PRELIMINARY MAPPING OF NATURAL HYDROGEN RESOURCES IN MOROCCO AND SOUTH AFRICA

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Credits: Breaking Lab

LEAP-RE STAKEHOLDER FORUM
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HyAfrica

LEAP-RE
Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

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HyAfrica- Natural hydrogen exploration in Africa

HyAfrica LEAP-RE

Objectives

- Map the natural H_2 resources in target regions of Morocco, Mozambique, South Africa, Togo.
- Regulatory and roadmap actions for target countries to engage on natural hydrogen.
- Socio-economic impact assessment and business models in standalone systems.
- Building capacity and raise awareness

Portugal — CONVERGE! I&D Geo-energia e Geofísica (coordinator)

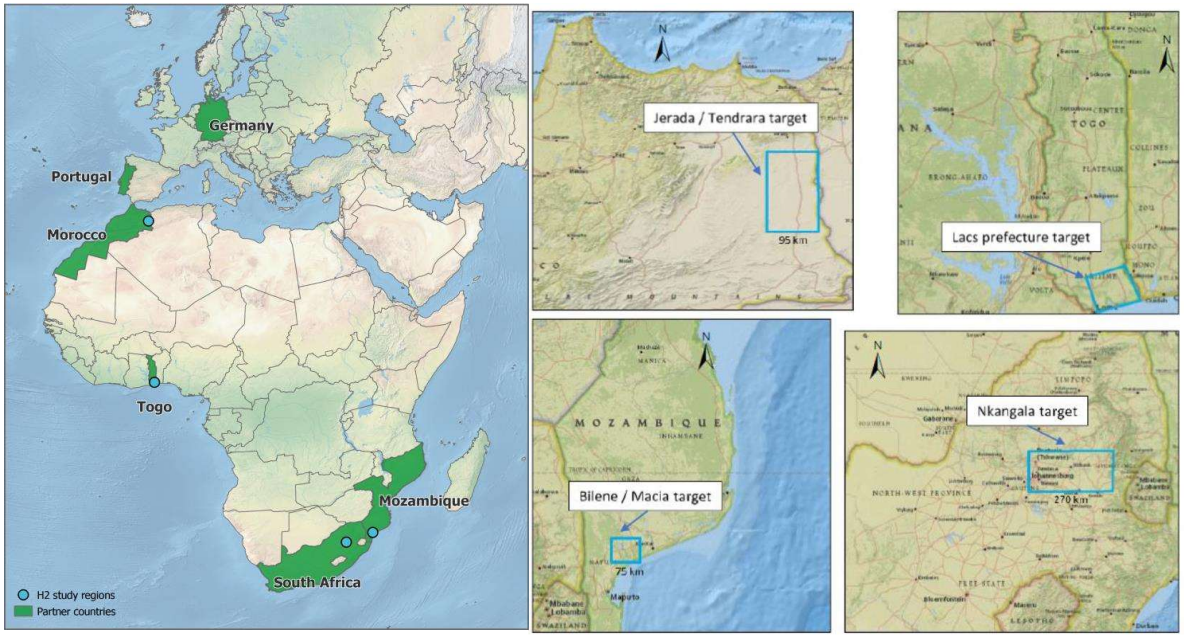
Germany — LIAG Leibniz Institute for Applied Geophysics; Fraunhofer IEE

Morocco — Université Mohammed Premier

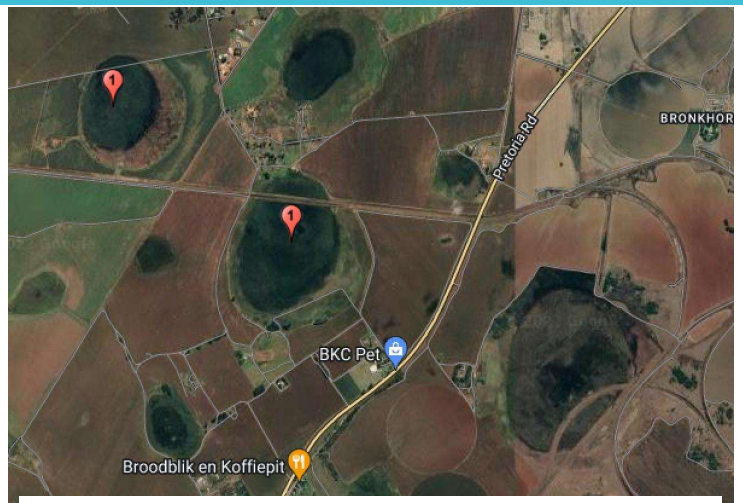
Mozambique — Universidade Eduardo Mondlane; DNGM Moçambique

