Natural H_2 associated to N_2 and He in intracratonic environments

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Natural occurrences of H_2 have been studied for several decades at mid-ocean ridges and in ophiolites. In these mafic/ultramafic environments, H_2 production is considered to be caused by fluid/rock interactions, where oxidation of Fe^{2+} and H_2O reduction explain generation of H_2. Natural H_2 production is also known in intra-cratonic settings. These settings account for over 50% of emerged continents and represent therefore an interesting potential for H_2 production. The prevalent hypotheses of intra-cratonic H_2 formation are 1) reduction of water in the presence of Fe^{2+}-rich rocks and 2) radiolysis of water.

In 2008, a 450 m-deep well (D#2) was drilled in Kansas, allowing access to a saline aquifer loaded with dissolved H_2 located in the sedimentary cover and in contact with Precambrian basement. In spite of the D#2 well having water compositions differing from those in H_2-producing ophiolitic terranes [i.e., almost neutral pH (7.4), high Fe content (1.1mM) and very high salinity in (55g/L)], its major dissolved gases (H_2, N_2, CH_4) are similar. In the intra-cratonic setting studied here, in addition to these major gases, He from crustal origin is present at up to 2.9%.

New geochemical results of the fluids produced from the D#2 well, together with a detailed review of the regional geological setting allowed (1) to put foward several scenarios for the origin and production process of H_2, CH_4, He and N_2, (2) to evidence the reactivity of H_2 in the sedimentary section, (3) to relate the volatiles from the studied aquifers to natural regional gas field in potential hydrogeological connection, such as the Hugoton Panhandle field.