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ECONOMIC GEOLOGY

Exploring for native hydrogen

Hydrogen is likely to play a critical role in the green energy transition, as it has capacity to buffer daily and seasonal shortages in hydro and wind power in a future energy mix dominated by renewable sources. Serpentinization of ultramafic rocks and subsurface biogenic processes can both produce native hydrogen. However, the geological conditions of hydrogen formation and storage are not well established, and as such, exploration strategies and resource assessments have yet to be carried out.

Nicolas Lefeuvre, at Université Grenoble Alpes, France, established a soil gas monitoring approach to identify hydrogen-fertile regions in the Pyrenean foothills. No previous H_2 seepage had been identified in the study region, although known mantle rocks at <10 km depth connected to the surface by major faults provided a potential source and exploration target. The hydrogen exploration strategy involved in situ soil multi-gas analysis (H_2, CO_2, CH_4, radon, among others) at 1 m depth, over an area of 7,500 km^2. Hotspots were identified mainly along major faults intersecting the ultramafic rocks at depth, such as the North Pyrenean Frontal Thrust. Where these faults met the surface, soil H_2, CO_2, and radon concentrations exceeded two orders of magnitude higher than the regional background. These results identified that the serpentinized mantle rocks are indeed a hydrogen source and that the faults can act as a migration pathway.

Credit: John Elk III/Getty Images

Therefore, mantle rocks undergoing hydrothermal alteration and intersected by faults could provide promising targets for future hydrogen exploration. However, trap structures are yet to be identified in the Pyrenees where the hydrogen could accumulate at economically extractable concentrations. Future research should aim to provide further constraints on whether native hydrogen exploration can contribute to a potential future hydrogen economy.

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