Geological H2 Systems – Exploration Play Assessment

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Abstract

To achieve net zero emissions in a close future, hydrogen (H2) has the potential to be a major contributor for the energy transition. In this perspective, natural or white hydrogen which is naturally sourced in the Earth's crust is now considered as a potential game changer as it may be the cheapest to produce. If the main geological processes responsible of the generation of H2 are relatively well understood (e.g. serpentinization of ultramafic rock, oxidation of ferrous iron-rich minerals, radiolysis), lot of uncertainties remain regarding the quantities, fluxes, possibility to trap large H2 accumulation in reservoirs. Shortly, fundamental parameters of natural H2 geosystem(s) are still lacking to produce predictive and scalable exploration strategies.

Interestingly, officialized discoveries in Mali and more recently in Australia (GoldHydrogen) demonstrated that hydrogen can be trapped within reservoirs in high concentration with a potential dynamic sourcing. Even though the communicated volumes need to be taken with caution and the scalable commercial quantities are yet to be proven, those first positive results triggered in 2023 a global rush for backing best prospective areas to find the first H2 giant fields.

When looking for undiscovered H2 plays, the research of surface indicators such as seeps detected in soil samples or water fountains, or measured H2 within O&G wells is preferably used as exploration strategy. If those "top-down" observations prove the presence of natural H2, they are not enough to understand geological parameters at play (source, migration timing and pathway, reservoir, seal, preservation) to determine high potential areas with predictive tools i.e. bottom-up approach. Both top-down observations and bottom-up concepts need to converge to explore and generate successful subsurface H2 prospects.

In this presentation, we propose to review the fundamentals of ultramafic H2 kitchen: one of the H2 generative systems that we studied based on the W-Europe portfolio we developed in the last decade. We will show how a bottom-up plays assessment was successfully built and lead to the first H2 exploration permits obtained in France. We will also present how a multidisciplinary approach combining geology, geophysics and geochemistry can be used to generate and de-risk H2 plays and define prospects to evaluate. Moreover, our dataset enabled us to run a pioneering H2 probabilistic evaluation presented in a companion contribution in this conference (Neumaier et al. 2024). Taking learnings from our H2 system play assessment methodology, we will briefly show how this exploration strategy is easily scalable globally and how we actively generate opportunities for this future geo-energy breakthrough.