

HOW TO FIND NATURAL HYDROGEN IN POLAND?

Krystian WÓJCIK

*NATURAL HYDROGEN:
an alternative route of renewable hydrogen production
in European Union?*

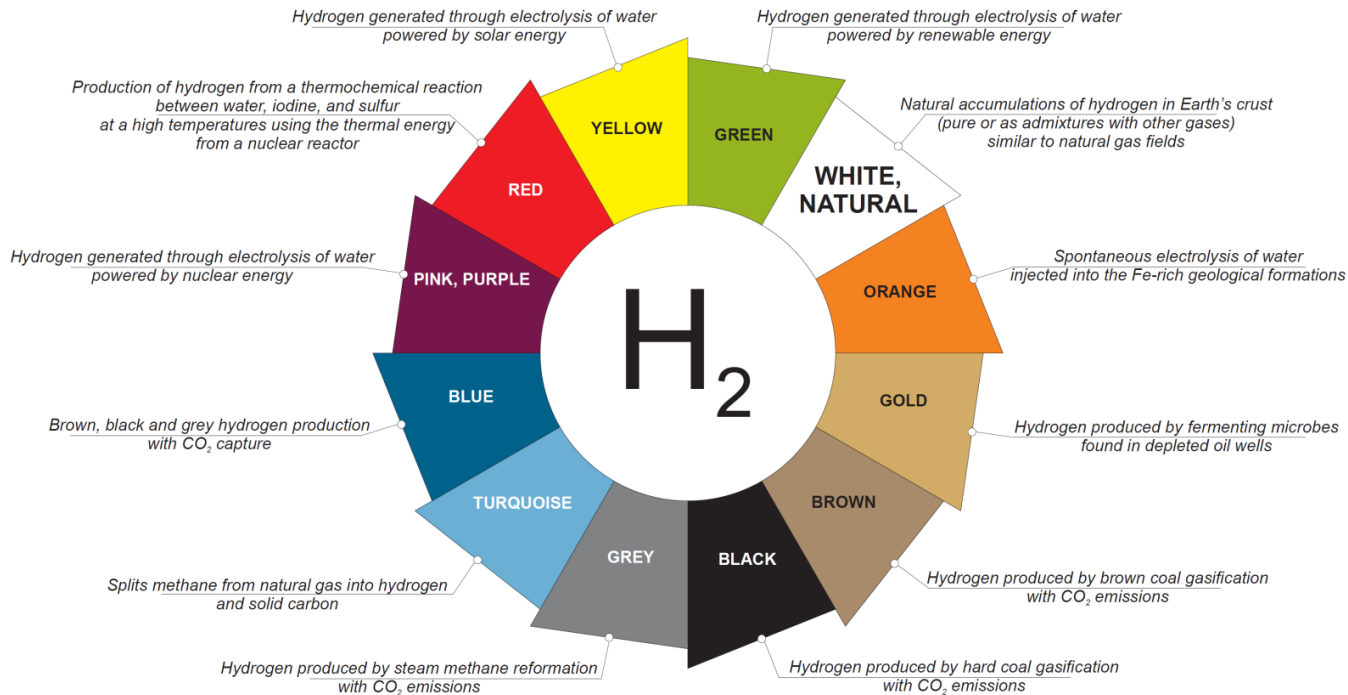


**Polish Geological Institute
National Research Institute**
Polish Geological Survey

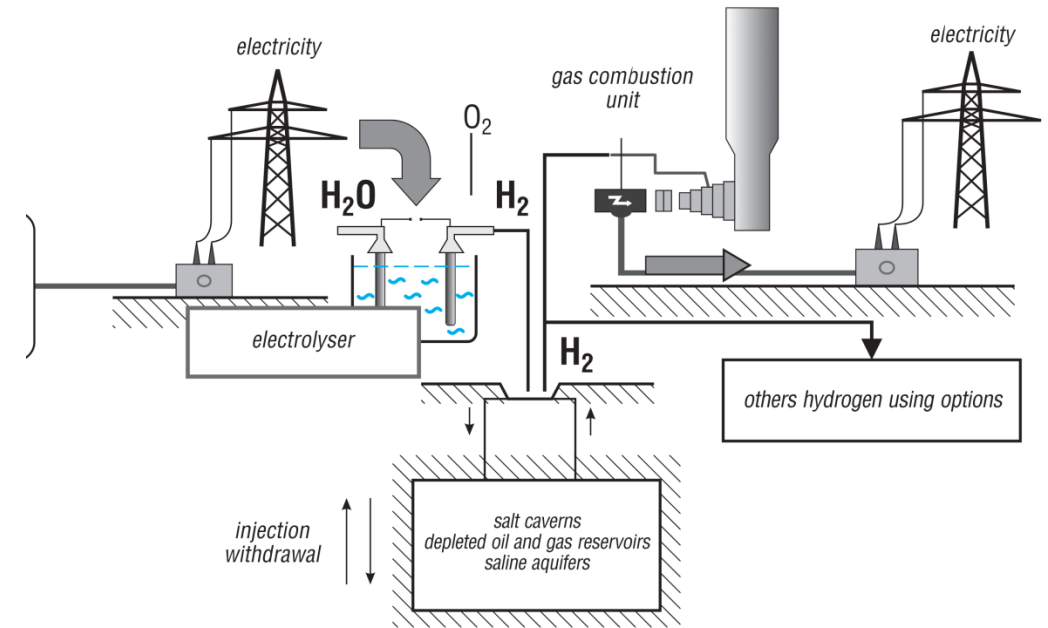
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HYDROGEN UMBRELLA COLORS AND SOURCES OF HYDROGEN



WHY TO SEARCH NATURAL HYDROGEN IN POLAND?



HYDROGEN MARKET IN POLAND

Production of **GREEN HYDROGEN** (2030) = 0.2 Mt
BLACK/GREY HYDROGEN (2030) = 1.5 Mt

HYDROGEN → ELECTRICITY (2040) = 2.5-4.3 Mt (30-52 BCM)
