Exploring for Natural Hydrogen in Ras Al Khaimah, UAE

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Abstract

The southern part of the Emirate of Ras Al Khaimah exposes the northern portion of the Semail Ophiolite of the Oman-UAE Mountains. As such it has a natural hydrogen potential from serpentinization of its ultramafic components. There is an ongoing effort to evaluate this potential by geophysical data acquisition (Full Tensor Gravity gradiometry and magnetics – reprocessed in 2022 – integrated with seismic data). The geological integration is by using a play-based exploration approach.

Exploration models have focussed on hydrogen systems derived from 'high-temperature' serpentinisation (185 - 320°C) known to be optimum for hydrogen production. Two 'high-temperature' hydrogen system scenarios are envisaged for the Semail Ophiolite:

'Late'-phase Serpentinisation
In this scenario hydrogen is generated in recent history by the action of circulating groundwater. The hydrogen prospects will depend on a major rock volumes of mantle ophiolites reaching depths of >8km (assuming a geothermal gradient of 30°C per km) in order to form a 'high-temperature' indigenous source kitchen. Hydrogen generation is also dependent on meteoric water penetrating, via faults or shear zones, to the deeper parts of the ophiolite. Geophysical modelling has been used to determine the external and internal structure of the ophiolite and produce depth-to-base ophiolite and isopach maps. With the recent generation of hydrogen, and probable presence of an impermeable metamorphic sole, it is likely that the gas generated stays within the ophiolite unless it becomes entrained in the groundwater system.

'Early'-phase Serpentinisation
In this scenario, serpentinisation and hydrogen generation is activated in the lower part of the ophiolite by water derived from de-hydration/metamorphism of subducting oceanic crust and/or de-watering of Haybi Complex and Hawasina sediments. Hydrogen generation was during the high-temperature conditions of subduction and/or obduction in the Late Cretaceous and to be preserved has to migrate into sub-ophiolite rock units. The Late Cretaceous thermal and structural history of the ophiolite and underlying rock units is critical to the understanding of the hydrogen systems formed by these processes.

These hydrogen systems and the geological and geophysical integration have led to the recognition of
exploration plays in ophiolite and sub-ophiolite rock units. Exploration of these plays and play fairways is ongoing with additional, focussed geophysical acquisition and geological studies. Key issues affecting the exploration potential of natural hydrogen and future exploitation in ophiolites are highlighted.