“Microbial aspects of underground hydrogen storage (UHS) and underground bio-methanation (UMR)”

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To reach the goal of a carbon neutral economy by 2050, as proposed by the European Union, development of both energy production and storage systems should be finely tuned to ensure the transition towards the full utilization of renewable sources.
The exploitation of depleted underground geological formations as storage sites for different type of gases represent a valuable solution allowing for high storage volume, stabilization of energy prices, wide diffusion of renewable energy carriers (i.e. green hydrogen, bio-methane). Although the practice of Underground Gas Storage (UGS) has been widely investigated, in recent years the possibility of storing other gases (i.e. hydrogen, carbon dioxide) in geological formations, triggered a wide number of studies encompassing the field of engineering, chemistry and geology. The main aim of such characterizations is the definition of the interactions occurring between the injected gases and the reservoir structures.
From the microbiological point of view, the presence of peculiar populations of both lithotrophic and organotrophic microorganisms inhabiting the reservoir could result in different impact on either storage or production of renewable energies.
Generally, reservoir microbial populations are characterized by the presence of acetogenic/homo-acetogenic and sulphate reducing bacteria along with methanogenic archaea. Although widely used in biotechnological applications, the interactions of the above-mentioned microbial clusters in reservoir environments and their response to gas injection still needs to be fully understood. In a game of balance, the activity of this microbes could allow or hinder storage of renewable energies, whilst at times they could provide resources for their production.
The aim of this work is the critically investigate the microbiological aspects of geological formations and the possible impact that such microorganisms could have on the energy transition, by considering both storage and production of renewable energies. Particularly, we will be referring to study cases evaluating the possibility of converting depleted gas reservoir on the Italian territory into underground hydrogen storage (UHS) sites and the perspective of developing underground bio-methanation reactor (UMR).