

HOW TO FIND NATURAL HYDROGEN IN POLAND?

Krystian WÓJCIK

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

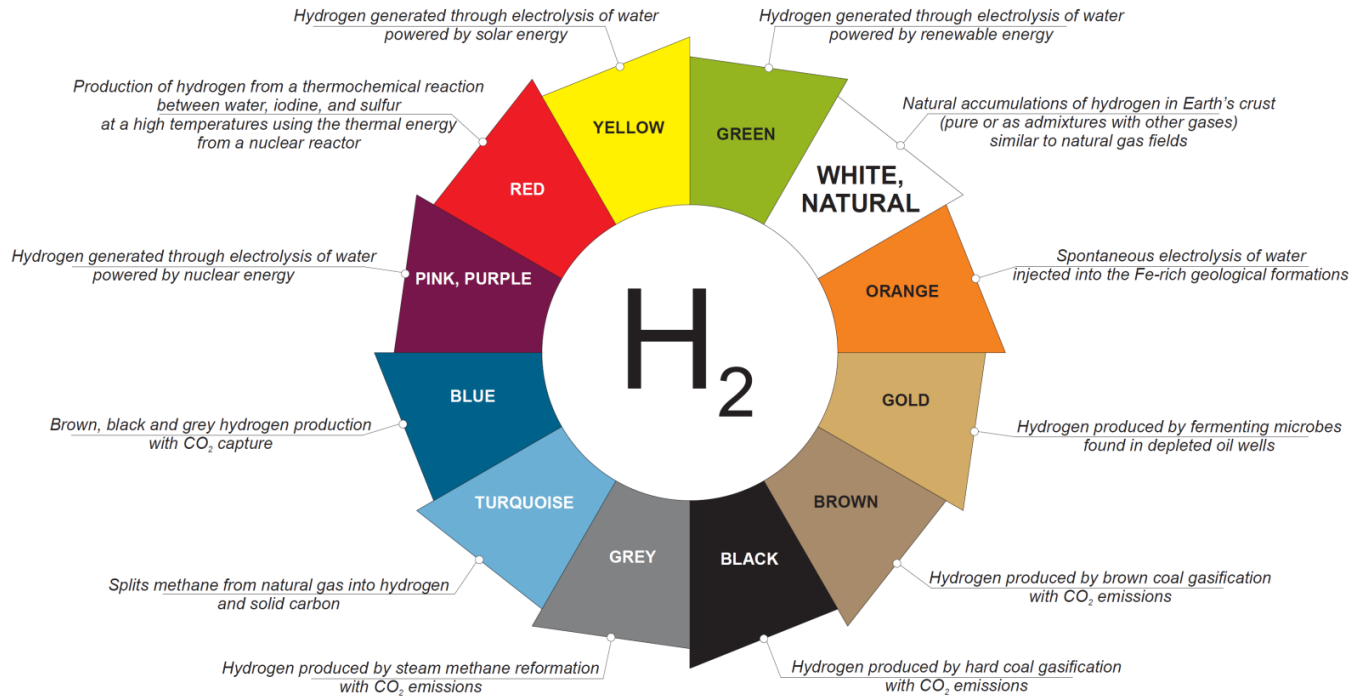


Polish Geological Institute
National Research Institute
Polish Geological Survey

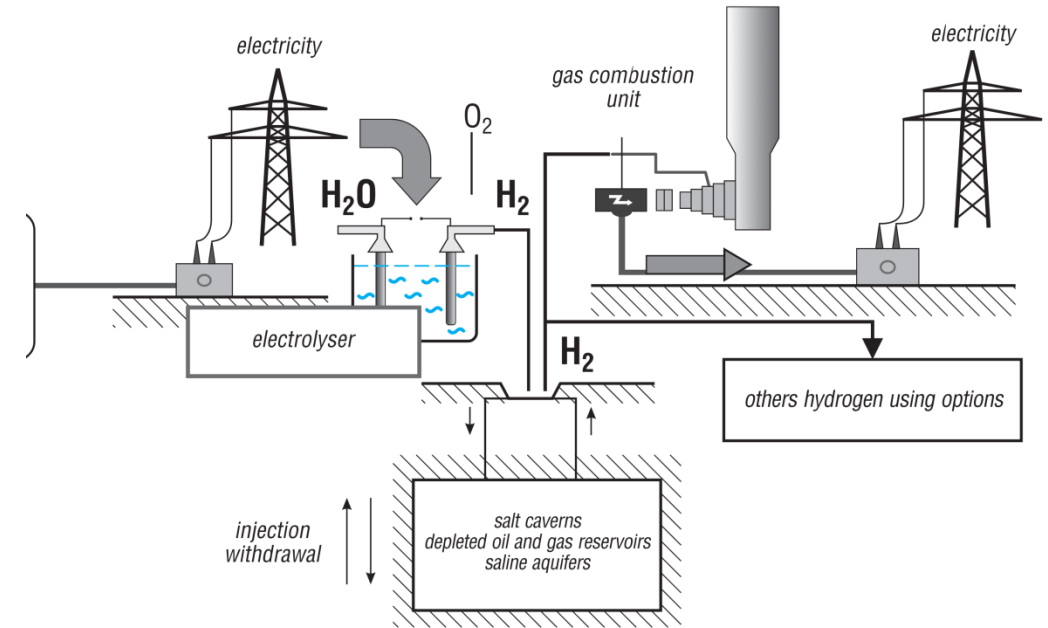
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HYDROGEN UMBRELLA COLORS AND SOURCES OF HYDROGEN



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.