 HYDROGEN → NATURAL GAS (2040) = 5.2 Mt (62 BCM)

**NATURAL HYDROGEN POSSIBLE EXPLOITATION (2024) 0.0007 Mt
 (8 MCM)**

Wójcik K. 2024. Natural hydrogen in Poland. *Przegląd Geologiczny*, **72** (11).

SPECTRA 2024. The hydrogen color wheel is expanding. Mitsubishi Heavy Industries Group.

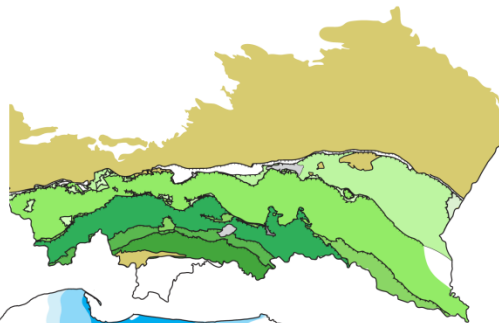
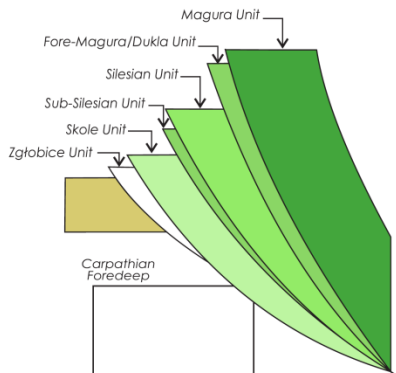
Tarkowski R. 2017. Some aspects of underground hydrogen storage. *Przegląd Geologiczny*, **65**, 282-291.

PSW 2021. Polish Hydrogen Strategy until 2030 with an outlook until 2040. Ministry of Climate and Environment.

HOW TO FIND NATURAL HYDROGEN IN POLAND? DEEP WELLS!