South Africa — Universiteit van Pretoria; University of Lisbon

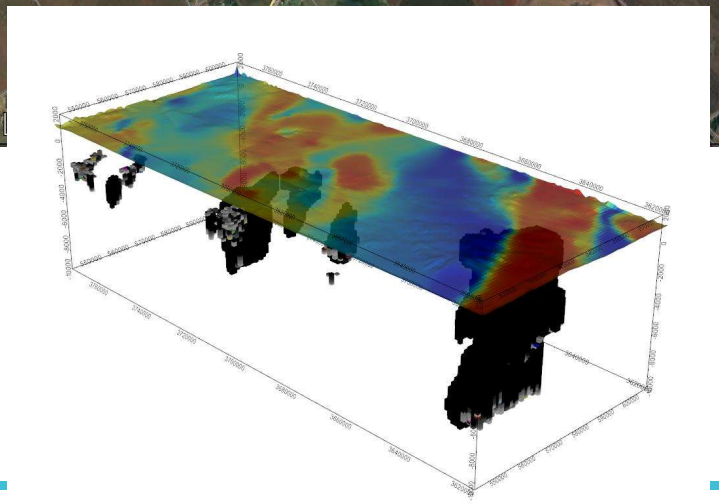
Togo — Université de Lomé

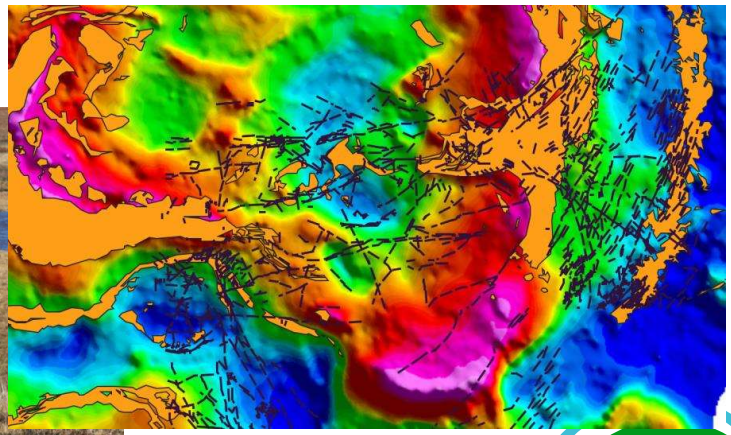


Methodology: exploration workflow



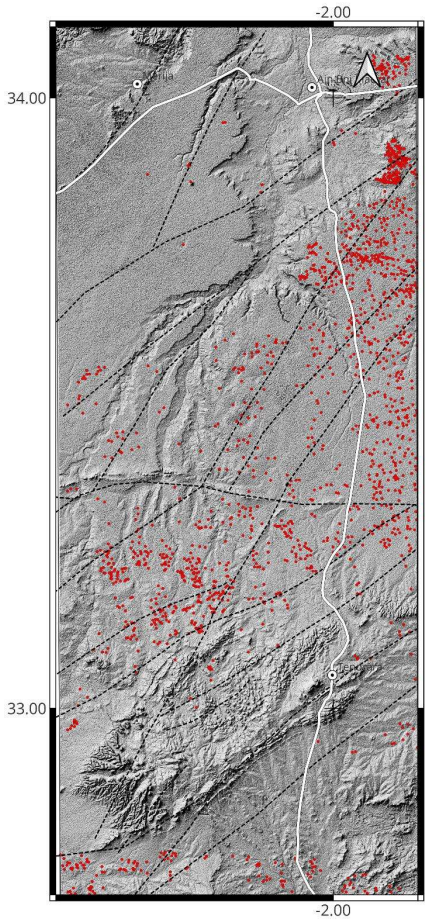
- Remote sensing: Depressions / pans as proxies for seeps;
- Surface geochemistry: in situ H_2 measurements
- Surface geophysics: gamma spectrometry (and radon meas.)
- Laboratory analysis: soil gas composition
- Structural geology: regional discontinuities and deep faults
- Magnetic / gravimetric anomalies: 3D modelling and H_2 origin
- **Definition of hydrogen system**