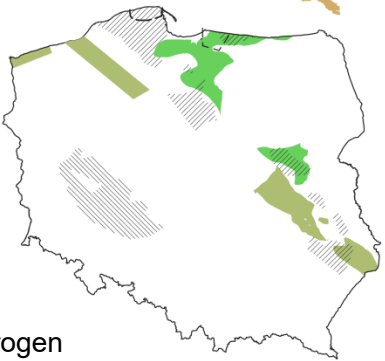
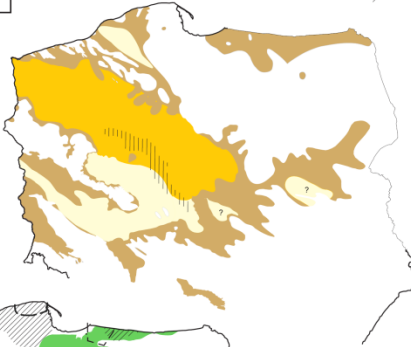
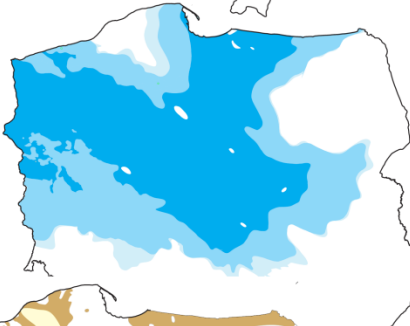
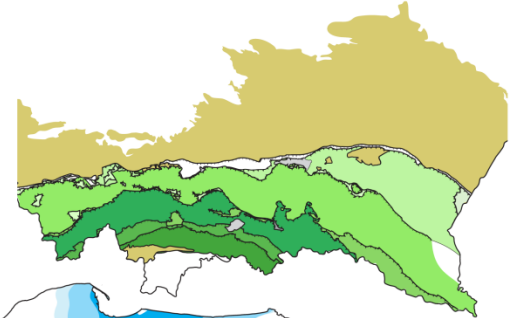
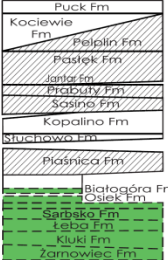
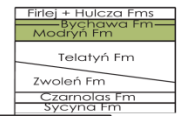
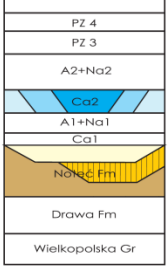
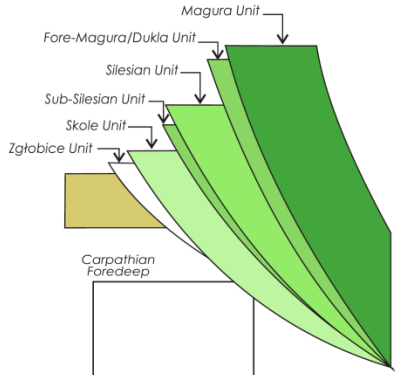
Tarkowski R. 2017. Some aspects of underground hydrogen storage. *Przegląd Geologiczny*, **65**, 282-291.

