CBM Gilowice Project – Applied Fracturing Technology and the Obtained Results

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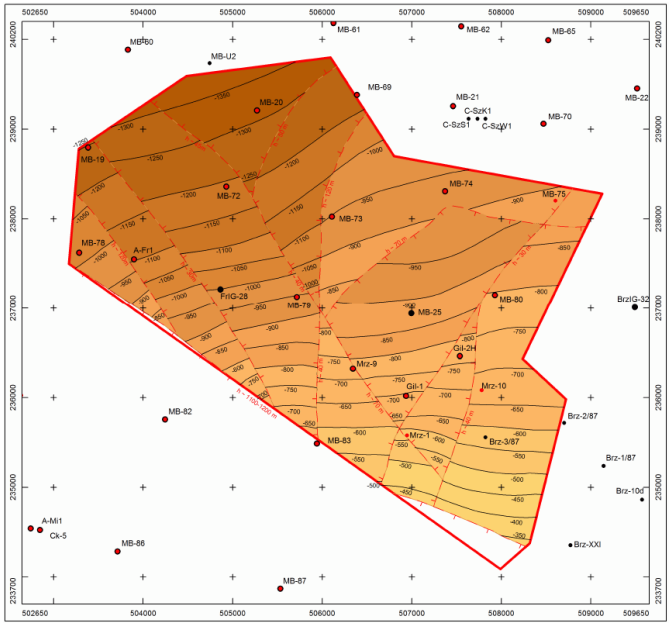
Agenda

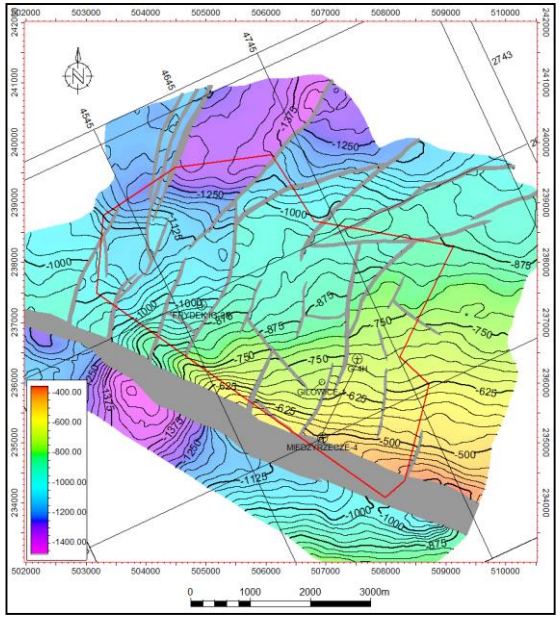
1. New seismic interpretation data
2. Fracturing treatments
3. CBM pads development

Structural Interpretation of the Międzyrzecze CBM License Area

- ✓ Previous interpretation of the 510 coal seam structure contour as of 2016:
  - fault system concept limited to multi-well correlation,
  - high level of uncertainty regarding faults geometry.
- ✓ Previous experience in the Upper Silesian basin demonstrated that the fault network of mature mining areas is generally much more complicated than it was predicted based on pre-mining interpretations.
- ✓ New challenge – 3D seismic interpretation is critical for the understanding of structural setting in this tectonically complicated area.



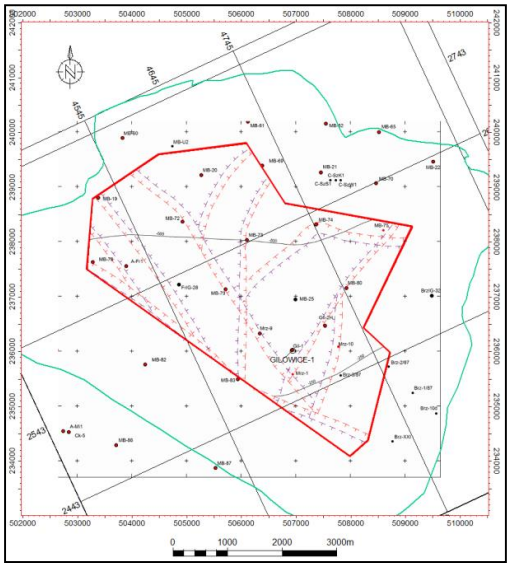
Source: „Międzyrzecze" geological data package, based on PGI case study (Jureczka et al., 2016) .



