EGI Energy & Geoscience Institute
THE UNIVERSITY OF UTAH

NATURAL HYDROGEN KNOWLEDGE PLATFORM

An advanced analysis tool for opportunity prioritization in natural H_2 exploration and exploitation

Eiichi Setoyama, Ph.D., Bryony Richards, Ph.D., Christopher Kesler

VALUE

The Natural Hydrogen Knowledge Platform is for forward-thinking energy companies and academic researchers who are tackling the challenge of efficiently identifying and prioritizing investment in this emerging clean energy source. Setting itself apart from traditional databases or mapping solutions, the platform offers a dynamic, comprehensive, and interconnected view of global natural hydrogen systems (Figure 1), facilitating smarter exploration strategies and fostering innovative energy solutions in the renewable sector.

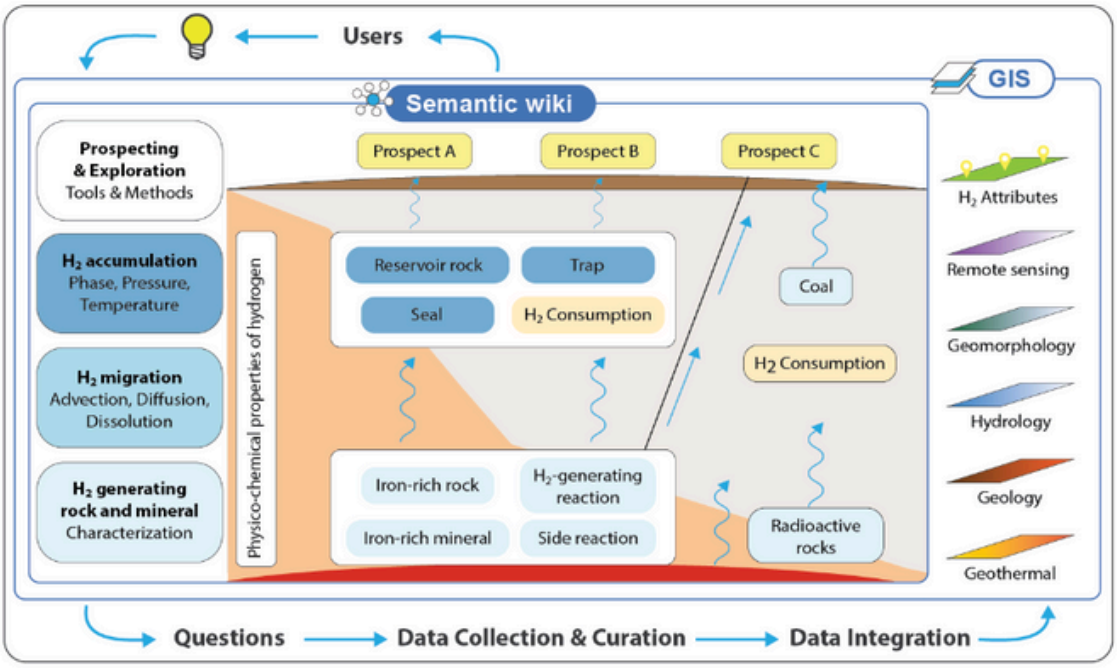

Figure 1: Schematic Summary of Natural Hydrogen Knowledge Platform.

INTRODUCTION

Natural hydrogen is a new, clean primary energy source with the potential to supplement other renewable technologies and support the increased hydrogen use in the future energy mix. Recently, exploration and research on natural H_2 have gathered momentum, resulting in an exponential increase in the amount of information and data (Figure 2).

Although natural H_2 systems are often compared with petroleum systems, research on the former is still in its infancy, and clarifying differences between the two systems is crucial for natural H_2 exploration. For that purpose, the team at EGI is developing a knowledge platform consisting of a GIS project of natural H_2 sites, with relevant geological data and a collection of interlinked documents. These include site summaries, source rocks, generation reactions, and H_2 properties.

