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Numerical modeling of natural hydrogen migration from deep sources within fault zones

FRÉDÉRIC VICTOR DONZÉ[1], LUKAS BOURDET[2], LAURENT TRUCHE[3], AUDREY TAILLEFER[2], HUGO DUTOIT[2], CAMILLE DUSSEAUX[2] AND NICOLAS LEFEUVRE[4]

[1]Université Grenoble Alpes
[2]Universite Grenoble Alpes
[3]ISterre, CNRS
[4]ISTerre, Université Grenoble Alpes

Presenting Author: frederic.donze@univ-grenoble-alpes.fr

On continents, H_2-rich gas seepages have been observed along major fault zones ([1], 2], [3], [4]). Until now, there is no global consensus on the possible origins of this continental dihydrogen and several production mechanisms have been proposed, presuming that some of them may operate simultaneously (e.g. serpentinization or radiolysis of water). Moreover, the wide range of pressure, temperature, and chemical conditions H_2 encounters during its migration along the faults can modify its ultimate concentration dramatically.

Considering recently revised equation of states of H_2 (e.g. density, viscosity, solubility), we have set up a 3D reactive transport model based on MRST open source software [5], to assess the conditions for which H_2 can “survive” long migration distances along a fault. The Coupled Thermo-Hydro-Mechanical-Chemical approach with Permeability Evolution provides insights about how H_2 can eventually reach the surface, accumulate in deep reservoirs, or be consumed along the way by abiotic or microbially-mediated redox reactions.

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