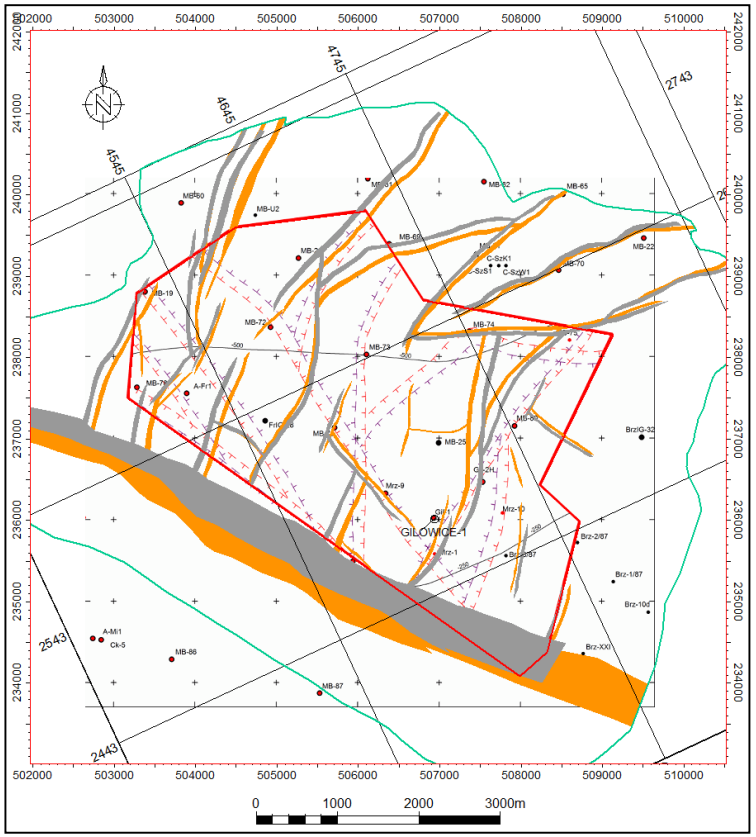
Source: Processing and interpretation of seismic data - 3D Międzyrzecze (Geofizyka Toruń, 2018) .

Structural Interpretation of the Recently Acquired 3D Seismic Data

- ✓ The new geological model differs from the previous interpretation.
- ✓ New insight into coal seams geometry based on structural interpretation.
- ✓ Existence of many normal and reverse faults, almost perpendicular to previously inferred faults (western part of Międzyrzecze block).
- ✓ New interpretation of fault polygons for the 350 and 510 coal seams.