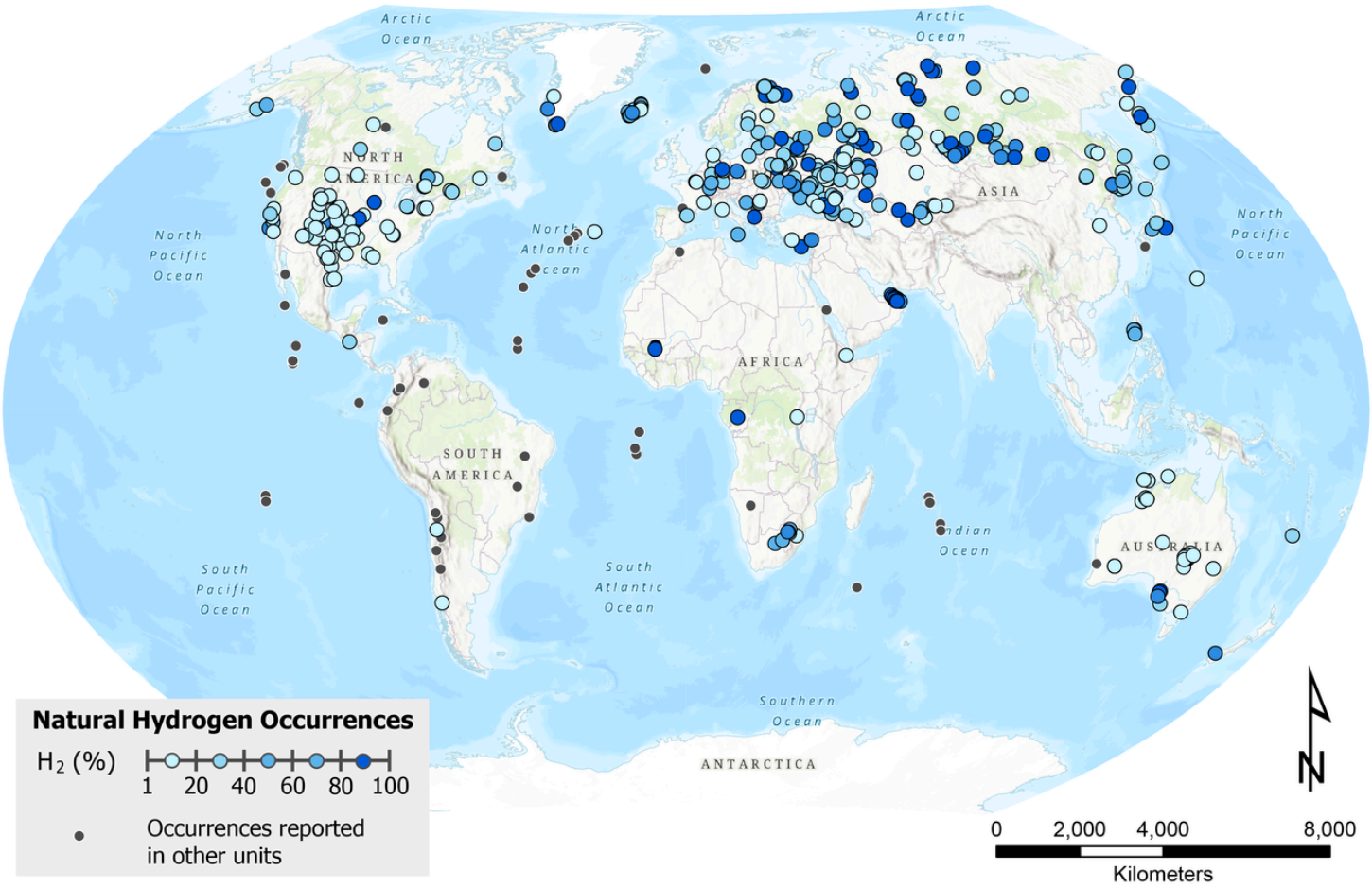

Figure 2. Natural H_2 sites. Data and information review will allow for air-correction of H_2 concentration, assessment of drill bit metamorphism (artificial H_2 generation), and attribute assignment (sample information, field and laboratory methods, and geology) for further analysis.

OBJECTIVES

- To capture and organize the ever-increasing information and data on natural H_2 (Figure 3)
- To identify key geological conditions for the generation of H_2 and the formation of economic accumulations and to rank the various mechanisms in terms of potential commercial viability
- To better understand the feasibility and risks of natural H_2 exploration and exploitation
- To apply the outcomes of data analysis and hyperspectral image analysis to characterize selected natural hydrogen sites (Figure 4)
- To identify knowledge gaps, in order to facilitate new research, and to propose new research directions

