CIVIL AND ENVIRONMENTAL ENGINEERING

Ateneo - Characterization of underground fluid storage

Funded By	Politecnico di TORINO [P.iva/CF:00518460019]
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Context of the research activity	Energy transition is a process toward decarbonization of the energy sources and mitigation of greenhouse gas emissions responsible for climate change. Renewable sources are considered key to decarbonizing energy systems and reduce dependency on fossil fuels. However, in the short-to-medium term, renewables will not be sufficient to replace fossil fuels. Natural gas is currently an essential part of the energy mix and underground storage provides a means for balancing supply and demand. To compensate CO2 emissions from burning fossil fuels, strategies such as CO2 capture and permanent storage (CCS) have been developed and applied in this transition to a more environmentally sustainable scenario. Storage in deep geological formations is considered one of the most significant and viable options for CO2 sequestration. Furthermore, technologies relying on solar energy and wind power are unstable and intermittent by nature. However, electrical power can be transformed into chemical energy in the form of H2 which can then be stored and used at a later time. It follows that several aspects of the energy transition require underground storage. At present, there are still scientific and technological challenges for efficient, economically and environmentally viable storage processes of natural gas, CO2, and hydrogen. The research is concerned with such scientific challenges, which are related to system characterization and numerical simulation.
Objectives	Whatever the considered fluid, underground gas storages require a multi-disciplinary study approach to define their capacity, injectivity, and integrity. Capacity depends on the storage porous volume at reservoir conditions and the fluid thermodynamic behavior. Injectivity requires the characterization of the rock's effective permeability to the injected fluid at reservoir conditions. Integrity comprises the hydraulic sealing efficiency of the cap rock, typically a low-permeability clayey formation, which must guarantee the long-term confinement of gases in the underlying reservoir. The research topic concerns theoretical and laboratory investigations to characterize the properties of a storage, experimental validation of the methods and of the obtained results, and analytical and numerical modeling of the phenomenon (or combination of phenomena) to be described at the relevant time and space scales. The focus of the PhD project is the laboratory determination of the key fluid, petrophysical, and fluid-rock interaction parameters (PVT,

	porosity, permeability, and threshold capillary pressure) of underground fluid storages and the subsequent forecast of the storage capacity, injectivity, and integrity with 3D numerical simulators using the obtained data as an input to predict the system response to fluid injection (and withdrawal when applicable) under a range of operational conditions.

Skills and competencies for the development of the activity	Strong background in petroleum engineering. Knowledge of laboratory testing equipment and methodologies for fluid and rock petrophysical characterization and 3D reservoir numerical simulation. A MSc degree in Petroleum Engineering / Petroleum and Mining Engineering / Georesources and Geoenergy Engineering will be preferentially considered.