

## Mapping geologic hydrogen resource prospectivity

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### Summary

Although the presence of natural hydrogen in the subsurface of the Earth is well documented in a variety of geologic environments, economic accumulations of natural hydrogen have generally been assumed to be non-existent. Recent discoveries in Africa, Australia, the US and elsewhere have challenged this notion, and there is a growing acknowledgement that geoscientists have not looked for natural hydrogen in the right places with the right tools. While much is known about the occurrence of subsurface hydrogen (e.g., generation mechanisms, consumptive processes, etc.), there is currently a lack of understanding of the processes and settings that are most conducive to the formation of significant accumulations of hydrogen. To develop effective strategies for exploration and assessment of geologic hydrogen resources, a comprehensive framework is required that could lead to the discovery of economic hydrogen accumulations.

The U.S. Geological Survey has developed a preliminary “hydrogen system” model for understanding the potential generation of economic accumulations of hydrogen resources in the Earth’s subsurface based on the “petroleum systems” concept. The essential components that make up the models (e.g., source, migration pathway, reservoir, seals, etc.) are the same but the details of each of the components vary and may not be directly comparable. For example, thermal maturation of organic-rich rocks is well understood to be the primary mechanism for petroleum generation, whereas serpentinization of ultramafic rocks is generally recognized as a major pathway for hydrogen generation in geologic environments. Although thermal maturity (i.e., time and temperature) and content of reactant materials (i.e., organic carbon in the case of petroleum source rocks or iron content for hydrogen generation) are factors that are common to both systems, the hydrogen system may also be critically dependent on the water-rock contact area and time. Such distinctions have important implications for understanding resource potential and designing exploration strategies.

Given our nascent understanding of geologic hydrogen, many components of the hydrogen system are highly uncertain. However, the uncertainty associated with each of the essential components of the hydrogen system can be estimated and used to assign risk. A workflow has been developed for mapping the individual components of the hydrogen system and the associated uncertainty on a regional scale. This approach has been used to provide a preliminary estimate of the most prospective regions for discovery of geologic hydrogen resources in the conterminous U.S. This presentation will discuss the details of the workflow used for mapping hydrogen prospectivity on a regional scale as well as the requisite datasets. Details of ongoing research to further refine the hydrogen system model, to improve geologic hydrogen prospectivity mapping capabilities, and to reduce the associated uncertainty (i.e., risk) will be presented.