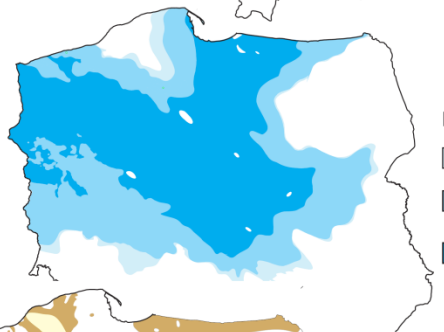
STRATIGRAPHY

NEOGENE	MIOCENE		
	PALEOGENE		
	CRETACEOUS		
	JURASSIC		
PERMIAN	ZECHSTEIN	PZ 4	
		PZ 3	
		PZ 2	
		PZ 1	
	ROTLEIEND	UPPER	Ca2
			A1+Na1
			Ca1
		LOWER	Na+Ca Fm
			Drawa Fm
			Wielkopolska Gr
CARBONIFEROUS	PENNSYLVANIAN	Magnuszew Fm	
		Lublin Fm	
		Wieliczka Fm	
		Terebin Fm	
	VISEAN	Huczwa Fm	
	TOURNAISIAN		
	DEVONIAN	UPPER	Firlej + Huczwa Fms
			Bychawa Fm
Modryń Fm			
Telatyń Fm			
LOWER/MIDDLE		Zwoleń Fm	
		Czarnolas Fm	
		Sycyna Fm	
SILURIAN	UPPER	Puck Fm	
		Kociewie Fm	
		Pełplin Fm	
		Piaszek Fm	
	LOWER	Janki Fm	
		Prabuty Fm	
		Sosino Fm	
		Kopalino Fm	
		Strachowo Fm	
		Piastka Fm	
ORDOVICIAN	UPPER	Hirń Fm	
		Katian Fm	
		Sandrin Fm	
		Darwił Fm	
	LOWER	Darwił Fm	
		Fłoczn Fm	
		Trematoc Fm	
CAMBRIAN	FURONGIAN	Białogóra Fm	
		Osiek Fm	
	SERIES 3	Sarbska Fm	
		Łeba Fm	
SERIES 2	Kłuck Fm		
	TERRENEUVIAN	Zarnowiec Fm	



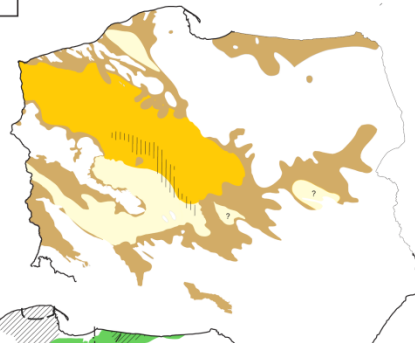
Outer Carpathians and Carpathian Foredeep

- Miocene: Carpathian Foredeep and intramountain depressions (prospective zone for gas occurrences)
- Outer Carpathians: Złobice and Stebnik Units
- Outer Carpathians: Skole, Sub-Silesian and Silesian Units
- Outer Carpathians: Dukla and Fore-Magura Units
- Outer Carpathians: Magura Units (Krynica, Bystrzyca and Siary sub-units)



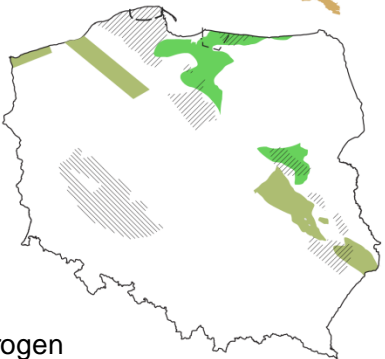
Permian – Main Dolomite

- Sebha
- Carbonate platform sediments (prospective zones for conventional oil and gas occurrences)
- Basin plain sediments