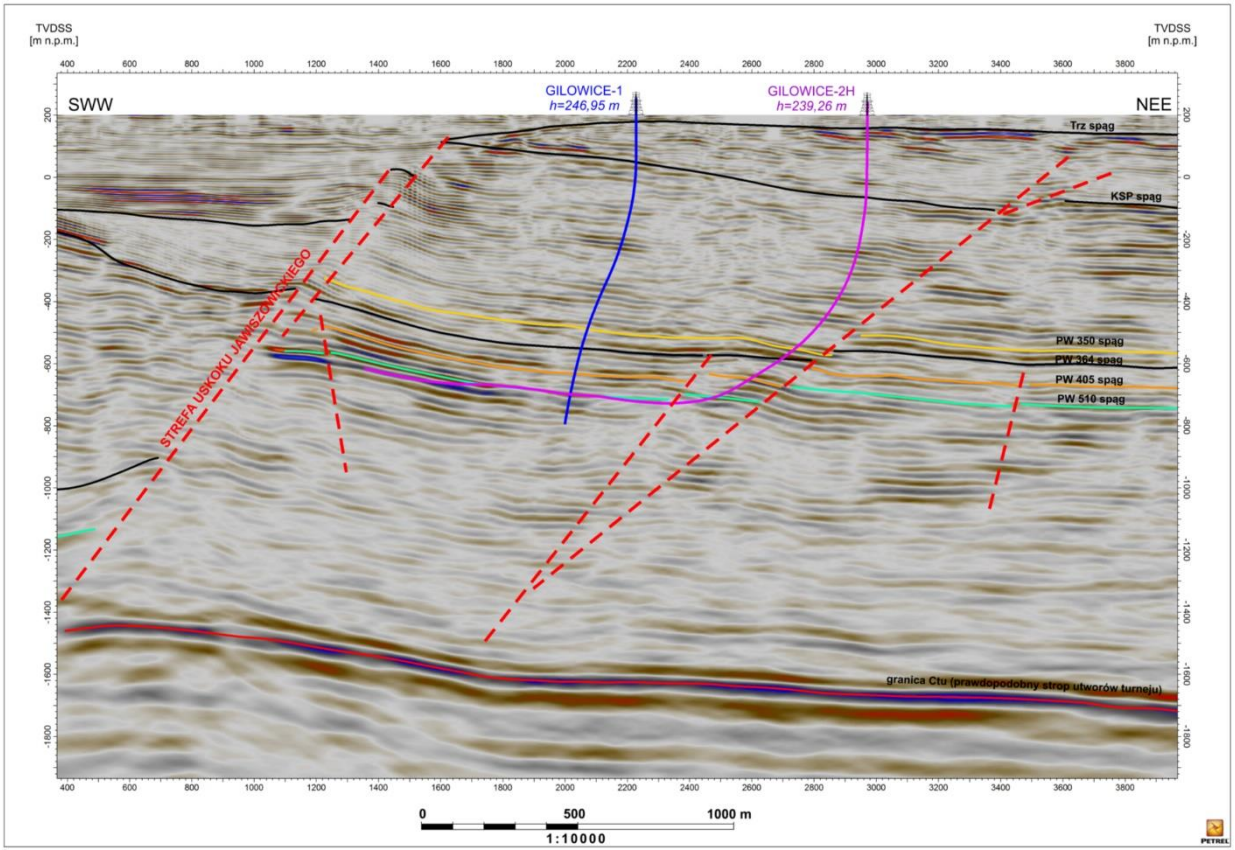


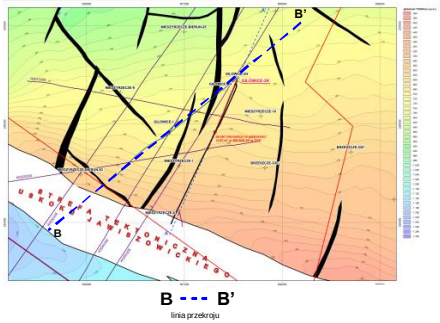
Contour on top of gassy coal seams (Jureczka J. et al., 2016). Red – faults of the 350 coal seam, purple – faults of the 510 coal seam.



