geoconvention
Calgary • Canada • June 17-19 2024

# Natural gases in the Finnish bedrock – current status and future prospects

*Timo J. Hietava, Markku T. Hagström, Teppo T. Arola, Heini M. Reijonen, Evgenii Kortunov, Jukka P. Konnunaho, Meri A. Wiberg*
*Geological Survey of Finland*

*Riikka E. Kietäväinen*
*University of Helsinki*

## Summary

Deep groundwaters, associated with Archean and Paleoproterozoic bedrock in Finland, have been under extensive studies over the past few decades. The studies are mainly driven by the need to understand the deep groundwater circulation related to deep geological disposal of radioactive waste. Sampling and analysis of groundwater chemistry and dissolved natural gases (e.g. methane, hydrogen, helium, nitrogen, argon) has been performed at variable depths (0-~2500 m) from the diamond drillholes by several operators over the years. These data have been collected from various drillholes by GTK into a deep groundwater database of Finland. Only a single analysis has been made in most of the sampling locations, but on few occasions time series samples have also been taken.

## Theory

Certain geological formations within Finland are known to include rock types such as serpentinized ultramafic bodies and U-, Th-, and K-bearing granitic rocks, that in theory are prospective for natural hydrogen, due to associated hydrothermal alteration and radioactive decay processes within these rock types. The areal distribution of these possibly prospective rock types for $H_2$ is presented in Figure 1, and these rock types could provide exploration vectors towards investigating these geological formations for gas accumulation and potential.

Various ultramafic rock successions around the country such as hydrothermally modified Outokumpu-type ophiolites, serpentinized komaatites in Archean and Paleoproterozoic greenstone belts and 2.44 Ga layered intrusion magmatism related mafic-ultramafic bodies form potential targets for the occurrence of natural gases. Additionally, potential of iron-rich lithologies such as IOCG deposits, oxide gabbros and carbonatites have also been discussed.

Existing gas measurement capabilities at GTK will be employed and developed further to begin more targeted investigations on the gas potential of the different rock formations and rock types. Existing drillholes within the formations, previously used for mineral exploration and geological research will be used to gain access to the subsurface.