Permian – Rotliegend

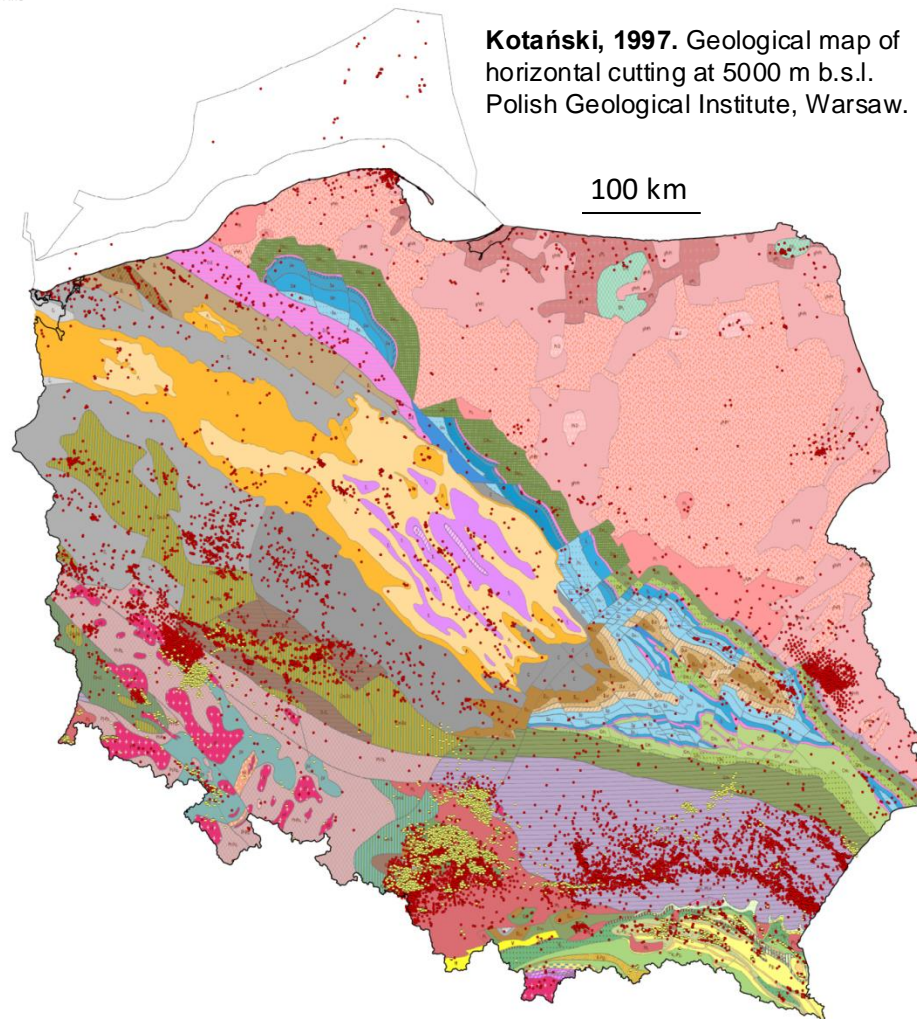
- Alluvial and fluvial sediments
- Playa-lake sediments
- Aeolian sediments (prospective zones for conventional gas occurrences)
- prospective zones for tight-gas occurrences



Paleozoic without Permian

- Cambrian: prospective zones for conventional hydrocarbon occurrences
- Devonian and Carboniferous: prospective zones for conventional hydrocarbon occurrences
- Cambrian: prospective zones for tight-gas occurrences
- Lower Paleozoic: prospective zones for shale-gas occurrences
- Carboniferous: prospective zones for shale-gas occurrences

Kotański, 1997. Geological map of horizontal cutting at 5000 m b.s.l. Polish Geological Institute, Warsaw.



HOW TO FIND NATURAL HYDROGEN IN POLAND? GAS FIELDS!