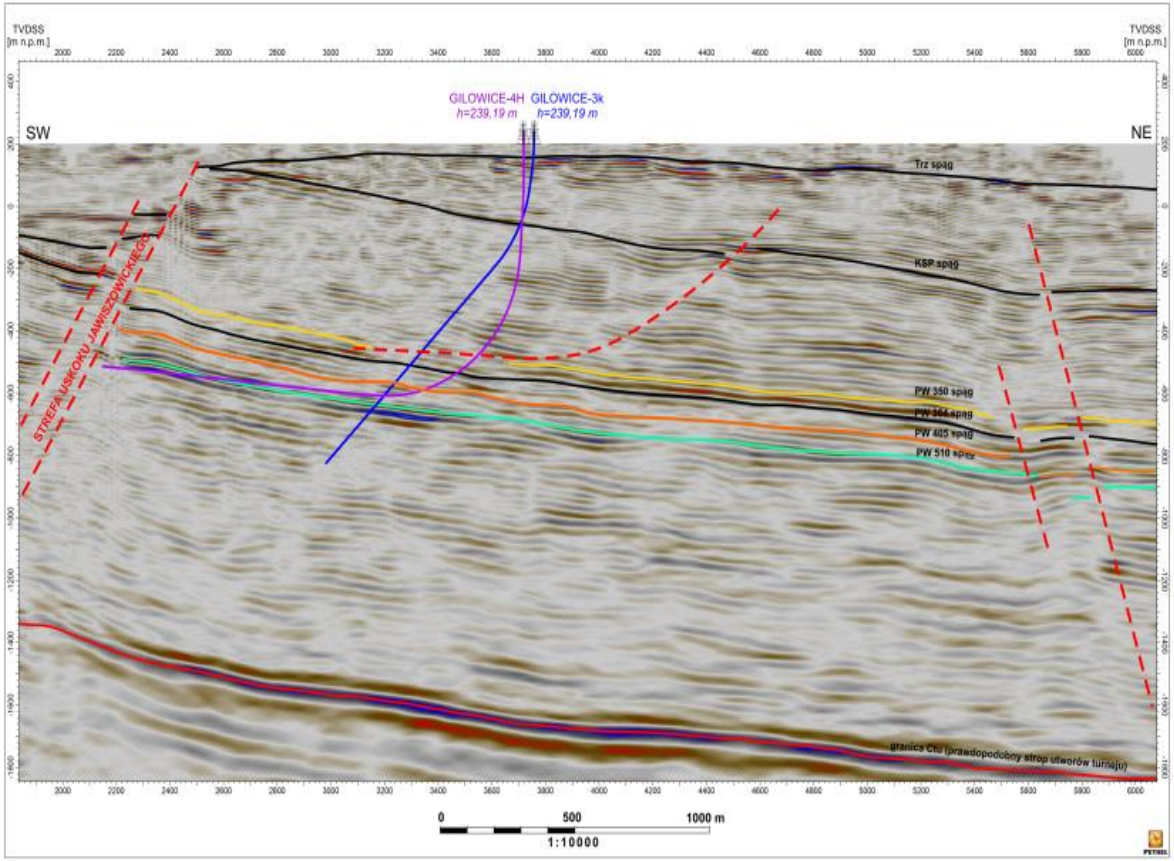
Contour on top of gassy coal seams (Geofizyka Toruń, 2018). Grey – of the 350 coal seam, orange – faults of the 510 coal seam.

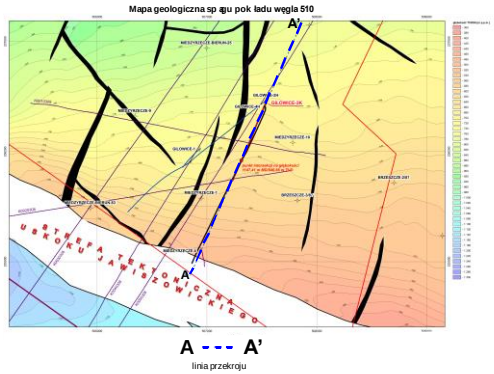
Seismic Cross-section Through Gilowice-1 and Gilowice-2H wells