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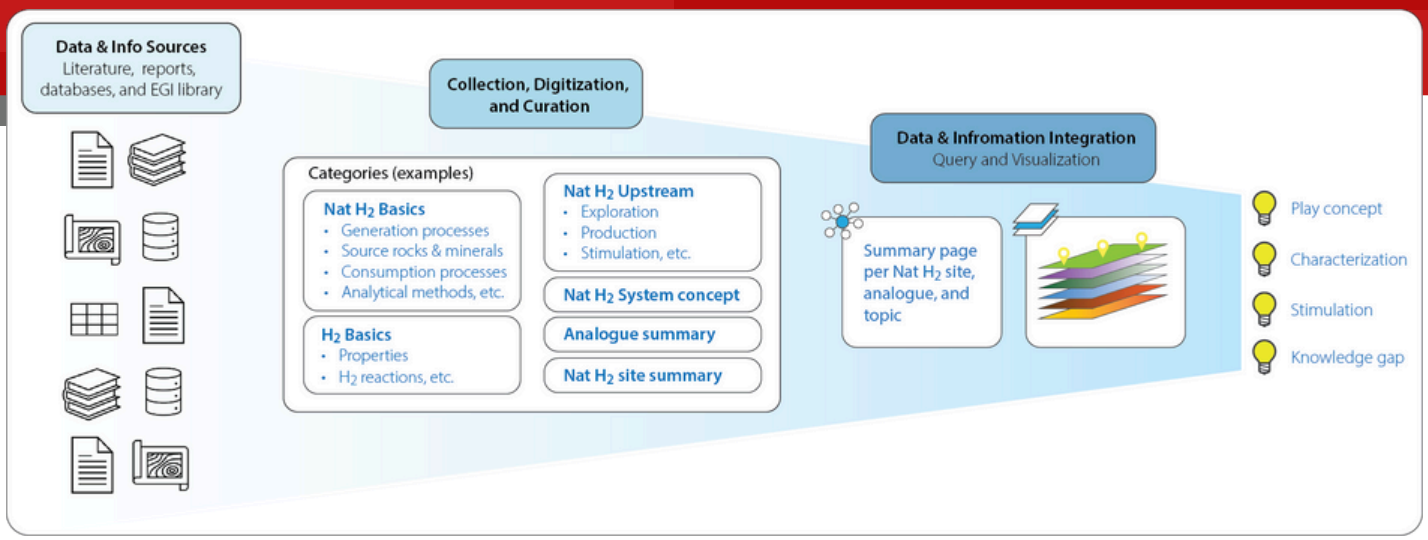

Figure 3. Methodology: extending from data acquisition to new data-driven research ideas.