Jeninieć oil field

Acreage: 142.12 ha

Reservoir thickness: 16.5 m

$P_{start}/P_{current}$: 55.01 Mpa / 23.28 MPa

Vabs: 43.2 t/d

Original oilgeological resources : 282.0 kt

Current oil geological resources : 222.3 kt

Production 2023: 3.67 kt

Original gas geological resources: 20 MCM

Current gas geological resources: 26 MCM

Production 2023: 0.29 MCM

CH₄ = 52.73%; N₂ = 34.89%; He = 0.049%; H₂ = 10.358%

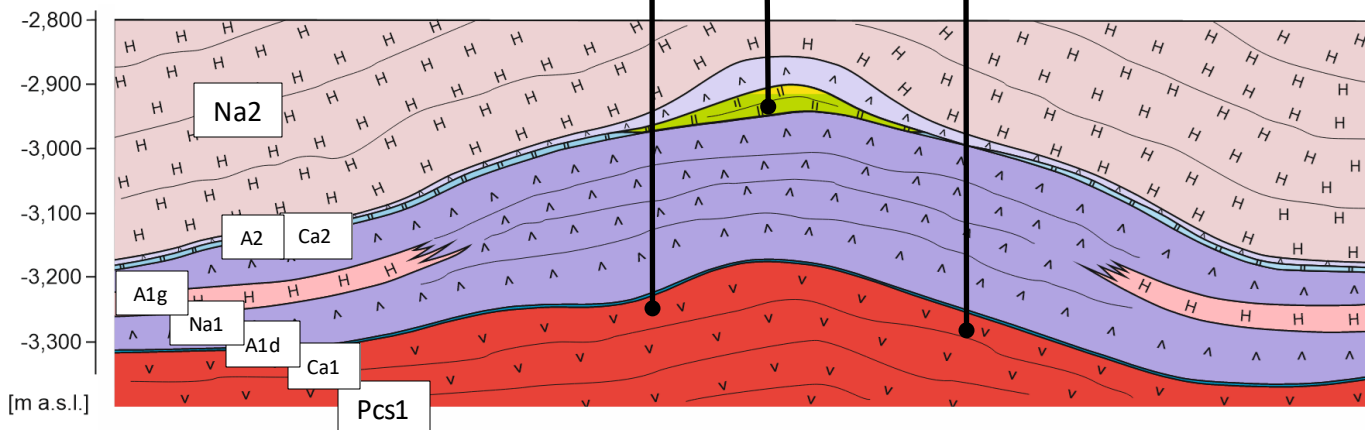
← **MIDAS 2024.** System of management and protection of mineral resources in Poland. PGI-NRI, Warsaw.

Czekański et al. 1989. Jeninieć oil field geological report. CAG PIG 16487 CUG, Warsaw.