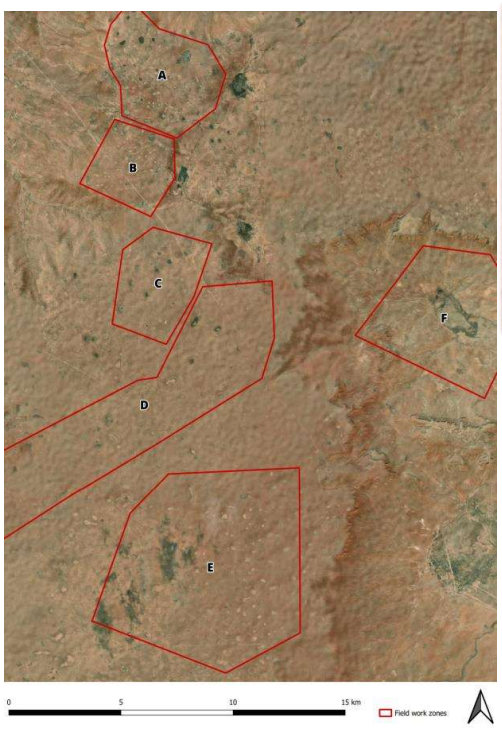


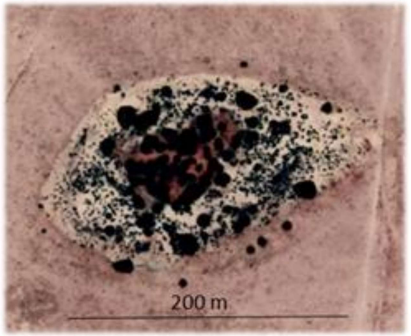
Preliminary results - Morocco

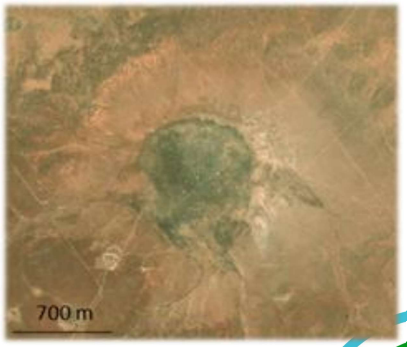
- Remote sensing identified potential seeps in the province of Jerada South of Ain Beni Mathar.
- Other targets can be spotted around the town of Tendrara in the Figuig province.



Potential hydrogen seeping structures







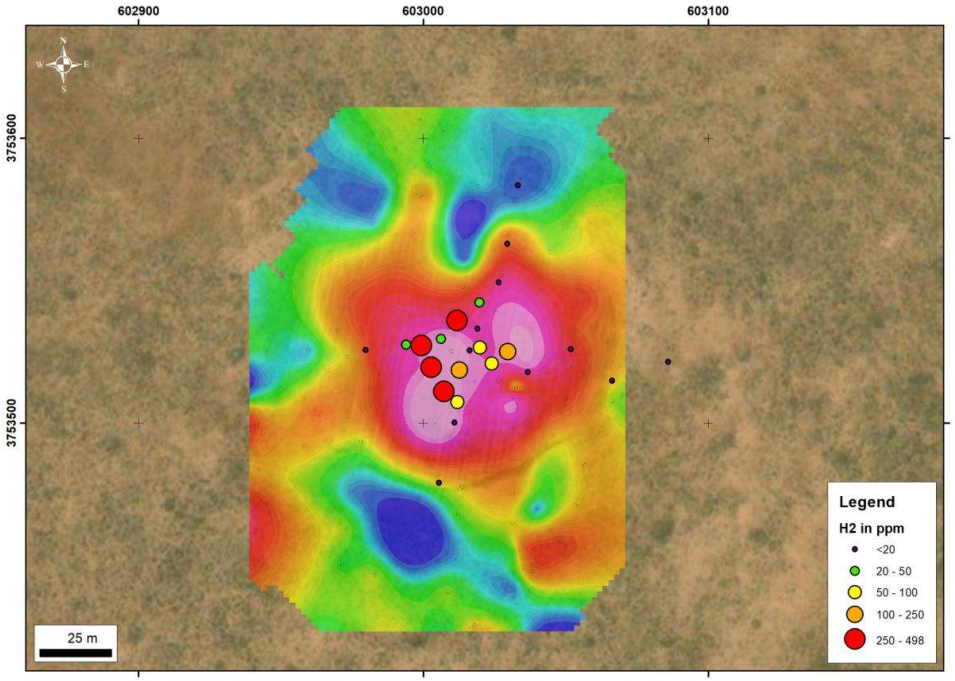
Preliminary results - Morocco

Field survey

- 287 H_2 measurements covering the 6 identified areas
- 25 targets investigated
- 923 gamma ray measurements

Field measurement results

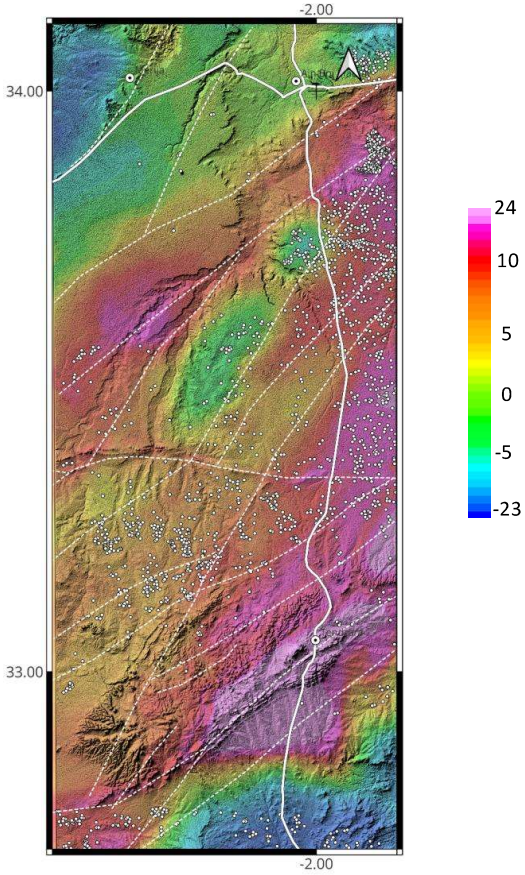
- H_2 concentration up to 498 ppm
- 8 of the targets have grades > 100 ppm
- Some targets show good correlation between hydrogen concentration and gamma-ray measurements