Seismic Cross-section Through Gilowice-3K and Gilowice-4H wells





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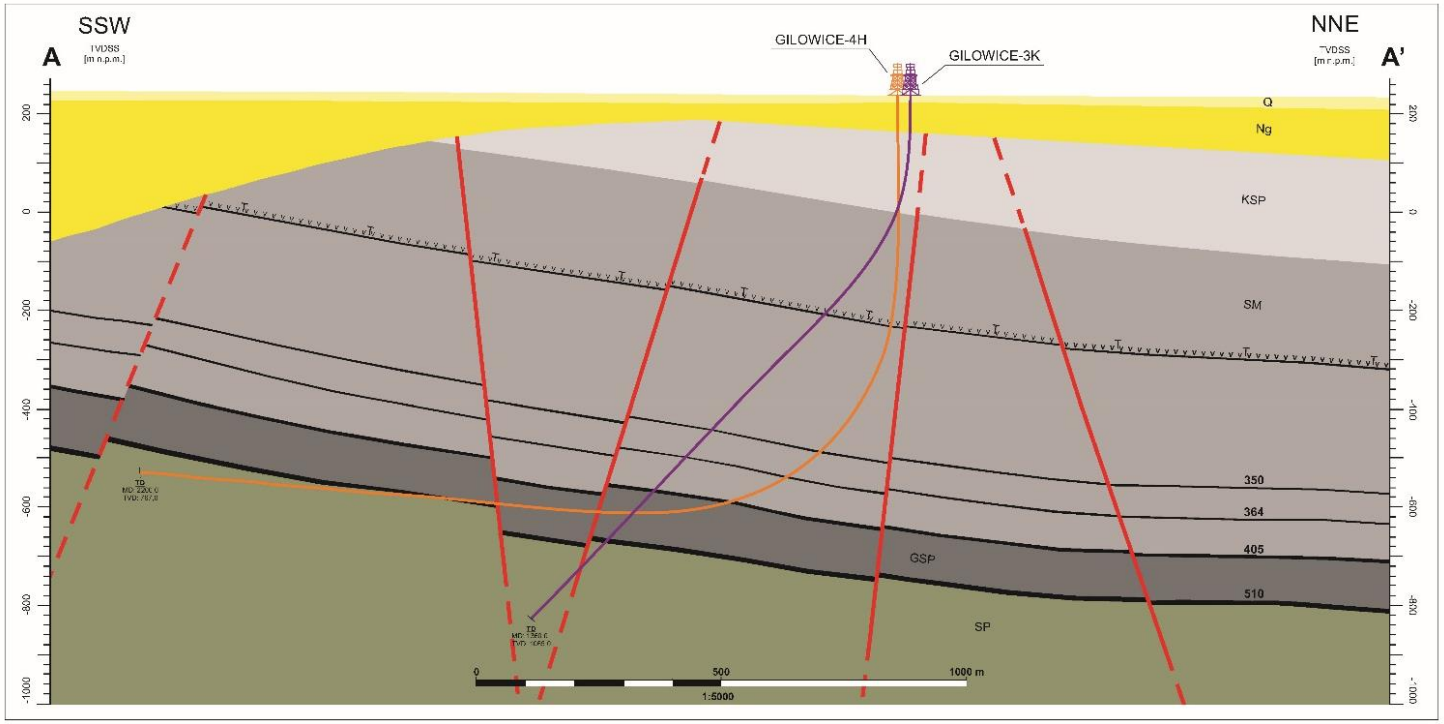
Gilowice-3K and Gilowice-4H wells

Well Gilowice-3K

- final depth – 1360 m (TVD 1062.8 m)
- vertical displacement – 774 m
- max. inclination ~ 45°

Well Gilowice-4H

- final depth – 2200 m (TVD 752.2 m)
- vertical displacement – 1570 m
- maximum inclination ~ 95°
- length of horizontal section – 1070 m