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	
	ROTLEGEND	UPPER	Na1+Ca1
			Ca2
			A2+Na2
		LOWER	Drawa Fm
			Wielkopolska Gr
CARBONIFEROUS	PENNSYLVANIAN	Moscovian	
		Bashkirian	
		Serpukhovian	
		Visean	
	DEVONIAN	UPPER	Tournaisian
			Famennian
			Frasnian
		LOWER/MIDDLE	Givetian
			Eifelian
			Frisian
SILURIAN	PRYDOL	Pridoli	
		Lodlow	
		Ludlow	
		Wenlock	
	ORDOVICIAN	UPPER	Hirn
			Katian
			Sandbian
		LOWER	Darriwill
			Dapingian
			Floian
CAMBRIAN	FURONGIAN	Plasencia Fm	
		Białogóra Fm	
	SERIES 3	Ośiek Fm	
		Sarbska Fm	
SERIES 2	Łeba Fm		
	TERRENEUVIAN	Kłuki Fm	
	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

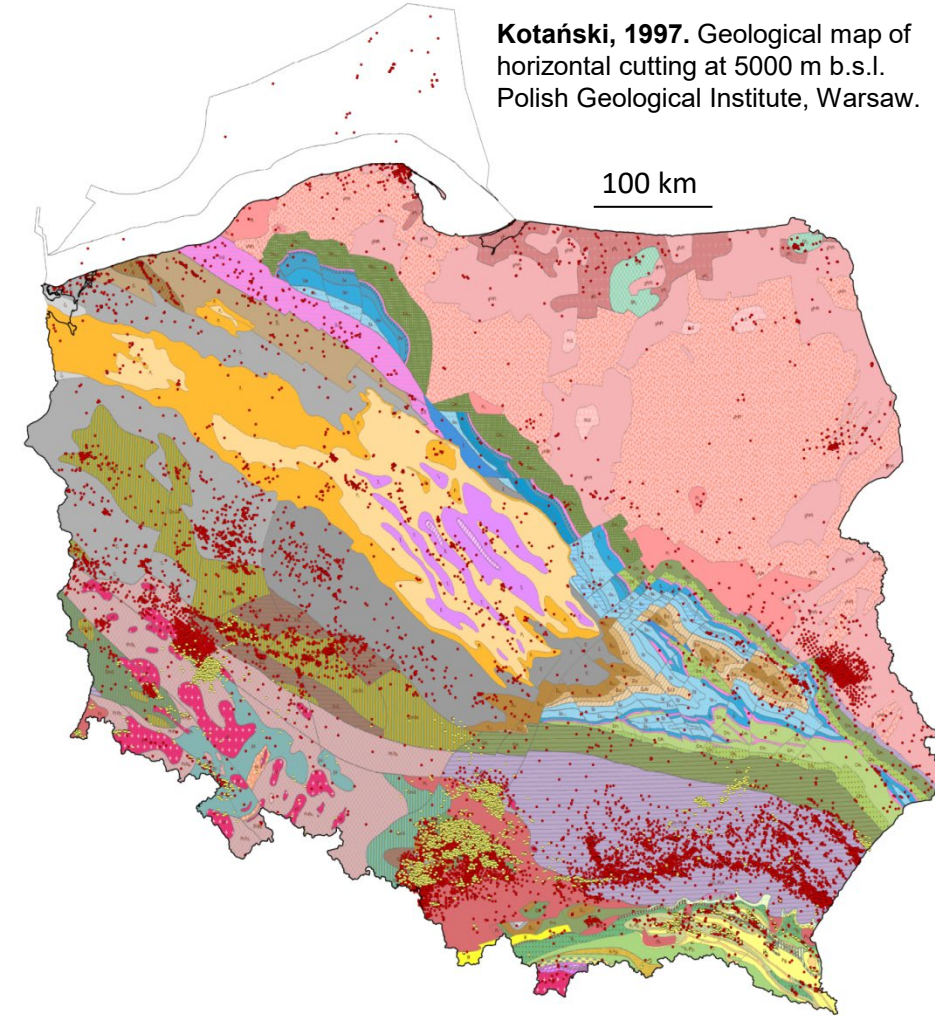
Permian – Rotliegend

- 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

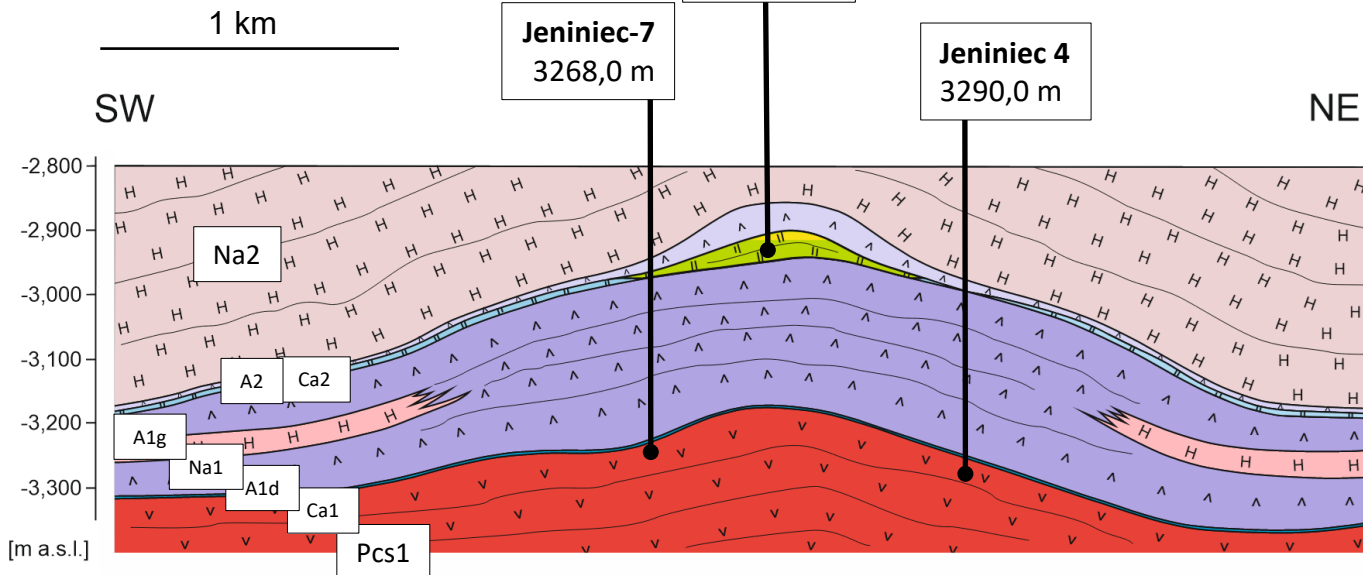
CH₄ = 52.73%; N₂ = 34.89%; He = 0.049%; H₂ = 10.358%

