EGU22-2440
https://doi.org/10.5194/egusphere-egu22-2440
EGU General Assembly 2022

Understanding the effects of leaking gas in geological carbon sequestration through geophysical characterization of natural CO2 gas emission systems

Rosanna Salone, Claudio De Paola, Luigi Ferranti, and Rosa Di Maio
Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli Federico II, Naples, Italy

Gas leakage from deep geologic storage formations to the Earth's surface is one of the main hazards in geological carbon sequestration and storage. Permeable sediment covers or natural and artificial pathways, such as faults and well structures, are the main factors controlling surface leakages. Therefore, the characterization of natural systems, where large amounts of CO_2 are released, can be helpful for understanding the effects of potential gas leaks from storage carbon systems. In this framework, we propose a combined use of geoelectrical investigations (i.e., resistivity tomography and self-potential surveys) for characterizing natural CO_2 leakage areas, as well as gas storage sites. Such methodologies appear to be among the most suitable for revealing spatial distributions of carbon dioxide and monitoring subsurface fluid migration processes, because of the strong dependence of the electrical properties of water-bearing permeable rock, or unconsolidated materials, on many factors relevant to CO_2 storage (i.e., porosity, fracturing, water saturation, etc.). Indeed, the electric resistivity of porous water-bearing sediments decreases significantly when CO_2 dissolves in pore-water, in contrast to the effect in the gas phase and supercritical CO_2, while the anomalous concentrations of natural electric charge are directly related to carbon dioxide migration along porous and fractured rock systems. The effectiveness of the suggested multi-methodological geoelectrical approach is tested in some areas of natural CO_2 degassing located in the Southern Apennines (Italy), which could represent natural analogues of gas storage sites. Specifically, electrical resistivity and self-potential surveys are targeted at reconstructing shallow buried fracture networks in the cap-rock and detecting preferential CO_2 migration pathways. Our findings are promising for imaging the CO_2 plume within a carbon storage reservoir and for identifying possible CO_2 leakages through the cap-rock formation, suggesting that the proposed approach can be very helpful also for the monitoring of carbon sequestration systems.