

Geochemical characterization of the geological-hydrogen potential of Northeastern Minnesota

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The Mid-Continent Rift (MCR) extends from Kansas to the Lake Superior region and has been targeted in the past decades for geological hydrogen exploration. In Northeastern Minnesota, the MCR is made of outcropping Fe-rich igneous rocks known for their significant ore mineralization contents (Ni, Cu, PGE, Au). Highly alkaline and reducing waters, usually known as markers for geological hydrogen production, are associated with these rocks. Interestingly, gas was found bubbling from these groundwaters. The main gas species and their carbon isotopic signatures were characterized respectively by gas chromatography (GC) and cavity ring-down spectroscopy (Picarro analyzer). The water chemistry, as well as dissolved inorganic and organic carbon contents, were characterized by induced coupled plasma-optical emission spectroscopy (ICP-OES) and isotope ratio mass spectrometry (IRMS). In addition, we collected rocks associated with these gas-rich groundwaters and conducted low-temperature water-rock experiments to characterize their geological hydrogen production potential. Here we will present the results of this geochemical study and propose a first comprehensive picture of geological hydrogen production and cycling in the subsurface rocks in Northeastern Minnesota.