

## **Is abiotic hydrogen generation possible from the granitic basement in the Soultz-sous-Forêts EGS site (Rhine Graben, France)? A hydro-geochemical modeling approach**

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H<sub>2</sub> generation in natural reservoirs has recently promoted important researches in Earth Sciences stimulated by the challenge of energy transition with possible alternatives to fossil fuel energy sources.

Spontaneous H<sub>2</sub> generation in natural geological systems has been described in the context of serpentinization of mafic and ultra-mafic rocks. In these systems the formation of H<sub>2</sub> in fluid-rock interactions is due to the oxidation of Fe(II) bearing minerals and the often called reduction of H<sub>2</sub>O, which corresponds to the reduction of protons. We investigate a way for abiotic H<sub>2</sub> generation from the biotite-rich granite constituting the deep geothermal reservoir of the Soultz-sous-Forêts Enhanced Geothermal System.

We applied the coupled transport and reaction model KIRMAT to show that hydrogen production is possible under certain redox conditions in the fluids (low Eh, T between 165 and 200°C) and hydrothermal alteration of biotite as a source of Fe<sup>2+</sup>, which oxidizes to Fe<sup>3+</sup> and precipitates into magnetite, while protons H<sup>+</sup> are reduced into hydrogen H<sub>2</sub>. Looking for such favorable conditions is a challenge for future research.

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