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Preliminary assessment of possibility for hydrogen production in geological formations

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Abstract

Hydrogen will play a significant role in economy decarbonisation, including a large part of heavy industry and transport systems that together are responsible for 52% of CO2 emissions. According to the International Energy Agency estimates 400Mt of hydrogen will be used in 2050. This will require cheaper clean hydrogen alternatives to green hydrogen that uses renewable energy to split water. One such alternative might be underground hydrogen generation. Estimated hydrogen production rates mainly from mafic/ultramafic and granitic rocks (water radiolysis and serpentinization) for onshore Australia down to a depth of 1 km gives an H2 resource potential ~1.6-58 MMm3year-1. While these figures show tremendous potential, in the inventory of global H2 inferred resources, Australian hydrogen is either under-represented or not accurately estimated. The prediction and subsequent identification of hydrogen that can be generated underground remain enigmatic. Moreover, developing underground hydrogen production faces a number of challenges that require fundamental research. These challenges include but are not limited to potential host rock description, quantification, mapping, and understanding of optimal generation/production conditions - specifically, the rock physics of coupled processes in porous media.

In this work, we develop AI/ML-based technology to search for Hydrogen Generation Optimal Locations (HGOLs) analysing the Australian National Rock Collection. The technology is based on existing infrastructure, namely, the National Virtual Core Library and the fleet of CSIRO-invented HyLogger spectral scanners in all State Geological Surveys. As geological lithotypes are critical for screening for HGOLs and subsurface energy storage, a rapid spectroscopic logging and imaging scanner (HyLogger) is used to digitise rock chips/cuttings, the only continuous record of lithotypes extracted from the subsurface. Recently developed AI/ML and computer vision algorithms are trained, validated, and tested for automatically extracting lithological information from the digitised database. We concentrate but do not limit ourselves to the datasets from the onshore wells in Australia, including those where geogenic hydrogen has been detected. The work combines AI/ML approaches and domain expertise to understand HGOLs across Australia and assist geologists with decision-making via a fast, automatic, non-biased, and user-friendly application. It will improve data discoverability and automatic search for HGOLs as well as be suitable for compressed air and CO2 storage, critical energy minerals, rare earth elements, etc. The outcomes will enable rapid and objective business decision-making about land and underground use for which energy and mineral exploration, underground energy storage, and the solar/wind farm industry are competing now.