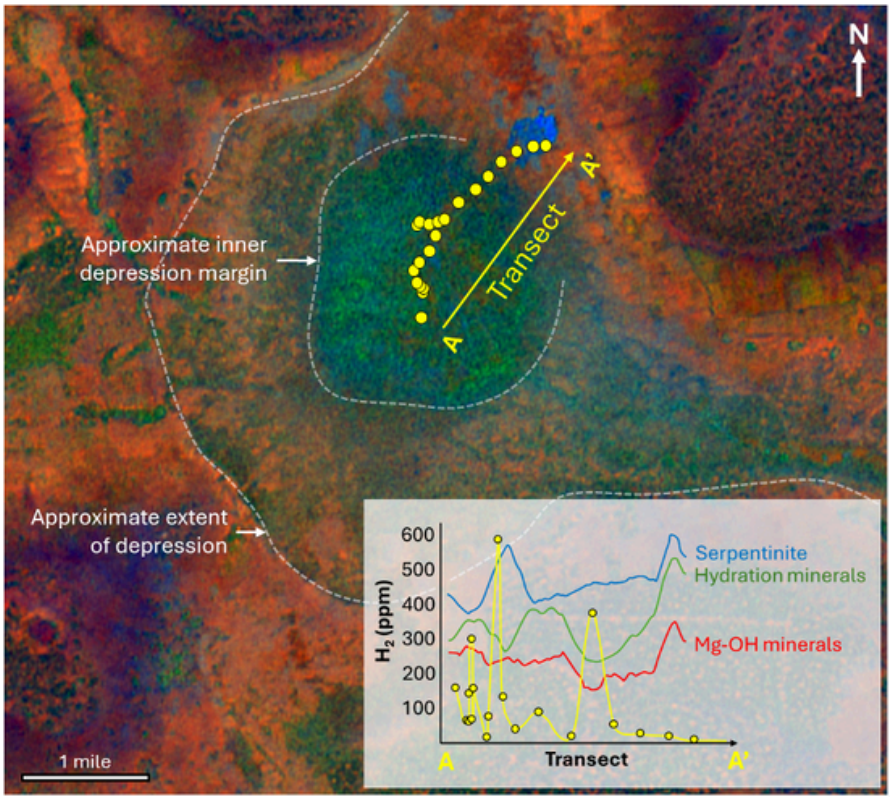

Figure 4. An example of hyperspectral image analysis of a "fairy circle" associated with H_2 seep. EGI is developing a method utilizing data from different satellites. The figure depicts a H_2-seeping semicircular depression characterized by both an inner and outer margin, marked by a dashed white line. Transect A–A' highlights the locations of H_2 data from Prinzhofer et al. (2018, Int. J. Hydrog. Energy). Along with the H_2 data, spectral analysis from this study reveals mineralogical associations related to H_2 concentrations across the depression.

BENEFITS FOR SPONSORS

- A go-to database curated by EGI scientists for ideas generation in natural H_2 exploration and exploitation
- Regular updates to keep up with ever-increasing publications
- A platform designed to: (1) aid in learning about natural H_2 systems, (2) facilitate the data-based assessment of natural H_2 exploration and production feasibility, and (3) support innovation of new exploration and production technology and methods.

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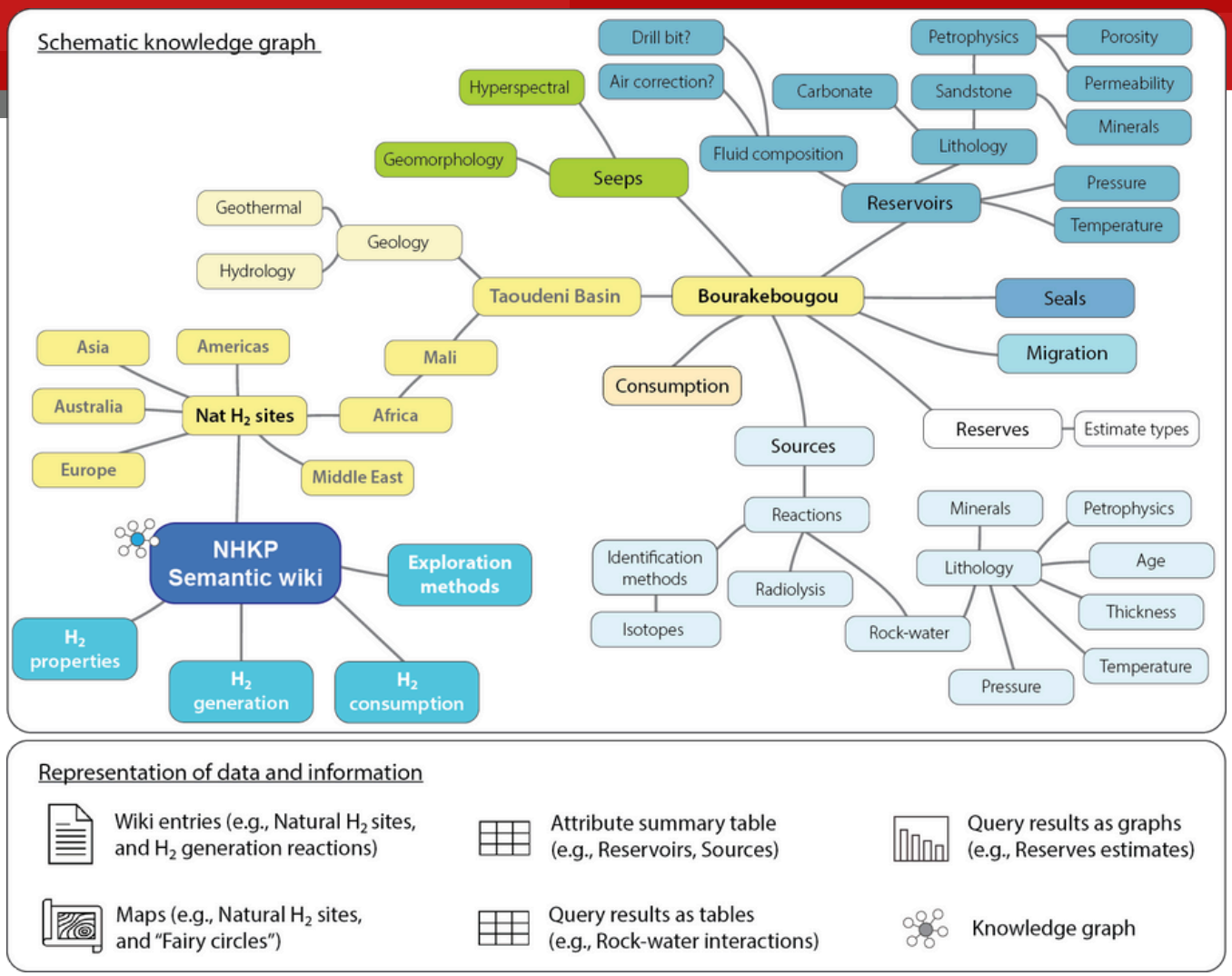

