydraulic fracturing modelling), sanding, underground gas storage (natural gas and anthropogenic CO₂), nuclear wastes disposals.

Vincenzo De Gennaro: vdegennaro@slb.com

Experimental and numerical approaches to assess well integrity, by_Kateryna Voronetska (IFP-EN)

In the near-well area, interfaces represent the most probable leakage paths, through delamination and formation of micro-annuli (between cement and steel casing or cement and formation). Several authors used a near-well finite element analysis to show that the different parts of the completion (casing, cement, rocks) were below their mechanical critical stress for the studied cases. Detailed laboratory investigations, however, are still required to fully determine damage criteria for the cement/steel interface itself.

IFPEN owns a wide range of efficient and various experimental facilities that we can use to study the materials behaviour under the relevant transport conditions. Over the last 4 years, IFPEN performed an experimental characterization of cement/steel and cement/formation interfaces with and without exposure to CO₂ on the reduced well scale and developed numerical simulations on the scale of the well. The objective of the presentation will be to share our global approach used to assess well integrity.



Kateryna Voronetska is a project manager at IFPEN (IFP Energies nouvelles) in charge of "CO₂: conditioning, transportation and well integrity". Kateryna is graduated of both the National University of Dnipropetrovsk (Ukraine) and the École Normale Supérieure de Cachan (France). She specialized in Fluid Mechanics and Mathematics. In 2012, she defended her PhD thesis in fluid mechanics with University of Bordeaux and IFPEN. Previously Kateryna worked as a 'Reservoir Engineer' at Beicip-Franlab and then as a 'Process Modelling Engineer' in Air Liquide's Research and Development Centre, where she leads a number of CFD modelling and simulation studies, in particular for the gas separation processes and medical industry. In 2014, she became project manager in charge of adsorption simulation. Kateryna returned at IFPEN in 2019 as a research engineer in the Applied Mechanics and Physical Chemistry department. She was appointed head of the "CO₂: compression, transport and well integrity" project in 2021, for the "Chemistry for Industry Results Centre".

CO₂ Storage technical challenges by Sylvain Thibeau (TotalEnergies)

CO₂ storage has many similarities to fluid injection and production during standard Oil and Gas production but also striking differences. Some due to the nature of the fluid injected, other due to the objective of long term and potentially pressurized storage. I will discuss consequences for depleted reservoirs and saline aquifer

CO2 Storage resources in saline aquifers by Sylvain Thibeau (TotalEnergies)

Analytical aquifer methods (Van Everdingen & Hurst) have been used for decades to model aquifer support for oil and gas production. We have extended the method to saline aquifer CO2 storage, to estimate pressure limited resources - <https://doi.org/10.1144/geoenergy2022-003>

Sylvain Thibeau – Expert, geological storage of CO₂



Sylvain Thibeau works for TotalEnergies and is focused on CO₂ geological storage in 2000 when based at the Stavanger Research Centre evaluating Sleipner CO₂ storage modelling and monitoring technologies. Sylvain led the geosciences and reservoir aspects of the Lacq demonstration pilot where 51 000 tonnes of CO₂ were injected onshore France between 2010 and 2013. He was appointed Expert in CO₂ geological storage and acid gas reinjection in 2011. He is now providing guidance to TotalEnergies CCS studies, whether R&D, development studies, large scale evaluations. He also leads the OGCI Storage Work Group developing the CO₂ Storage Catalogue, the first global, open database of published CO₂ storage assessments and is a member of the SPE CO₂ Storage Resource Committee. Sylvain Thibeau is the author of over 40 publications related to CO₂ geological storage, four of them cited more than 100 times. He is also co-editor of two books (Results of CO2Store R&D projects and Results of the Lacq-Rousse demonstration pilot).

CO2 Injection into depleted gas fields, Some Well performance challenges – ARAMIS Phase 1 example by Benoît DECHELETTE (TotalEnergies)

During CO₂ injection into depleted gas fields, wellperformance will have to accommodate the very low reservoir pressure at early stage and the strong reservoir pressure increase at later stage; which brings different constraints. Problematic and solutions retained for Aramis phase 1 will be presented.

Benoit Déchelette – Wellperformance specialist for CCS projects



Benoit Dechelette works for TotalEnergies since 2001 and is currently focused on Wellperformance aspects of CCS projects. After a Master of Science in Petroleum Engineering in the IFP school, he started working for TotalEnergies in France as reservoir engineer. He then moved in many affiliates during almost 15 years (Libya, Gabon, Argentina, Netherlands and Russia) where he occupied various positions in Geosciences, WellPerformance and production optimization. Since 2022, he is back to France where he coordinates CCS wellperformance studies and provides guidance for them.

Monitoring, Measurement and Verification (MMV) Technology – How fiber optic gains popularity in subsurface CO2 Storage monitoring by Kamal Jansen, CCS Technical Director, SLB

Carbon Capture and Storage (CCS) is gaining momentum in the last few years driven by public pressure to decarbonize the energy system and supported by various regulations that either incentivize or penalize emitters to reduce their carbon footprint. Subsurface sequestrations of CO₂ have the

potential to scale up to meet the challenge and contribute to the global emission reduction as outlined by International Energy Agency (IEA).

To ensure that the CO₂ is safely stored in the subsurface, regulators have mandated a series of Monitoring, Measurement and Verification (MMV) requirements to the storage operators. Various technologies are required to monitor the surface / near surface of the storage site, the subsurface and well integrity. A combination of these technologies is required to satisfy the regulatory requirements and ensure that the whereabouts of the CO₂ plume underground is known.

Within the MMV technology portfolio, fiber optic is gaining popularity and being considered as the technology of choice for CCS projects, whenever it is possible to be deployed. When pulses of laser is sent into the fiber, reflected wave known as backscatter frequency carries interesting data alongside the length of the fiber. Various applications is made possible by carefully discriminating the backscatter frequency spectrum. Distributed Temperature Sensing (DTS), Distributed Acoustic Sensing (DAS) and Distributed Strain and Temperature Sensing (DSTS) are the techniques used in optic based monitoring systems. A closer look at this technology and its applications will hopefully provide the audience with an understanding of its value and why it is suitable for CO₂ storage monitoring.

Kamal Jansen has more than 25 years of experience in the energy sector, working in various capacities including business development, consulting, operations management, and technical role. He holds a bachelor's degree in electrical engineering majoring in computer science and system control. He also holds an Executive Master of Business Administration from University of Western Australia. During his long career, he resided and worked in different countries in Asia, Australia, Central Asia, USA and Europe. He is currently the CCS and New Energy Technical Director for SLB, based in Paris, France. Within the CCS space, he is responsible for the application of CO₂ storage evaluation and monitoring technology.