Natural Hydrogen Generation : Evidence for Active Mantle Serpentinization in Taiwan

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Résumé

Natural hydrogen is emerging as a promising carbon-free energy source, attracting growing scientific and technological interest. Among the key mechanisms identified for its production, the active serpentinization of shallow mantle rocks is considered a major contributor. However, fundamental questions remain regarding the origin, intensity, and accumulation zones of natural hydrogen emissions. The Taiwan orogenic belt offers a unique natural laboratory to investigate these processes, due to the presence of a shallow mantle body and active fault systems that facilitate fluid circulation-potentially enabling ongoing serpentinization. This study aims to assess and determine the origin of natural hydrogen production in the Taiwan range. Soil gas measurements and analyses of hot spring gases in southeastern Taiwan reveal significant hydrogen concentrations in the Central Range, alongside helium isotopic signatures indicative of a mantle source. Additionally, integrated geological and tomographic data have been used to construct a new lithospheric cross-section, supporting a model of Eurasian crustal delamination that explains the presence of a shallow lithospheric mantle wedge. Petrophysical modeling with the LitMod 2D code further confirms the presence of a hydrated mantle body (_˜9 wt% HO) at a depth of _˜10 km, reinforcing the hypothesis of active hydrogen generation in the region. These findings highlight Taiwan's potential as a natural hydrogen system and provide new insights into the geodynamic, tectonic and petrological conditions favorable for hydrogen production.

Mots-Clés: Taiwan, Hydrogen emanations, mantle serpentinization, active collision zone

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