Figure 5. Examples of concepts and attributes in the Natural Hydrogen Knowledge Platform semantic wiki. A semantic wiki is similar to a regular wiki, e.g., Wikipedia, but with improved data organization (relationships and ontogenies) and flexible data manipulation and querying capabilities. Users can query using not only keywords, but categories, attributes, and relationships and view results in different formats (lists, tables, maps, and graphs).

KEY DELIVERABLES

- GIS project for geospatial data visualization, analysis, and interpretation
- Semantic wiki on natural H_2 with topics, such as known natural H_2 sites, natural H_2 system elements and processes, and H_2 properties (Figures 5, 6), in sync with the GIS project
- Hyperspectral image analysis of known and potential natural hydrogen seeps
- Preliminary deliverables will be made available to sponsors and updated regularly.

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A) Rock-water interactions

Reactant	Reactant formula	Commonly found in	Product	Process	Temperature range
Olivine	$(Mg^{2+},Fe^{2+})_2SiO_4$	Ultramafic, mafic, peridotite, ophiolite	Serpentinite, Magnetite, H_2	Serpentinization	20–350°C
Siderite	$Fe^{2+}CO_3$	Hydrothermal veins, sedimentary rocks	Magnetite, CO_2, H_2	Fe-carbonate dissolution	<200°C, 300°C
Magnetite	$Fe^{2+}Fe^{3+}{}_2O_4$	Banded Iron Formation	Goethite/Hematite, H_2	Fe2+-bearing oxide alteration	80°C and 200°C by experiment, Possibly in ambient temperature

B) Natural hydrogen reserves estimates

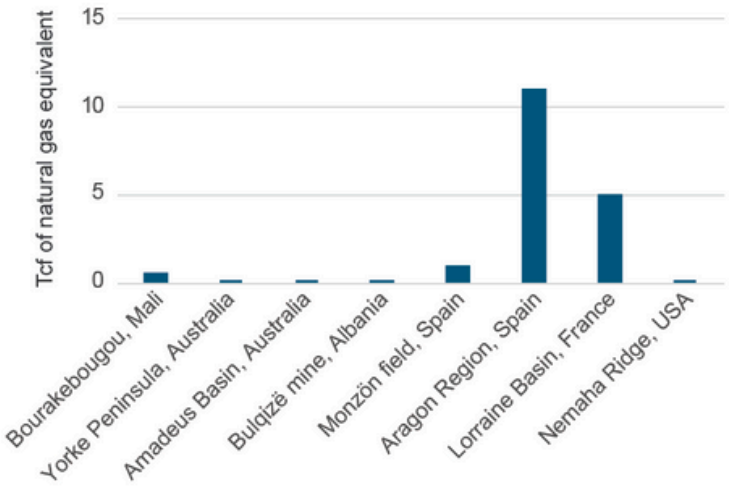

Figure 6. Examples of query results. A) Selected H_2-generating rock-water interaction. B) Reserves estimates for selected hydrogen sites. The estimates are not by EGI and the estimate types differ between sites.

MILESTONES

Completed tasks that will be regularly updated

- Global natural H_2 occurrences (Figure 2)
- H_2 generating reactions (Figure 6)

- **End of June 2024**: Release of EGI NHKP StoryMaps (https://arcg.is/0C0Deb)
- **End of August 2024**: Alpha release of NHKP to sponsors with selected natural hydrogen site and concept wiki entries
- **Late October 2024**: Workshop during the EGI technical conference in Houston
- **End of November 2024**: Beta release of NHKP to sponsors
- **End of March 2025**: Project completion and workshop
- Regular updates to NHKP after the completion

PROJECT DURATION

12 months (April 2024–March 2025) for the construction of the platform and analysis, with subsequent updates as required.

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