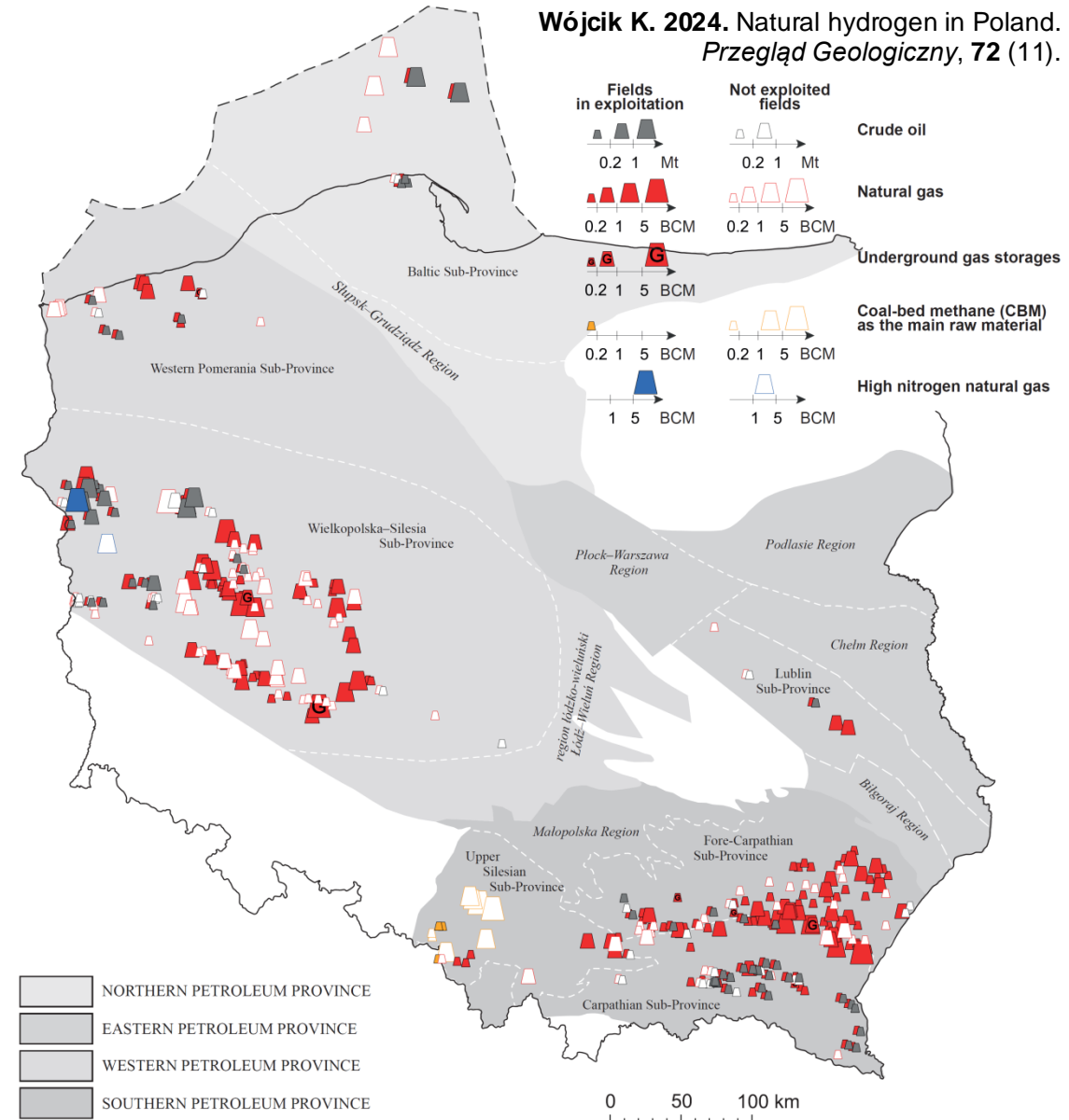
Jeninieć-1
2925,0 m

Jeninieć-7
3268,0 m

Jeninieć 4
3290,0 m



Wójcik K. 2024. Natural hydrogen in Poland. *Przełęcz Geologiczna*, 72 (11).



HOW TO FIND NATURAL HYDROGEN IN POLAND? CHECK THE ORIGIN!

Considered H₂ origin in Poland and how to check it

- migration from deeper parts of the Earth's mantle/core along deep faults

(correlation of H₂ and He content in individual stratigraphic horizons)
where: all geological horizons

- serpentinization of mafic/ultramafic rocks

(correlation of elevated H₂ content with ultramafic rocks occurrences in the basement; source rock geochemistry)
where: Sudetes and Fore-Sudetic Monocline

- hydrolysis in iron-rich formations

(correlation of elevated H₂ content with Banded Iron Formations occurrences)
where: East European Platform

