Formulating a natural hydrogen prospecitivity map of South Australia

M A Daruso[1]

1.Event Manager, AusIMM Adelaide Student Chapter, 5031. Email: rumi.daruso@outlook.com

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ABSTRACT

Natural hydrogen has been identified as a promising source of inexpensive clean fuel in the formation of a low-emission energy economy, with many explorations attempts particularly focused in South Australia. This work attempts to produce one of the first hydrogen prospectivity maps of South Australia using a process similar to Skirrow et al. 2019 and Geoscience Australia's method of knowledge-driven data-rich prospectivity mapping for mineral systems. The formation of natural hydrogen is related to 5 key components paralleling that of petroleum systems.

Components of the "hydrogen system" can be translated into mappable criteria covering the two main types of natural hydrogen formation by serpentinization and radiolysis. These criteria are then normalised and weighted based on 3 components using the Sherman-Kent Scale.

(1) Source: magnetic anomaly (fluid-rich upper crust), radiogenic intrusive rocks, and ferromagnesian lower crustal rocks;

(2) maturation: known local/regional occurrences of serpentinite, ophiolite complexes, ancient subduction zone buffer, graphite occurrence, heat-metamorphosed rocks near radiogenic rocks, and low gravity (potential geophysical expression of serpentinised crust);

(3) migration: Faults and shear zones;

(4) entrapment: Dolerite sills or dykes, evaporite layers, and fold structures;

(5) preservation: Cover thickness and possible fairy circle structures;

Particularly, machine learning will be applied using an input dataset of known fairy circle structures that have had hydrogen detected in their proximity. This method is especially useful for hydrogen exploration because it has been proven to be capable of identifying new exploration areas which may have been overlooked, and natural hydrogen has been a particularly overlooked resource in Australia and the world. Successful creation of a natural hydrogen prospectivity map for South Australia will prove of benefit for other regions as well, as the GIS methods used to create it is easily replicable using various regional, national and global geological and geophysical datasets.