Exploring Natural Hydrogen Potential in Saudi Arabia

Manzar Fawad[1], Kebba Saidy[2], Scott A. Whattam[2], Abdullatif A. Al-Shuhail[2], Abdullah A. Al-Shuhail[2], Idrees Farooqui[2], Faris A. Sulistyohariyanto[2], Monica Campos Ramirez[2], Sabyasachi Chattopadhyay[1]

[1]King Fahd University of Petroleum and Minerals
[2]King Fahd University of Petroleum and Minerals

Abstract

The exploration of natural hydrogen (H2) has gained more attention because of the worldwide search for effective energy sources to reduce air pollution and lessen the effects of global warming. Evidence of H2 seeps has been reported over the previous three decades, however, the discovery of a natural H2 accumulation in Mali pointed towards an untapped potential. Previous studies have identified three main geological conditions that support natural H2 generation: 1) serpentinized ultramafic rocks in mid-ocean ridges, 2) compressional tectonic zones involving ophiolitic nappes, and 3) Precambrian crystalline shields. The Arabian Nubian shield is exposed in the western part of Saudi Arabia. It is made up of a series of intra-oceanic island arcs, which accreted in the late Proterozoic. These complexes are separated by sutures containing various levels of ophiolite sequences. The shield is overlain by sediments in the central and eastern parts of Saudi Arabia, with the thickness increasing towards the east. This geological setup points to a possible working "Hydrogen System", comprising serpentinized ultramafic source rocks, potential carbonate/siliciclastic reservoirs, and overlying caprocks. For identifying prolific areas suitable for natural hydrogen accumulations, a multidisciplinary approach is needed to investigate the source rock potential, possible migration pathways, and the presence of traps. The present study is a part of a broad scope of work aiming at the mineralogy and petrology of various ophiolites exposed in western Saudi Arabia in terms of hydrogen generation potential.

Systematic rock sampling was carried out in the Jabal-al-Wask area within Al-Ays province, about 115 km north of Yanbu city. Surface fractures were delineated using satellite imageries where in the next stage H2 concentration will be measured using a gas analyzer. Various levels of serpentinization were observed while the rocks were metamorphosed up to greenschist facies close to major shear zones. The ultramafic rocks are mostly serpentinized harzburgite with limited variations in mineral compositions. We identified several fracture networks on the surface possibly linking with the main sutures. These fractures could provide conduits for upward H2 migration. Completing the various milestones of this investigation will offer insightful information to help advance Saudi Arabia's pursuit of sustainable energy solutions and support international efforts to mitigate climate change.