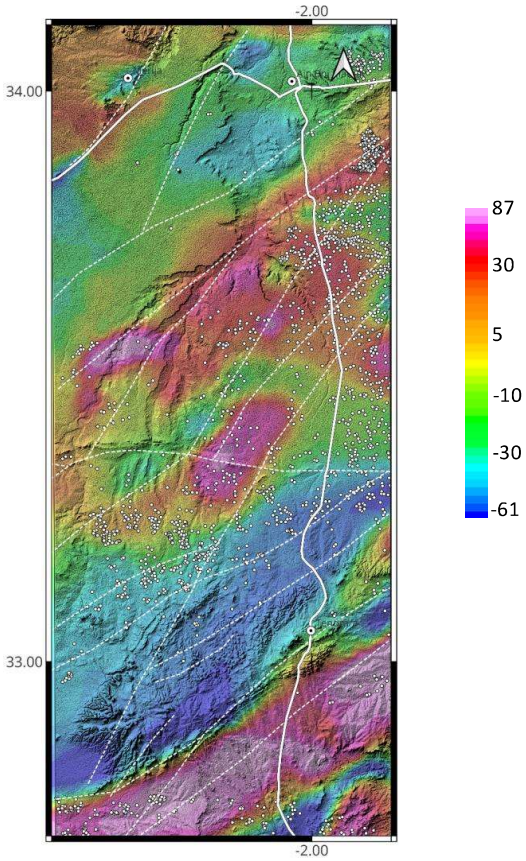
Contour map of natural H_2 concentration (ppm)

Morocco – geophysical data and analysis

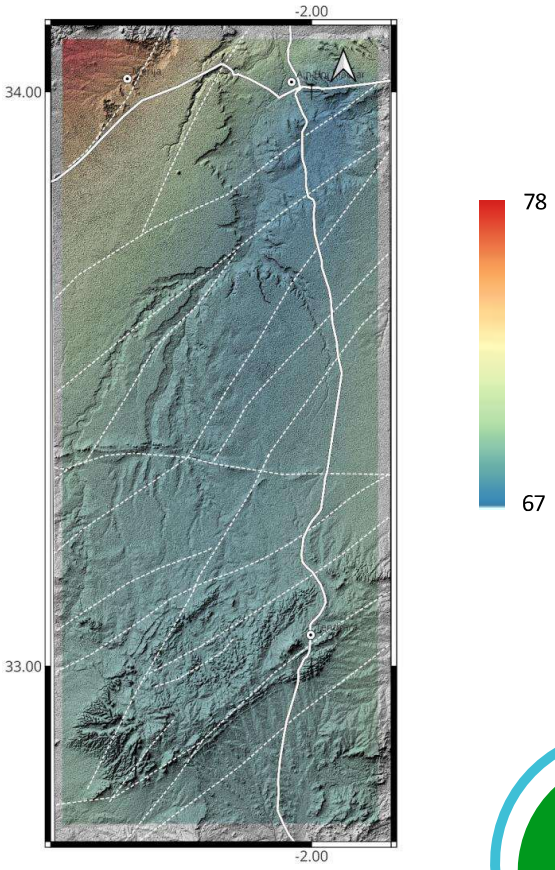
Residual Gravity (mGal)



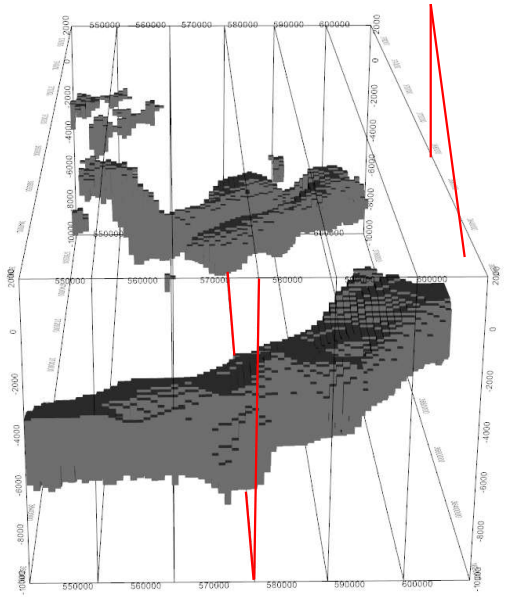
Residual Magnetic (nT)

