3D MT mapping of natural hydrogen prospectivity in South Australia

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SUMMARY

Natural (or 'gold') hydrogen is emerging as a cost-effective and transformative renewable energy resource in Australia, with South Australia leading exploration and licensing initiatives. This study aims to map potential natural hydrogen sources and migration pathways in the crust of the Eyre Peninsula and Yorke Peninsula. We use an integrated approach combining land and marine long-period and broadband MT and legacy geomagnetic depth sounding (GDS) responses to create a regional 3D resistivity model of the crust and mantle. This region, situated on Archean to Paleoproterozoic basement of the Gawler Craton, has been shown to have potential to generate natural hydrogen via serpentinization of mafic basement, radiolysis from naturally occurring Uranium and Thorium, and mantle degassing along lithospheric-scale fault.

Our results identify significant crustal variations in resistivity, with mid-crustal regions (5-20 km depth) of <1 Ohm.m that are potentially associated with carbon-rich Paleoproterozoic sediments in continental accretionary settings, and delineate the granulite-facies mafic lower crust at depths > 20 km. Significant crustal-scale faults bound these regions of low resistivity, which have been reactivated through multiple orogenic phases, and are still seismically active. We argue that there is significant potential for hydrogen migration through these crustal-scale faults, and by mapping their vertical extent to the surface we can define regional scale prospectivity to target new exploration targets.

Keywords: Natural hydrogen; South Australia; serpentinization; radiolysis; lithospheric faults