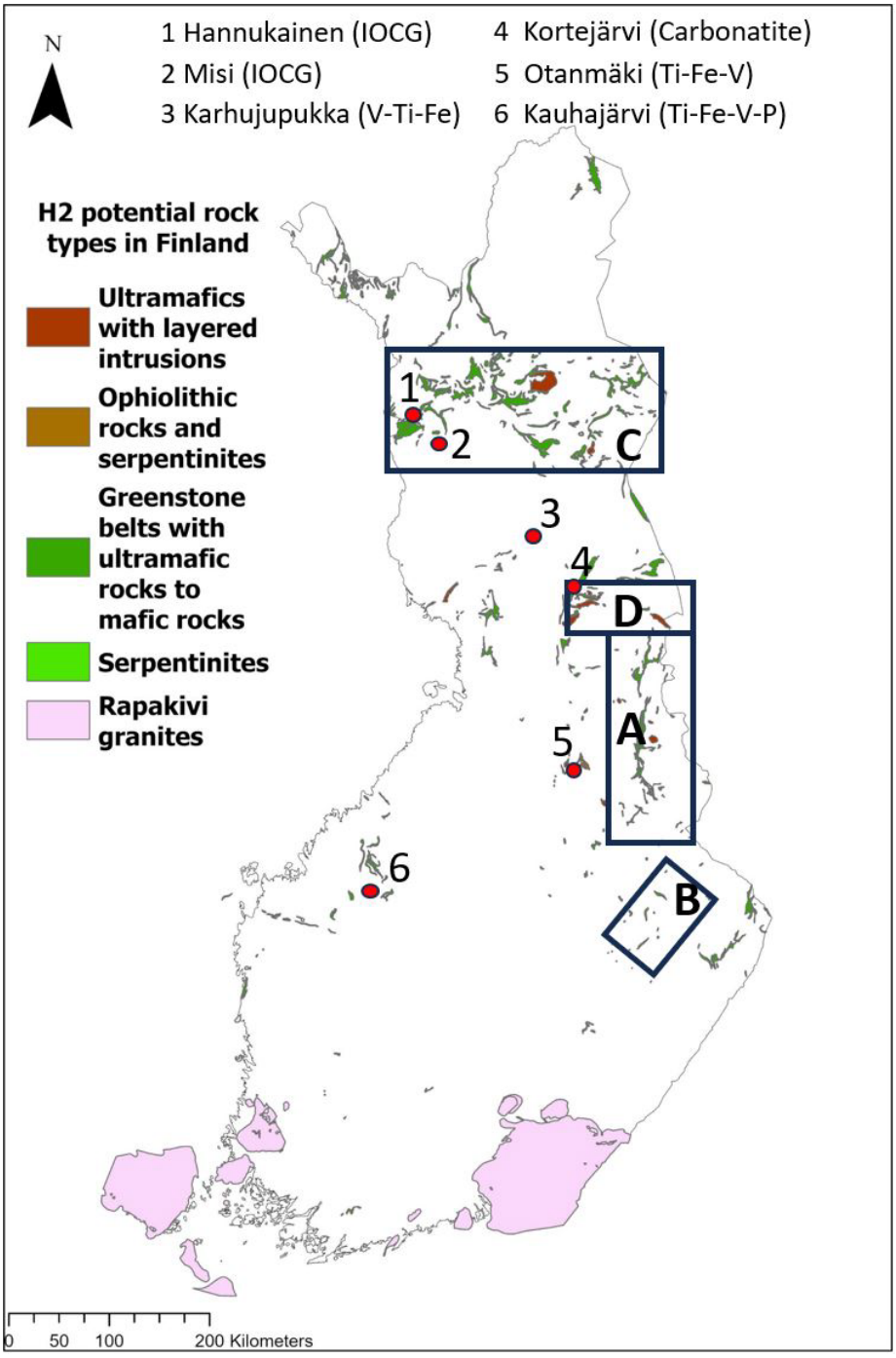


*Figure 1. Initially prospective rocks in Finland for serpentinites and radiogenic rocks attributed to hydrothermal alteration and radiolysis processes and some examples of potential target deposits (1-6). A) Archean Tipasjärvi-Kuhmo-Suomussalmi and associated ultramafic rocks, B) Outokumpu-type hydrothermally modified ophiolites, C) Paleoproterozoic Central Lapland Schist belt with komatiitic lithologies, D) Koillismaa 2.44 Ga layered intrusion complex.*

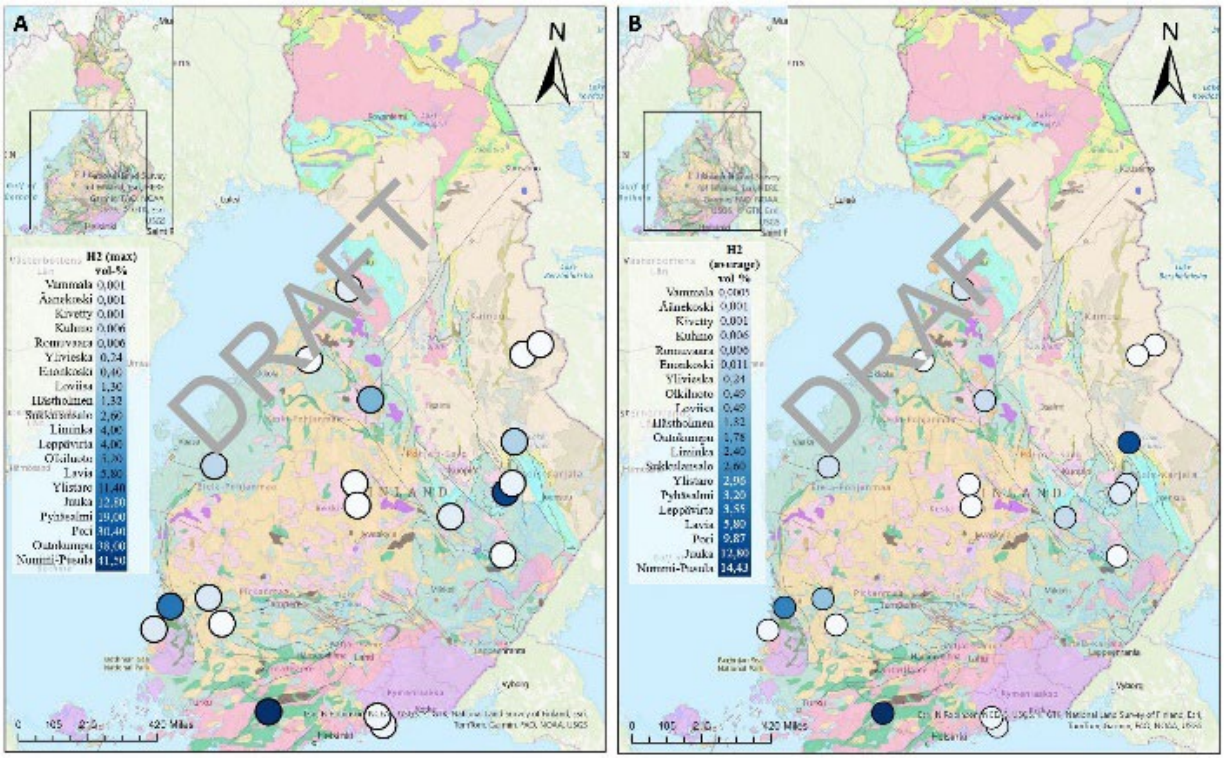


*Figure 2. Preliminary data on measured H2 concentrations from drillholes in Finland. A) Max vol-%, B) Avg. vol-%.*

## Results

The data covers variable geological environments, ranging lithologies from felsic to ultramafic igneous bodies to supracrustal rocks, for example. In this presentation, we show the preliminary maps for hydrogen (Figure 2) concentrations from previous measurements tied to a geological context of Finland. At some locations only the gas volume fractions were measured without gas to water volumes at standard conditions. For these reasons, only volume fractions of gases are presented at this stage.

We assess the overall data QA/QC aspects and provide first insights on the overall occurrence of natural gases in the Finnish bedrock and showcase the further implications on the research needed to meet the full potential of the natural and/or enhanced gas utilization in Finland.

## Additive Information

Results from this and future studies will be used to further assess the total effects of the potential of natural gases e.g. to the Finnish Hydrogen Strategy.