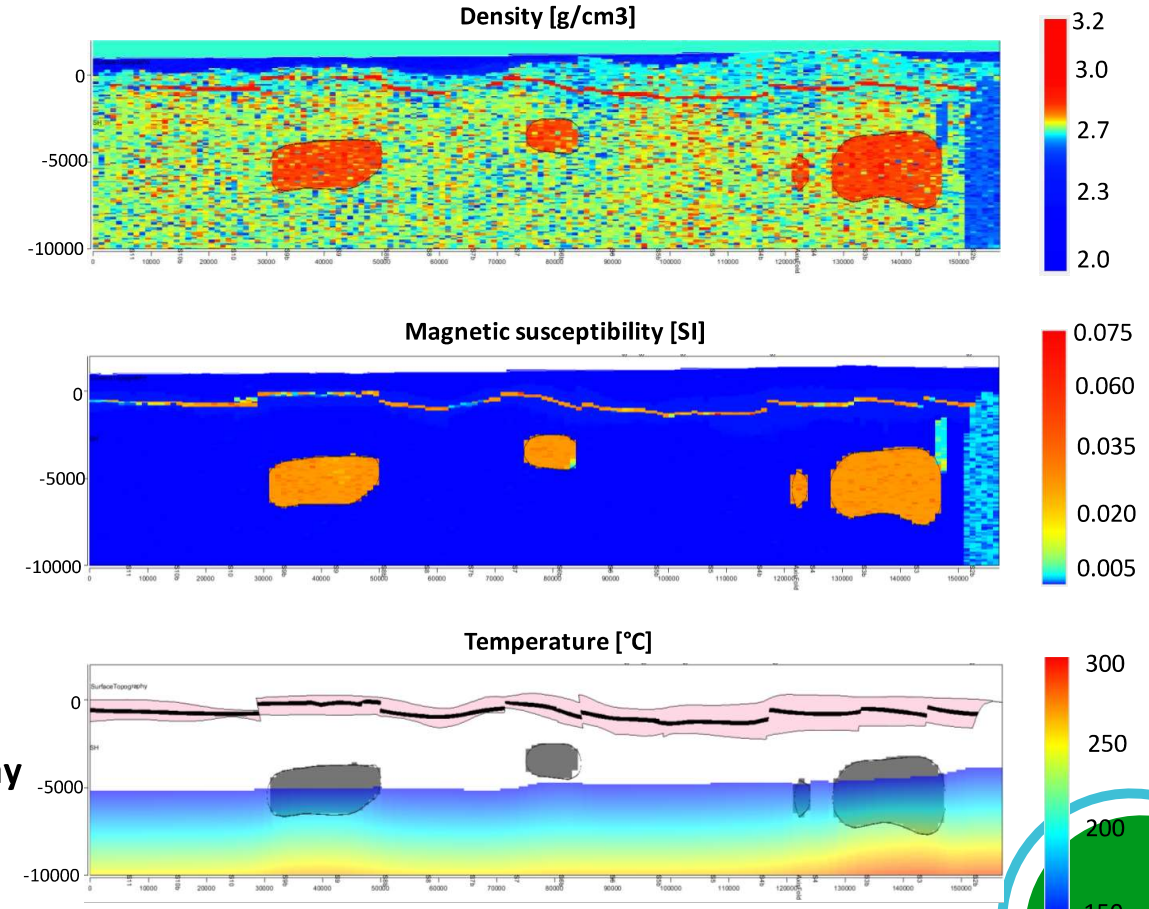


Heat flow (mW/m^2)



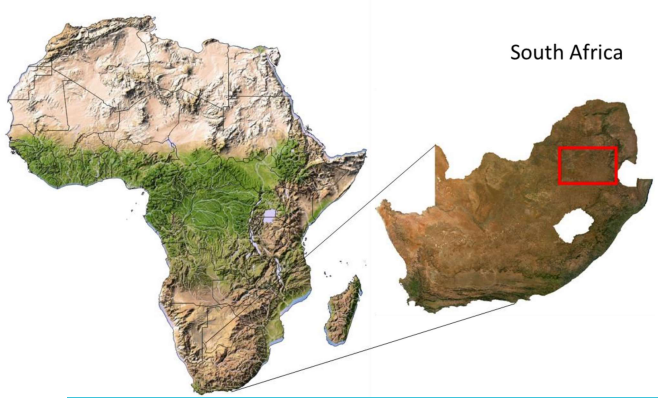
Morocco: modelling of the possible H_2 sources - serpentinisation





Corrected estimated production:
Lower limit: **21 to 225 kg of H_2/day**
Considering fractures (x4 surface): **1000 kg of H_2 /day**
Accumulated volume: **???**

