

H₂ producing water-rock interactions: Comparing the geological environments.

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H₂ natural production is reported in different types of geological environments : hydrothermal vents at mid oceanic ridges, hyperalkaline springs in ophiolite massif, Precambrian continental subsurface, including crystalline basements - covered or not with sediments- and mines. In all cases, the valency change of ferrous iron to ferric iron is believed to drive dihydrogen production by water reduction.

The conditions prevailing at the formation of natural dihydrogen are different from one geological environment to the other, in terms of mineral paragenesis, water chemical and physical properties, such as distinct geochemical features are recorded by the resulting H₂-rich gas mixtures in terms of molecular concentrations, stable isotope signatures and noble gas concentrations and isotopic ratios.

We propose to delineate the main features of the different geological environments and notably to compare peridotite hydration in different contexts to intracontinental H₂ production. Gas and water analytical results obtained in ophiolite complexes (Oman, New Caledonia, Philippines and Turkey) on one hand and intracontinental contexts (Kansas, Sweden) on the other hand will be compared to literature data for mid-oceanic ridge hydrothermal vents and mining environments.

While the water chemistry and notably pH and Eh are very different and particular to each environments, in all cases, naturally produced H₂ occurs jointly to CH₄ and N₂, although in varying proportions. The noble gas signatures of the gas mixtures record source end-members that are mostly atmospheric and crustal, excluding for most cases a mantle contribution for dihydrogen genesis. Stable isotope proxies, mostly used to infer interaction between gases, depict different sources of carbon and hydrogen depending on different processes, mineral hydration, Fisher Tropsch type reactions, thermal maturation and biological activity. These features will be further discussed in order to enlighten origin and fate of natural dihydrogen in these specific reducing environments.