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2023 DISTINGUISHED INSTRUCTOR SHORT COURSE

WITH PHIL RINGROSE

Storage of Carbon Dioxide in Saline Aquifers

Building confidence by forecasting and monitoring

12th & 13th DEC • TOKYO VIRTUAL

Course Duration: One day

Description

Interest in carbon capture and storage (CCS) is growing rapidly as a crucial part of global efforts to reduce greenhouse gas emissions into the atmosphere. To support this growth in capture technology, we need an acceleration in new CO_2 storage project developments. In this course, we review the science and technology underpinning CO_2 storage in deep saline aquifer formations using insights from several industrial-scale projects. We analyze the main factors which limit storage capacity – constraints governed by flow dynamics, injectivity, pressure development, and geomechanics. Then, this physical basis provides a framework for determining how to optimize monitoring methods. Using the latest portfolio of geophysical methods for smart and cost-effective monitoring at the surface and downhole (including conventional seismic acquisition, passive seismic listening, and fiber-optic sensing), we discuss how short- and long-term storage assurance can be demonstrated with high levels of confidence. Next, we address the question of what is needed to achieve climate-significant scales of CCS deployment. Although technically achievable, the current socio-economic framing often makes storage project execution difficult in practice. By building technical confidence in project execution, we may be able 'turn the dial' and realize the gigatonne levels of storage needed over the coming decades.

Questions answered in this course

- What are the main processes involved in the geologic storage of CO_2?
- How should we estimate CO_2 storage capacity?
- What is the physical basis for estimates of storage efficiency?
- What are the constraints to storage? When does injectivity matter? Are pressure limits the main issue?
- What are the geomechanical limits? Should we expect significant levels of induced seismicity?
- How can we optimize monitoring methods to make them smart and cost-effective?
- How reliable is time-lapse seismic monitoring for detecting small CO_2 volumes in the subsurface?
- How can fiber-optic sensing (DAS) reduce the costs and footprints of monitoring schemes?
- How can we apply advanced analysis (e.g., FWI) for monitoring using sparse acquisitions?
- How can we assure long-term containment? What about leakage risks?
- And finally, is the required global scale-up in CCS deployment achievable?

Goals

The goal of this course is to review the main concepts involved in the engineered storage of CO_2 in saline aquifer formations, dispelling some common misunderstandings along the way. After explaining the main trapping mechanisms, we critically assess methods for estimating storage capacity and evaluate the key constraints for achieving the storage volumes needed over the project's timeframe. The course material has a strong focus on geophysical monitoring methods and data sets, which are key to the stated objective of building confidence in the technology and assuring long-term storage integrity.

Who should attend

All those interested in understanding the state of play in saline aquifer CO_2 storage technology will benefit from this course. The primary target audience is multi-disciplinary subsurface teams, and the content covers relevant aspects of

geoscience, geophysics, and reservoir engineering. Managers, team leaders, and business developers also should find most of the material accessible. For subsurface specialists, the focus is on learning across disciplines (e.g., how might flow analysis affect site selection choices or how do 'geological details' impact the engineering assessment?). With a strong focus on advanced geophysical monitoring (especially time-lapse seismic), geophysicists will find the course helpful for designing and interpreting seismic monitoring data sets. This course does not require advanced mathematical knowledge, although several governing equations are introduced and used. The main objective is to provide an intuitive understanding of the geoscience, physics, and geophysics of CO_2 storage in saline aquifers. A familiarity with integrated 3D subsurface modeling and seismic interpretation tools will be an advantage but is not essential.

Course Book

Course attendees receive the book as part of the registration fee. If you are unable to attend the DISC course but are interested in the book, it can be purchased separately in print or as an ebook.

Instructor Biography

Philip S. Ringrose is a Specialist in reservoir geoscience at Equinor and Adjunct Professor in CO_2 Storage at the Norwegian University of Science and Technology. He has been engaged with many CCS project developments over the last 15 years and has published widely on reservoir geoscience and fluid flow in rock media, including the textbooks 'Reservoir Model Design' and 'How to Store CO_2 underground.'

Ringrose holds a BSc in geology from the University of Edinburgh and a PhD in applied geology from University of Strathclyde in Scotland. He is a member of SEG, EAGE, and the Geological Society (London), and was the 2014-2015 President of the EAGE. In 2018 he was appointed as Honorary Professor at the University of Edinburgh and in 2020 he was elected as a member of The Royal Norwegian Society of Sciences and Letters (DKNVS).