

Origin and fate of natural H₂ occurrences in a saline sedimentary aquifer

J. GUELARD^{1,2}, V. BEAUMONT¹, F. GUYOT², E. DEVILLE¹
AND D. NEWELL³

¹IFP Energies Nouvelles, 1 et 4 av. Bois-Préau 92852 Rueil-Malmaison, France – julia.guelard@ifpen.fr, valerie.beaumont@ifpen.fr, eric.deville@ifpen.fr

²Sorbonne Universités-MNHN-IMPIC, 4 place Jussieu 75005 Paris, France – francois.guyot@impic.upmc.fr

³KGS, 1930 Constant Ave., Lawrence, KANSAS 66047-3724, USA – dnewell@kgs.ku.edu

As part of research on new clean and durable energy sources, we intend to understand the H₂ formation and consumption mechanisms in terrestrial environments. Natural occurrences of H₂ have been extensively studied in environments such as mid-ocean ridges and ophiolites where oxidation of ferrous iron is believed to play a key role in the production of H₂. Natural H₂ also occurs in intracratonic contexts [1-4] and the role of Fe in this geological settings is not yet understood.

In Eastern Kansas, few wells were reported to produce H₂, with the presence of gabbro and iron-rich sediments in the vicinity^{[3],[4]}. A moderately deep well (450 m) gives access to a groundwater saline aquifer loaded with dissolved H₂. Water displays a neutral pH, with a high Fe content (1.2 mM), comparable to the Pavin lake or the Mississippian Dome Salt aquifer. In these aspects, this water greatly differs from waters associated with H₂ in ophiolitic contexts. H₂, N₂ and CH₄ are, however, the major dissolved gas species, similarly to ophiolitic contexts. In the intracratonic context studied here, in addition to these major gases, He from crustal origin is measured at the percent level.

We could demonstrate that H₂ has a much deeper origin than the aquifer studied. Moreover, the data suggest strong consumption of H₂ in the aquifer sampled by the well, possibly due to ferric iron reduction. We propose several models/pathways to explain the origin and fate of H₂ in this intracratonic setting, mostly based on the redox reactions of iron that could happen both in crust and sediments.

[1] B. Sherwood Lollar et al., *Nature*, vol. **516**, no. 7531, pp. 379–382, 2014. [2] N. V. Larin et al., *Nat. Resour. Res.*, 2014. [3] R. M. J. Coveney et al., *Am. Assoc. Pet. Geol. Bull.*, vol. **71**, no. 1, pp. 39–48, 1987. [4] K. D. Newell et al., *Nat. Resour. Res.*, vol. **16**, no. 3, pp. 277–292, 2007.