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Hydraulic Fracturing

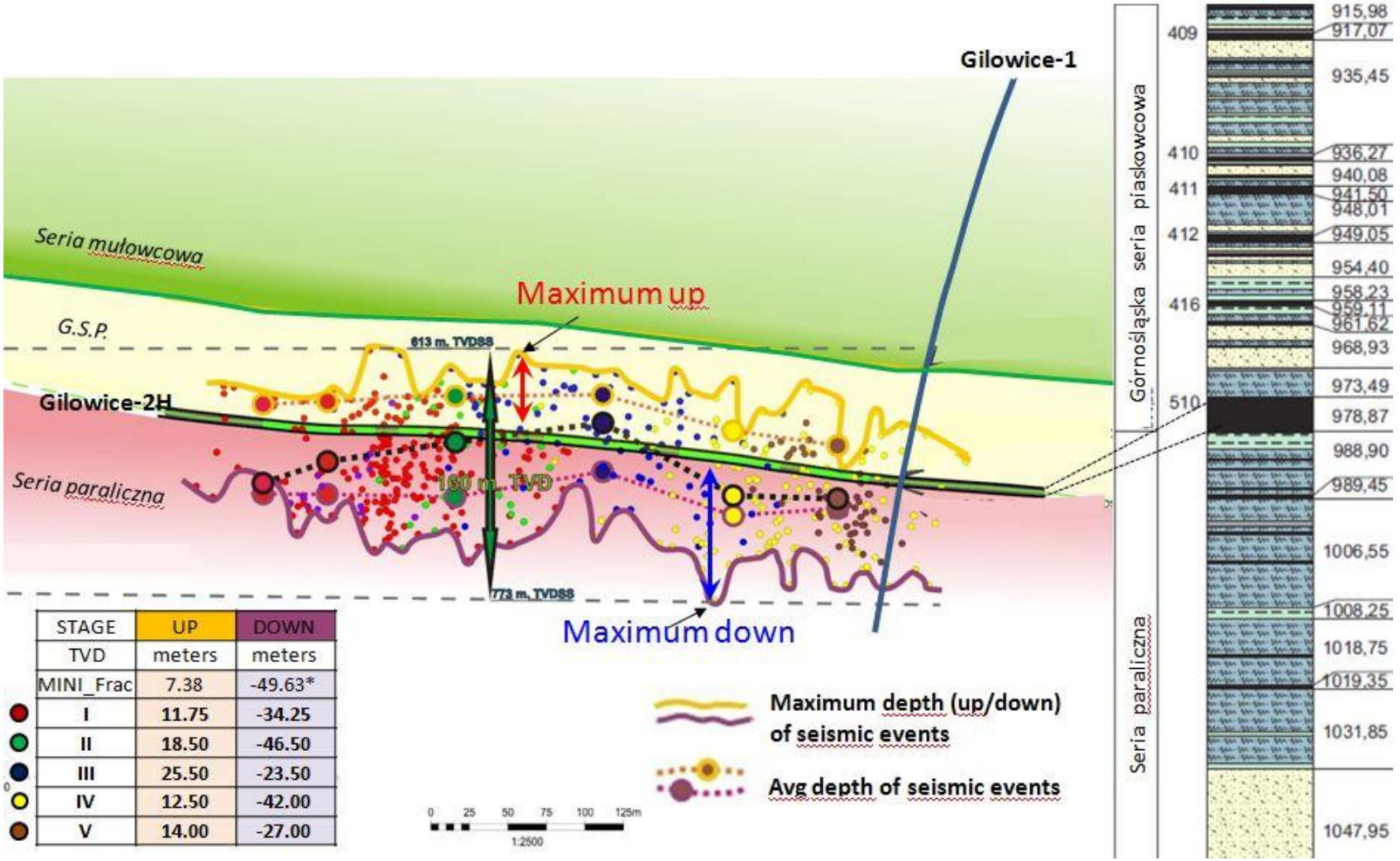
Gilowice-2H

- **5 stages** with Hybrid technology
- Fluid: 20-30# linear gel avg 390 m^3/stage + 30# X-link avg 125 m^3/stage. Total over **2580 m^3**
- Sand: 100 mesh avg 6,8 tons/stage + 40/70mesh avg 74 tons/stage (at the last stage 30/50mesh 40,5 tons instead of 40/70mesh). Total over **404 tons**
- Flow rate avg 6,7 m^3/min
- Plug&Perf with 6 clusters/stage
- **1 stage/day**

