Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.38269

Using Helium and Hydrogen Extracted from Rock Cores to Understand the Resource Potential of Geologic Hydrogen Systems

DANIEL T. HALFORD[1], JONATHAN TREFFKORN[2] AND KENNETH A. FARLEY[1]

[1]California Institute of Technology
[2]Caltech

There is currently limited availability of H_2-rich gas samples with which to investigate the origin, distribution, and behavior of subsurface H_2. In contrast, the abundance of legacy cores in H_2-rich areas encourages us to ask: do rocks harbor H_2 inherited from gases in nearby pores that can be utilized to understand H_2 sources/migration pathways? We present data (n=12) from 1) rock crushing experiments to measure H_2 using a gas chromatograph with a reduction gas detector and 2) on a separate aliquot, fusion experiments to measure helium (He) on a high-vacuum mass spectrometer, on core from the Duluth Complex, Minnesota, USA. Whole rock troctolite and mineral separate core chips (i.e., plagioclase feldspar and olivine) were analyzed from an extremely He-rich zone with high olivine content. We find that plagioclase is the dominant storage mineral for this He (23 to 401 μcc/g, 0.1 R_A) and that high H_2 abundances are also present (20 to 1809 μcc/g). Experiments comparing baked versus non baked samples indicate H_2 from adsorbed H_2O and from metal-on-metal reactions are minimal. Over large variations in concentration, He and H_2 are broadly correlated, indicating the two gases are linked despite likely different origins. Given these results and the existence of a nearby well yielding gases with high He concentration (~10% He in CO_2) we propose that He and H_2 are introduced into the rocks from nearby pore space containing elevated pressures of both gases. We advocate that He and H_2 measured in core (or cuttings) samples can be used to trace gaseous H_2 in the subsurface, and from such data we can obtain information on transport mechanisms and the retention/expulsion of H_2 in minerals.