

Glaucinite and ferric illite authigenesis in marine settings as a source for geologic hydrogen

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Reverse weathering, leading to the origin of authigenic glauconitic minerals, takes place today in a wide range of environments, across latitudes, and the evidence for the process has been documented in the rock record since early Proterozoic times. Here we show through mass balance equations that the formation of glauconite and ferric illite on different substrates generates a substantial amount of geologic hydrogen, almost 1-2 molar times the glauconitic minerals. Therefore, such authigenesis can add significantly to the global geologic hydrogen resources.

Keywords: Ferric illite, geologic hydrogen, glauconite, reverse weathering.

interactions and escape during migration⁸. However, the total natural hydrogen generation in all the geologic settings in the world⁹ is way below the projected requirement for usage as a major fuel by 2050 (ref. 8). Moreover, generation simply does not ensure availability because of the possible failure in subsurface entrapment. This calls for a search for other possible resources of natural hydrogen.

Geologic hydrogen can be produced by both biotic and abiotic processes¹⁰. The best-known example of abiotic processes releasing hydrogen is the hydrothermally induced serpentinisation of peridotite in ophiolitic sequences and oxidation of magnetite in the Banded Iron Formation common in cratonic regions⁹. Other abiotic processes include radiolytic decomposition and fracture-induced reduction of water. Biotic processes involve organic matter, thermal cracking and bacterial activity in aquifers and sedimentary basins¹¹. Two recent reviews^{12,13} elegantly outlined the potential sources of geologic hydrogen in India and emphasised the need for futuristic exploration strategies. The purpose of this short note is to present the potential of reverse weathering as an alternate white hydrogen source, based on the current understanding of the origin of certain clay minerals.

Marine clay mineral authigenesis (also known as reverse weathering) implies *in situ* formation of non-kaolinite clay minerals near the ocean floor¹⁴. While silicate weathering captures CO₂ from the atmosphere to break down silicates in the presence of water and cools the atmosphere, reverse weathering liberates CO₂ to the at-