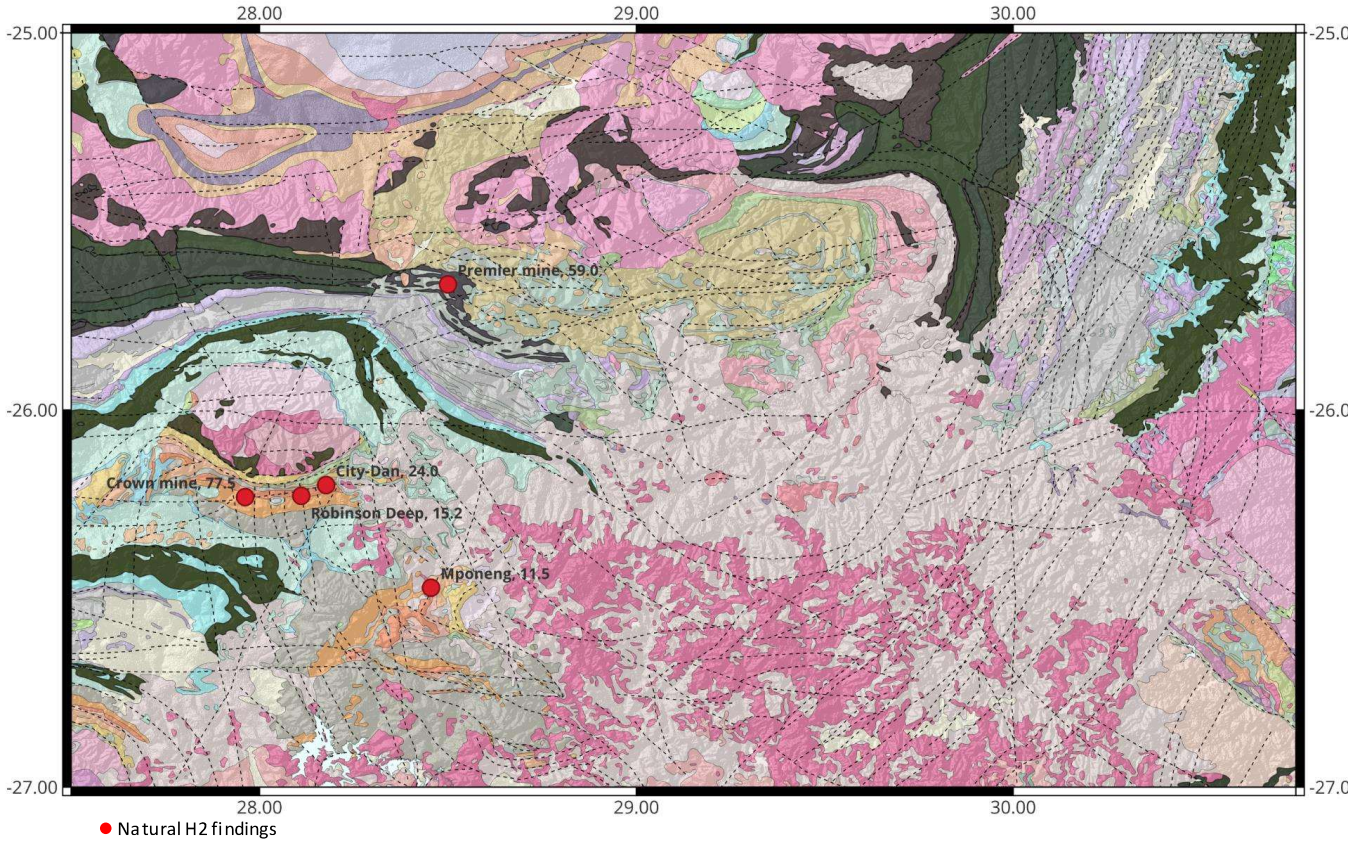
Preliminary results – South Africa



South Africa (Zgonnik, 2020)

Crown Mine - 77.5% H_2
Robinson Deep - 15.2% H_2
City Dan - 24% H_2
St. Helena Gold mine – 50%
Kimberly mine - 43.1% H_2
Driefontein – 10% H_2
Mponeng - 11.5% H_2

High H_2 concentrations were found in ground water samples from fractured rock in 24 South African wells.