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

Jeninieć-1
2925,0 m

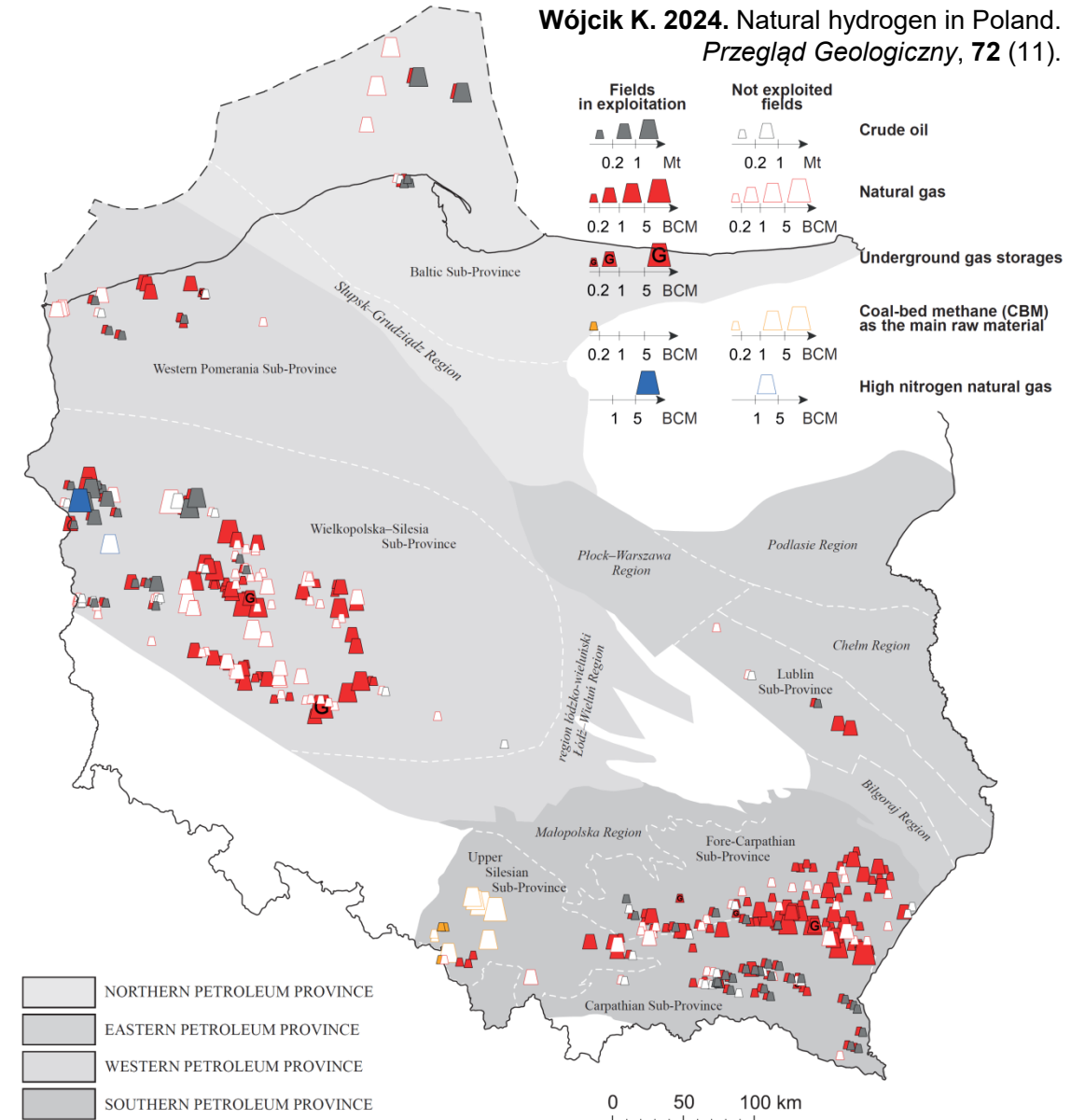
Jeninieć-7
3268,0 m

Jeninieć 4
3290,0 m



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

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

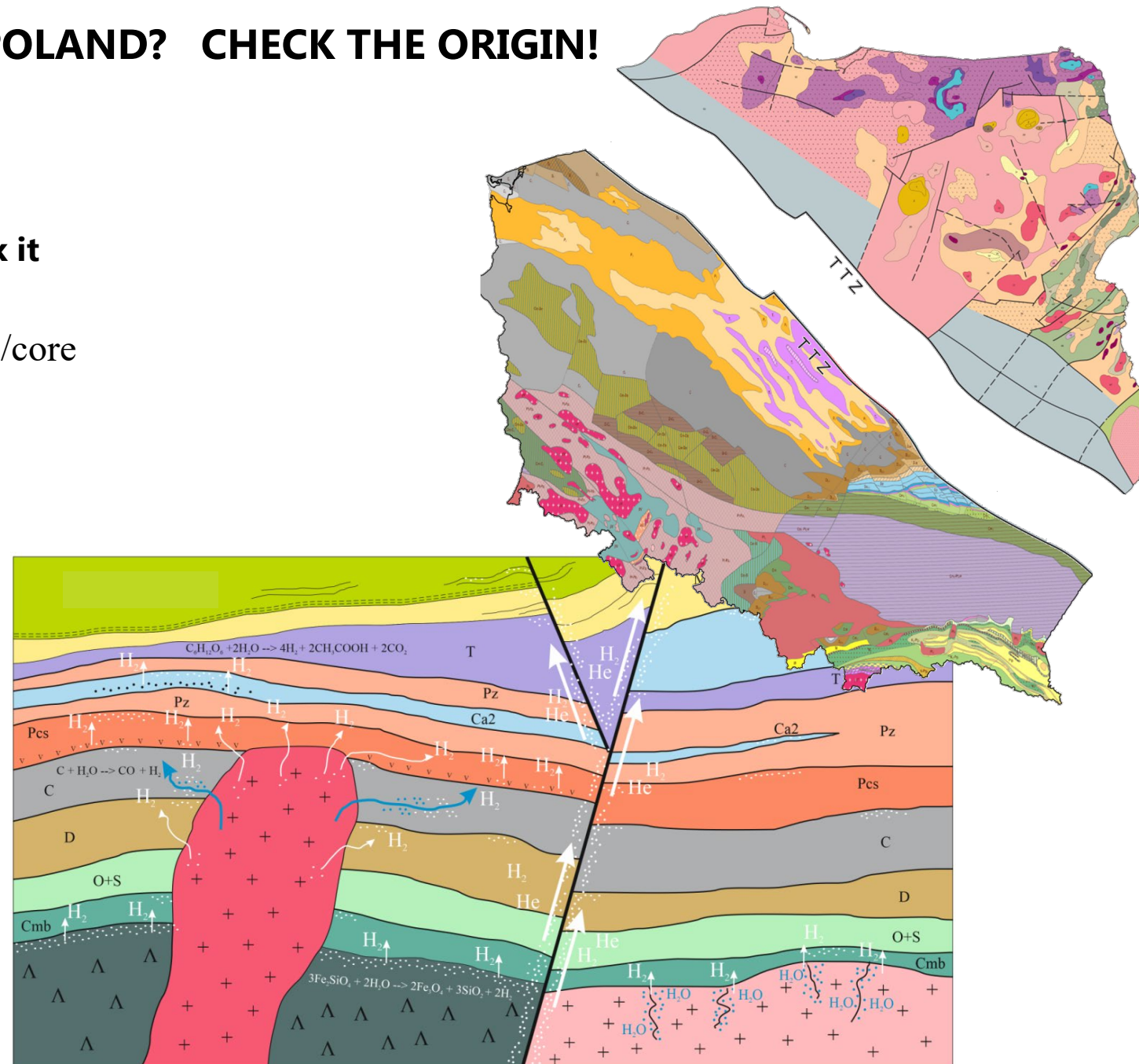
*(correlation of hydrogen isotopes between H₂, methane and volcanic gases)
where: Permian – Rotliegend*

- 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

Krystian WÓJCIK

Deputy Head
ECONOMIC GEOLOGY DEPARTMENT
POLISH GEOLOGICAL INSTITUTE – NATIONAL RESEARCH INSTITUTE

kwoj@pgi.gov.pl

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Polish Geological Institute
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