Gilowice-4H

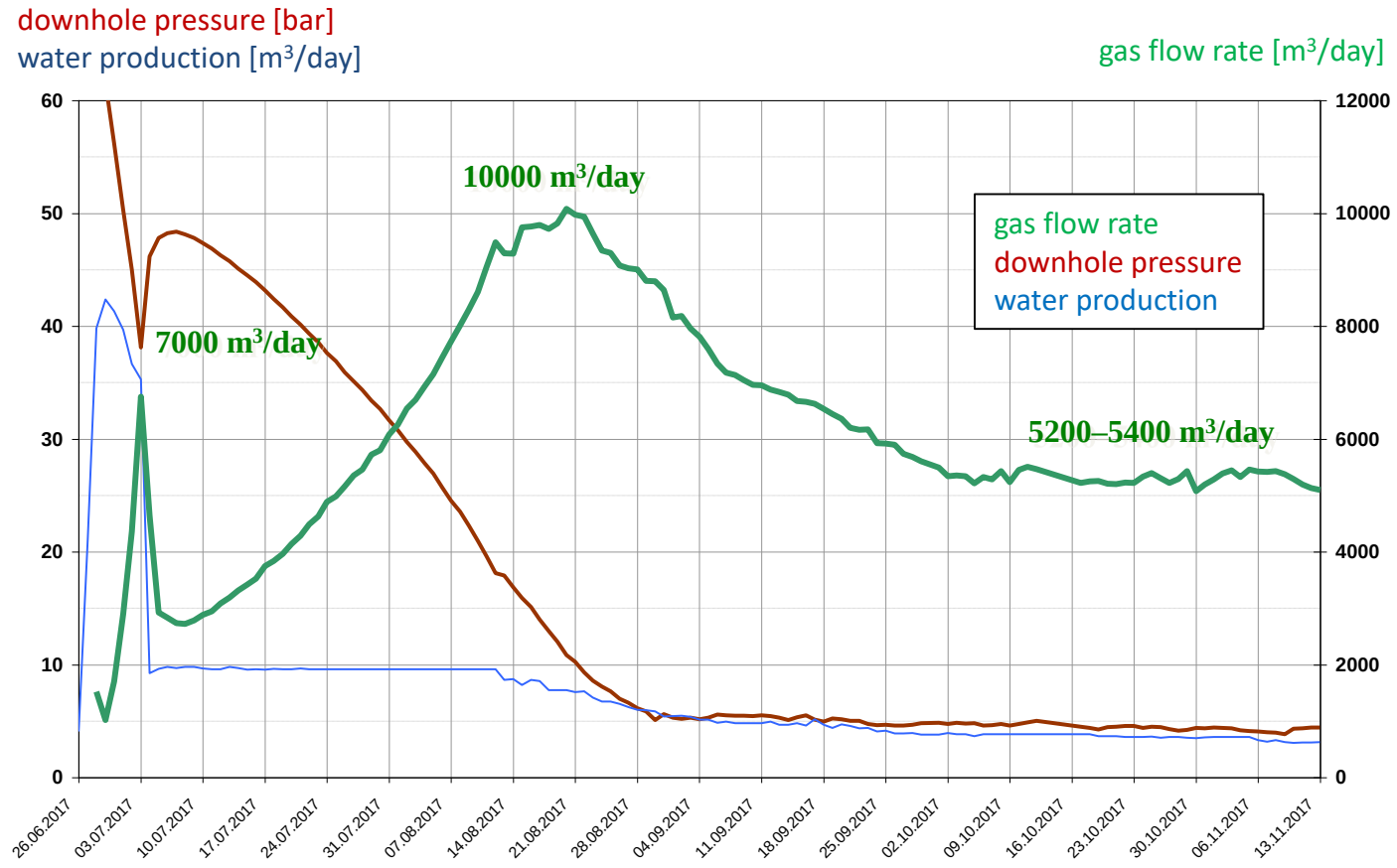
- **9 stages** with Hybrid technology
- Fluid: 20-25# linear gel avg 240 m^3/stage + 25-30# X-link avg 114 m^3/stage. Total over **3186 m^3**
- Sand: 40/70 mesh avg 39 tons/stage + 30/50mesh avg 29 tons /stage. Total over **612 tons**
- Flow rate avg 7,9 m^3/min
- Plug&Perf with 4 clusters/stage
- **2 stage/day**