Preliminary Results - South Africa

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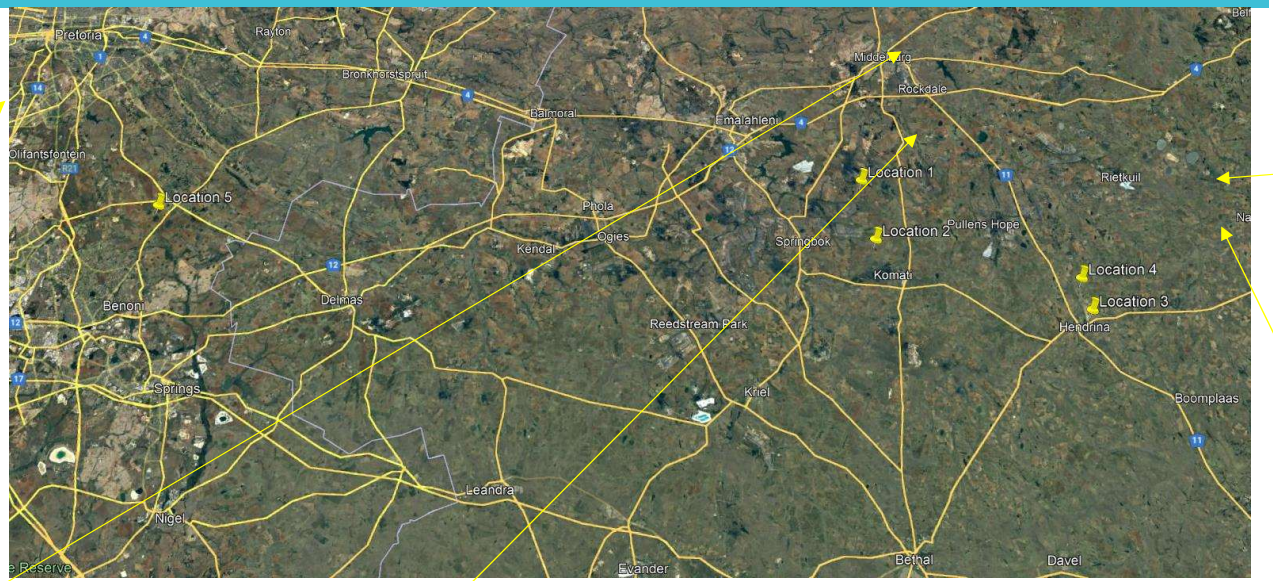
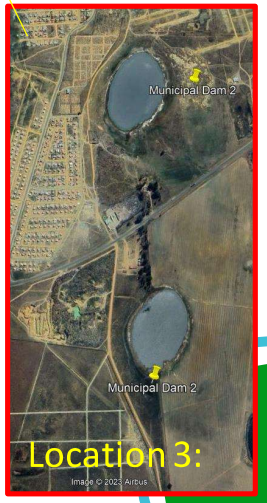
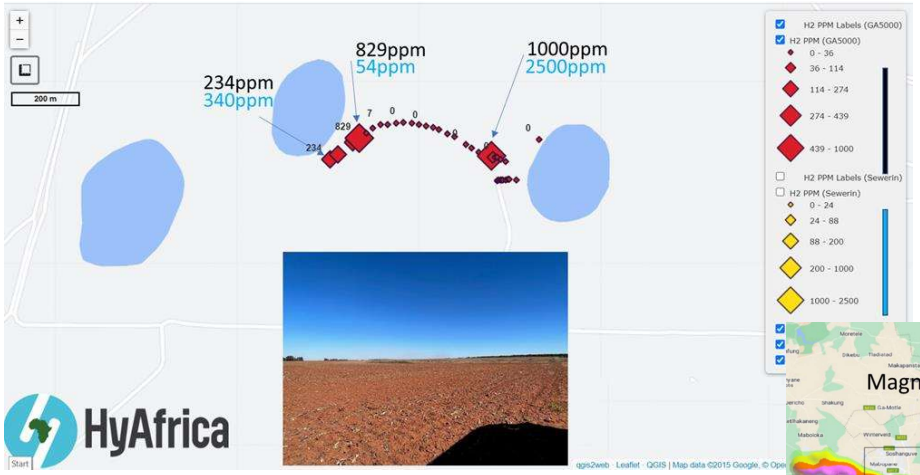
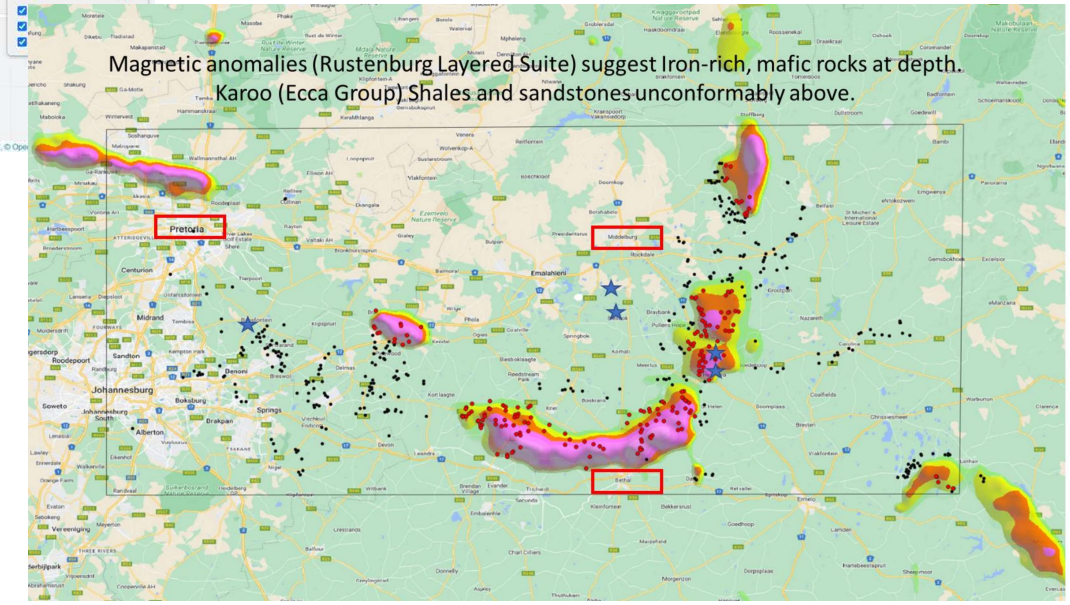