- Variscan magmatism and volcanism

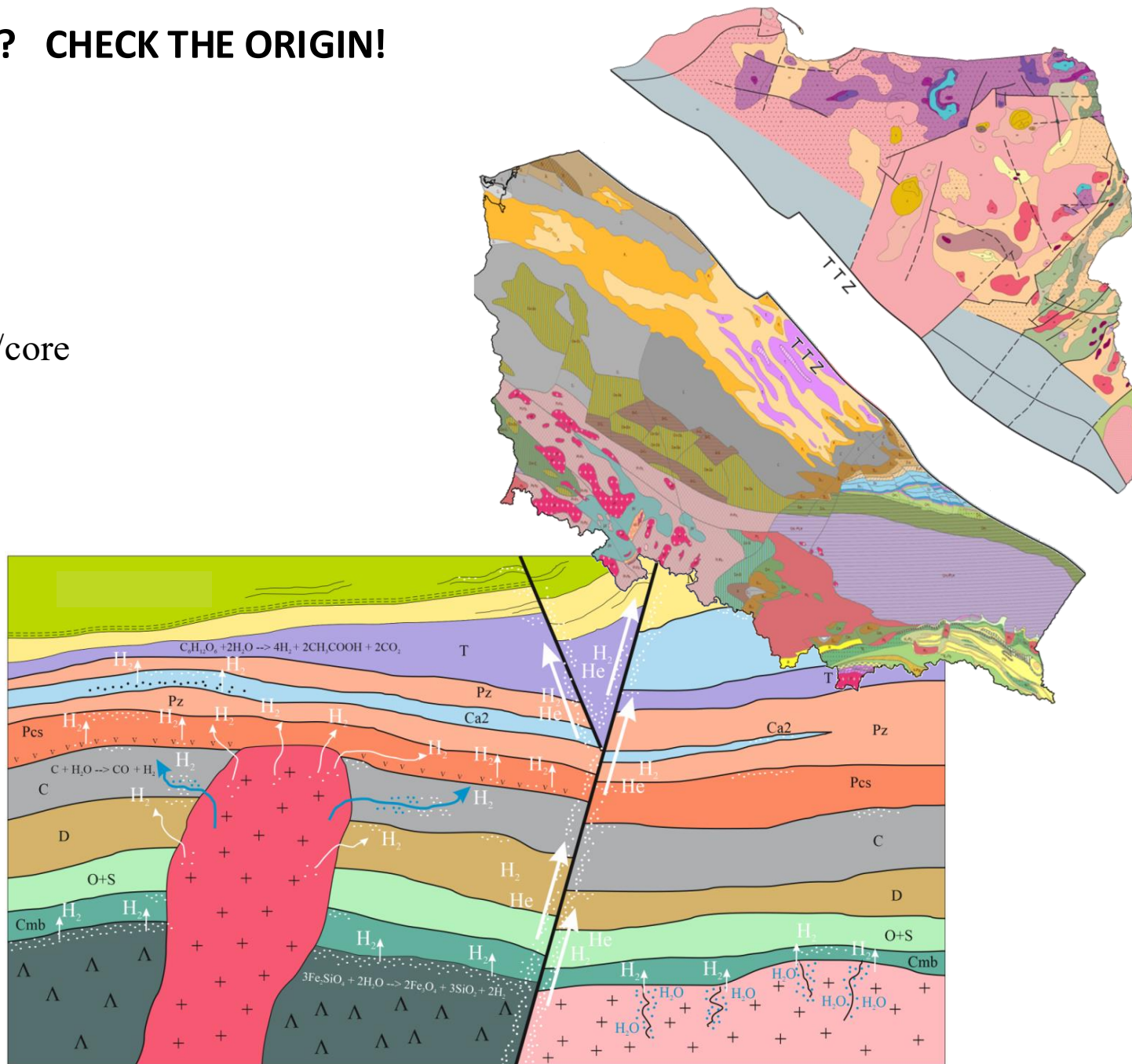
(correlation of hydrogen isotopes between H₂, methane and volcanic gases)
where: Permian – Rotliegend

- metamorphism of coal beds

(correlation of hydrogen isotopes between H₂, methane and volcanic gases)
where: Permian – Rotliegend,
Carboniferous of the Fore-Sudetic Monocline, Intra-Sudetic Depression

- biogenic decomposition of organic matter

(correlation of hydrogen isotopic composition between H₂ and source rocks for hydrocarbons)
where: Permian – Main Dolomite, Caropathians



HOW TO FIND NATURAL HYDROGEN IN POLAND/EUROPE/WORLD? DO IT WITH US!



Ministry of Climate and Environment
Republic of Poland



*Prospection, exploration and exploitation
of natural hydrogen fields in Poland – STAGE I (PGS)*

STAGE I – H₂ occurrences and content in Poland

- A. H₂ in oil and gas fields
- B. H₂ in deep wells
- C. H₂ in copper/salt/coal mines
- D. Data validation
- E. Content of H₂ in different geological horizons
- F. Prospective areas for H₂ occurrences

STAGE II – origin of H₂ in Poland

- A. Possible origin of H₂ and how to check it
- B. Natural gas fields sampling
- C. Molecular and isotope investigations of natural gas samples
- D. Chemical monitoring of gas fields and model of H₂ accumulation
- E. Analysis of H₂ source rocks
- F. Origin of selected H₂ accumulations
- G. Well geophysics



Mineral and Energy
Economy Research
Institute
Polish Academy of Sciences



Polish Natural Hydrogen Initiative



STAGE III – exploration of H₂ in EU

- A. Comparison of possible hydrogen systems in Europe
- B. International/European prospection and exploration strategies
- C. Discover and production from the first natural hydrogen field in Europe
- D. Transformation of oil and gas sector in Europe

(SRIA 2021-2027)

Alternative route of renewable hydrogen production

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