Hydraulic Fracturing Microseismic Mapping

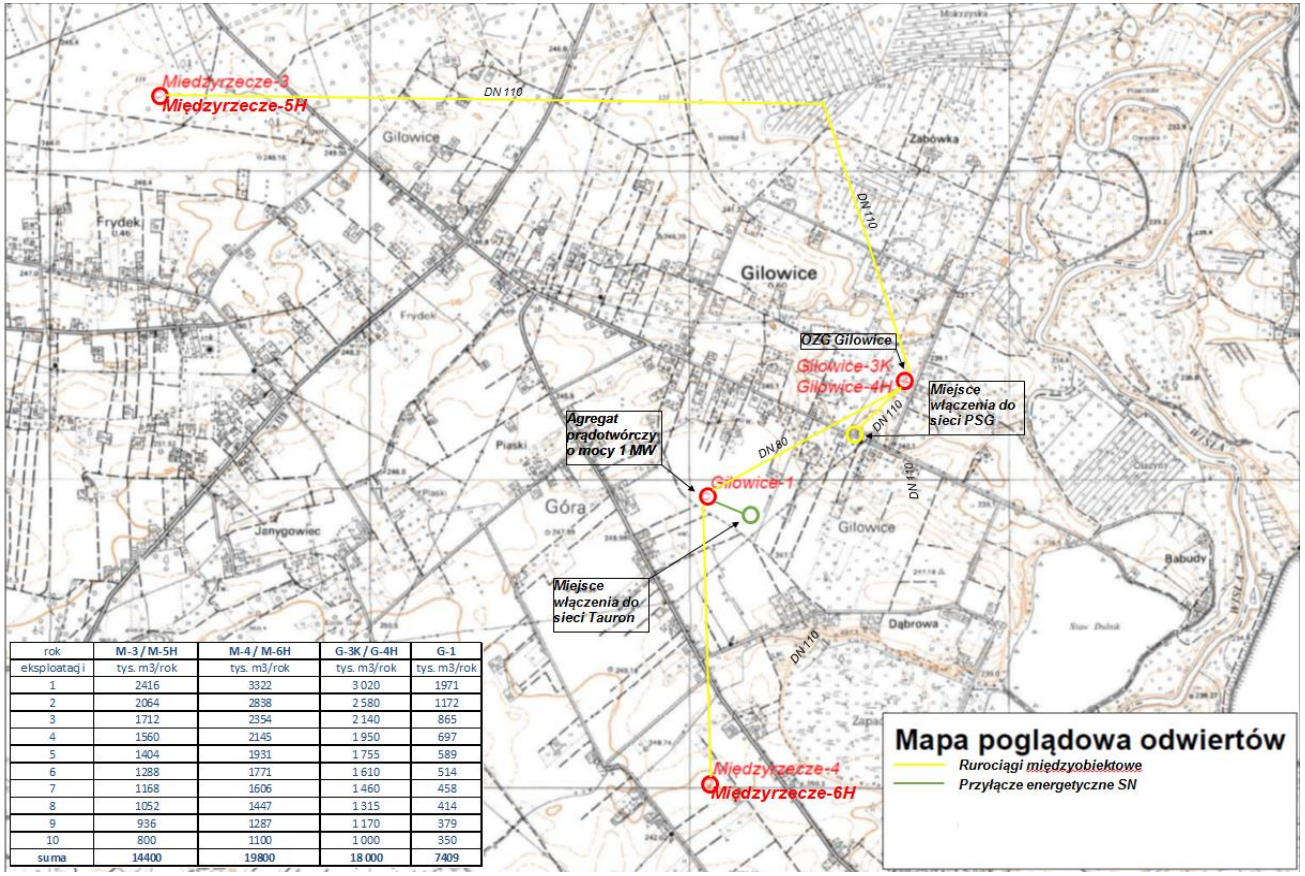


STAGE	UP	DOWN
TVD	meters	meters
MINI_Frac	7.38	-49.63*
I	11.75	-34.25
II	18.50	-46.50
III	25.50	-23.50
IV	12.50	-42.00
V	14.00	-27.00

Hydraulic Fracturing - Results



Pads Development: Gilowice-1, Gilowice-3K, Miedzyrzecze-3 and Międzyrzecze-4



rok eksploatacji	M-3 / M-5H tys. m3/rok	M-4 / M-6H tys. m3/rok	G-3K / G-4H tys. m3/rok	G-1 tys. m3/rok
1	2416	3322	3 020	1971
2	2064	2838	2 580	1172
3	1712	2354	2 140	865
4	1560	2145	1 950	697
5	1404	1931	1 755	589
6	1288	1771	1 610	514
7	1168	1606	1 460	458
8	1052	1447	1 315	414
9	936	1287	1 170	379
10	800	1100	1 000	350
suma	14400	19800	18 000	7409

Gilowice-1 Pad Development

- ✓ Installing the Caterpillarr Power Station CG170-12 – electrical power 1000 kW.
- ✓ Preparing gas on the installation and transfer to the Power Station.
- ✓ Transferring power to Tauron S.A network.

Gilowice-3K Pad Development

- ✓ Construction of surface infrastructure and pipeline to PSG network
- ✓ Surface infrastructure:
  - Pre-separation system
  - Heating and measuring system
  - Filtering system prior to compression
  - Installation of gas compressor with acoustic shield
- ✓ Pipeline:
  - Connection to PSG DN65 (350 m from G-3K)
  - Connection to DN 150 with pipeline passing near G-1 well (approx. 1150 m)
  - Conversion to electricity of excess gas volume using G-1 infrastructure

Międzyrzecze 3 and Międzyrzecze 4 Pads Development

- ✓ Collecting gas on the Christmas tree.
- ✓ Transferring to separation system.
- ✓ Pressure reduction and transferring to the surface infrastructure on Gilowice-3 Pad.
- ✓ Transferring to PSG gas pipeline network.

Thank you for your attention