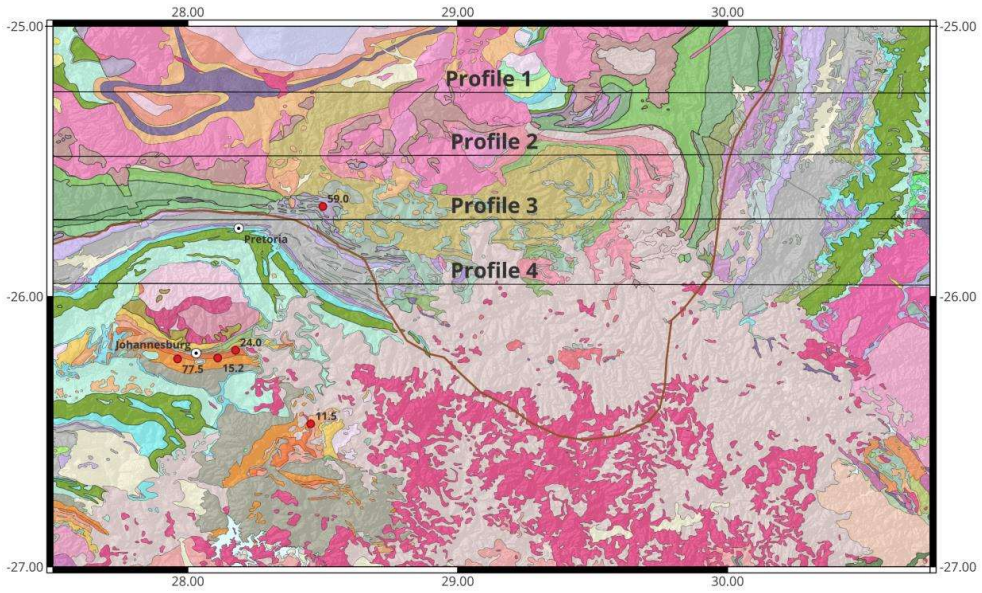
First field survey, June 2023
Second field survey, Sept. 2030
H_2 conc. > 1% vol (2m depth)

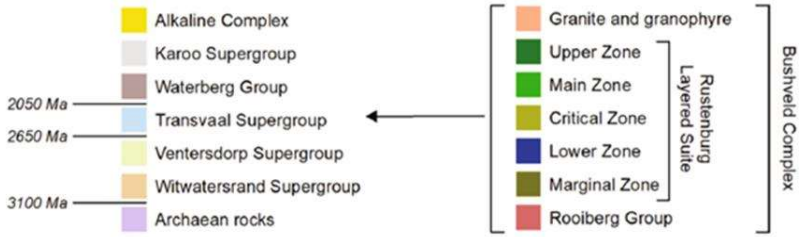
Preliminary Results - South Africa



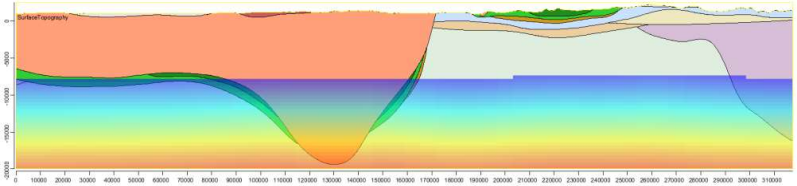


Modeling of potential H_2 sources - serpentinisation

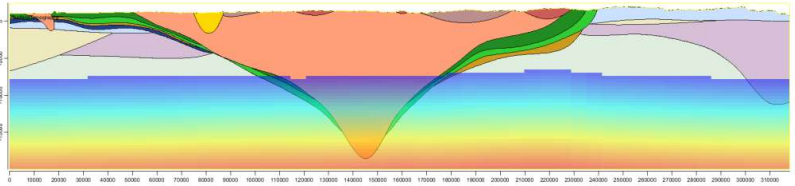




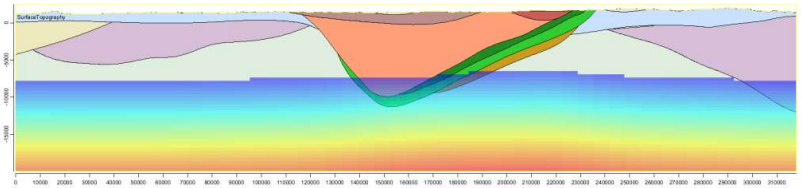
Profile 1



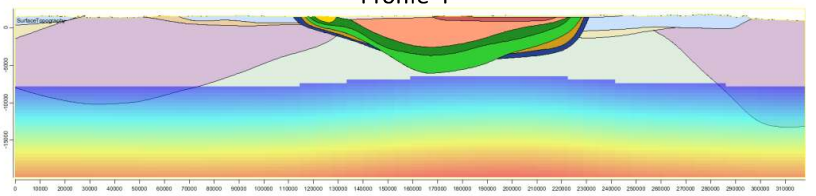
Profile 2

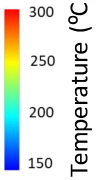


Profile 3



Profile 4





Conclusions

1. Hundreds of potential natural hydrogen seeps identified by remote sensing in the Morocco and South Africa target areas.
2. **High anomalous concentration of hydrogen at shallow depth (up to 1 m) demonstrated in both areas. Maximum values of 448 ppm in Morocco target; values above 1% (>10000 ppm) were found in South Africa.**
3. Geophysical anomalies (magnetic and gravimetric) have allowed to build 3D models of the iron-rich mafic rocks at depth, potential sources of hydrogen;
4. 3D-models and estimated depth-temperature profile indicate that the hydrogen system in Morocco is likely linked to serpentinization of mafic rocks;
5. **Hydrogen system in South Africa highly promising - very high concentrations (above 1% volume at near surface), with faults and lineaments providing structural control.**
6. **Hydrogen system in South Africa seems to be more complex – serpentinization may not be the origin (looking at natural radiolysis, mantle degassing …).**

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THANK YOU

CONTACT US FOR MORE INFORMATION

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