POLISH OIL and GAS INSTITUTE
KRAKOW

ACID GAS STORAGE IN THE NATURAL GAS STRUCTURE OF BORZĘCIN, NEW POTENTIAL PROJECTS IN POLISH OIL INDUSTRY

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- ***The natural gas produced from the Borzecin reservoirs contain large amounts of sour gases, i.e. 0.3 % of CO_2 and 0.05 % of H_2S***

- ***In the 1996 acid gas – injection facilities started to operate***

- ***It is used for reinjection gases, by-products of amine gas sweetening process containing 60% of CO_2 and 15% of H_2S into an aquifer directly underlying the Borzecin gas reservoir***

- ***the cumulative amount of acid gas injected into the aquifer up now is above 3 mln scm***

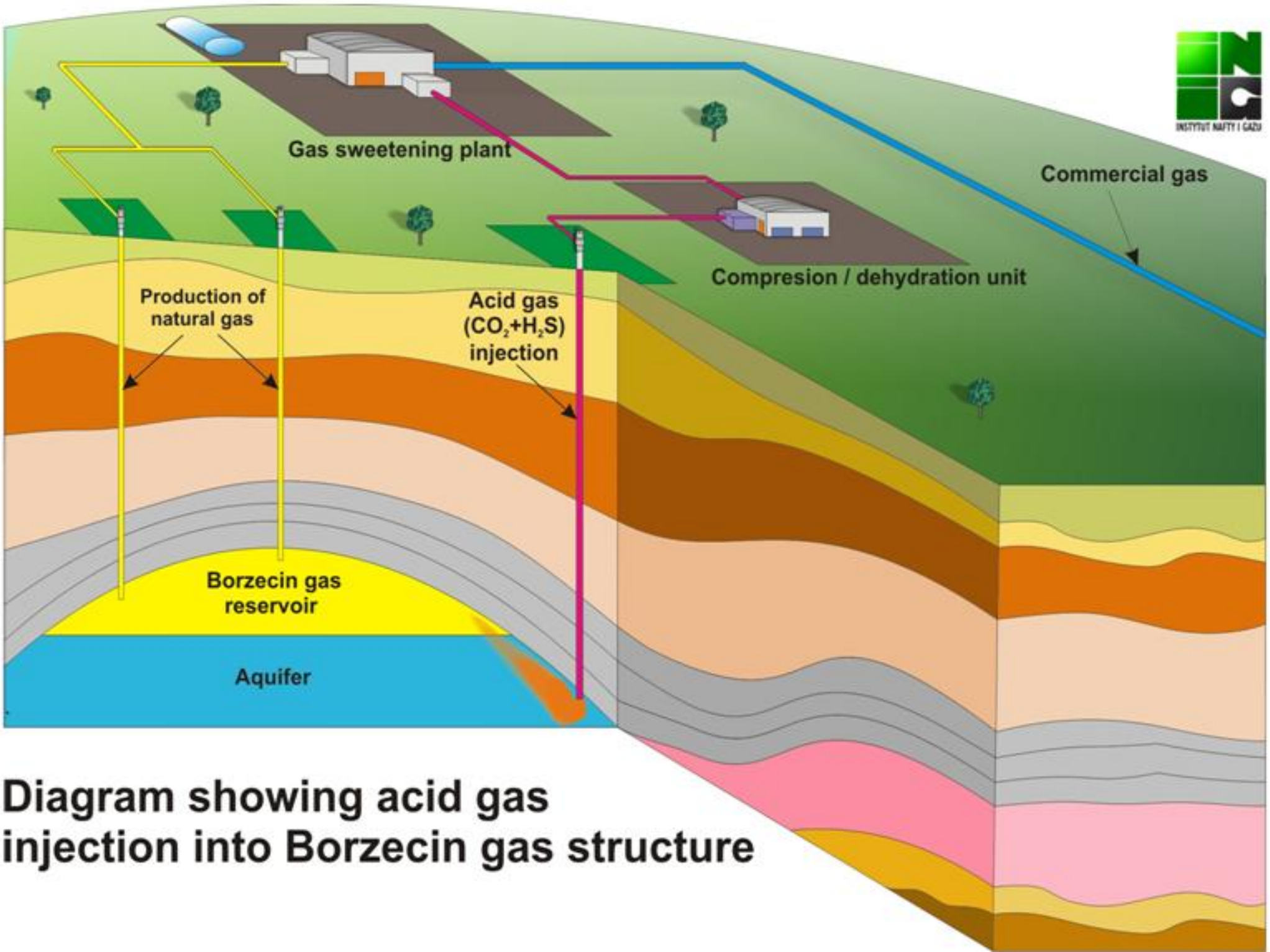
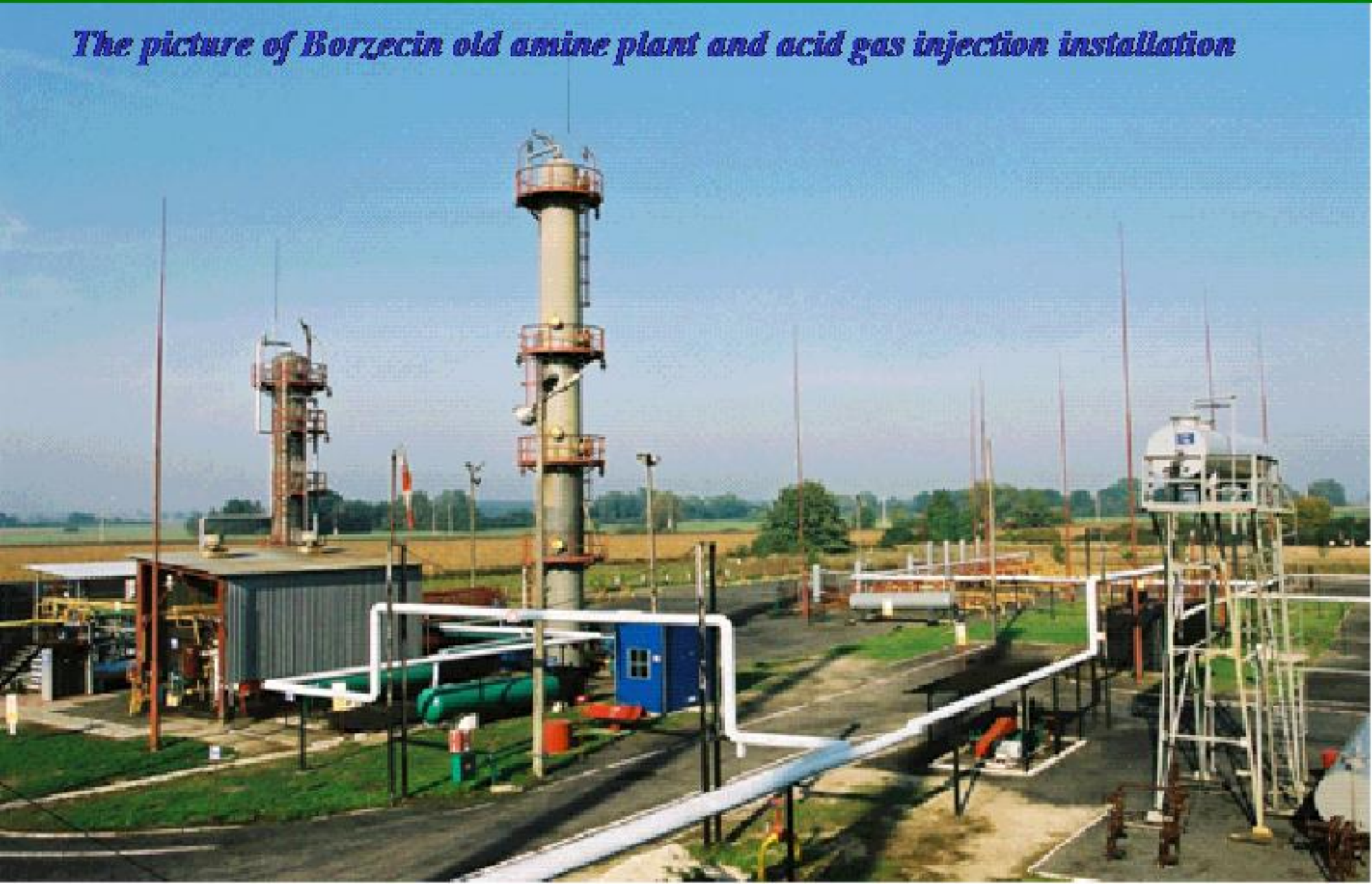


Diagram showing acid gas injection into Borzecin gas structure

Polish Oil & Gas Company

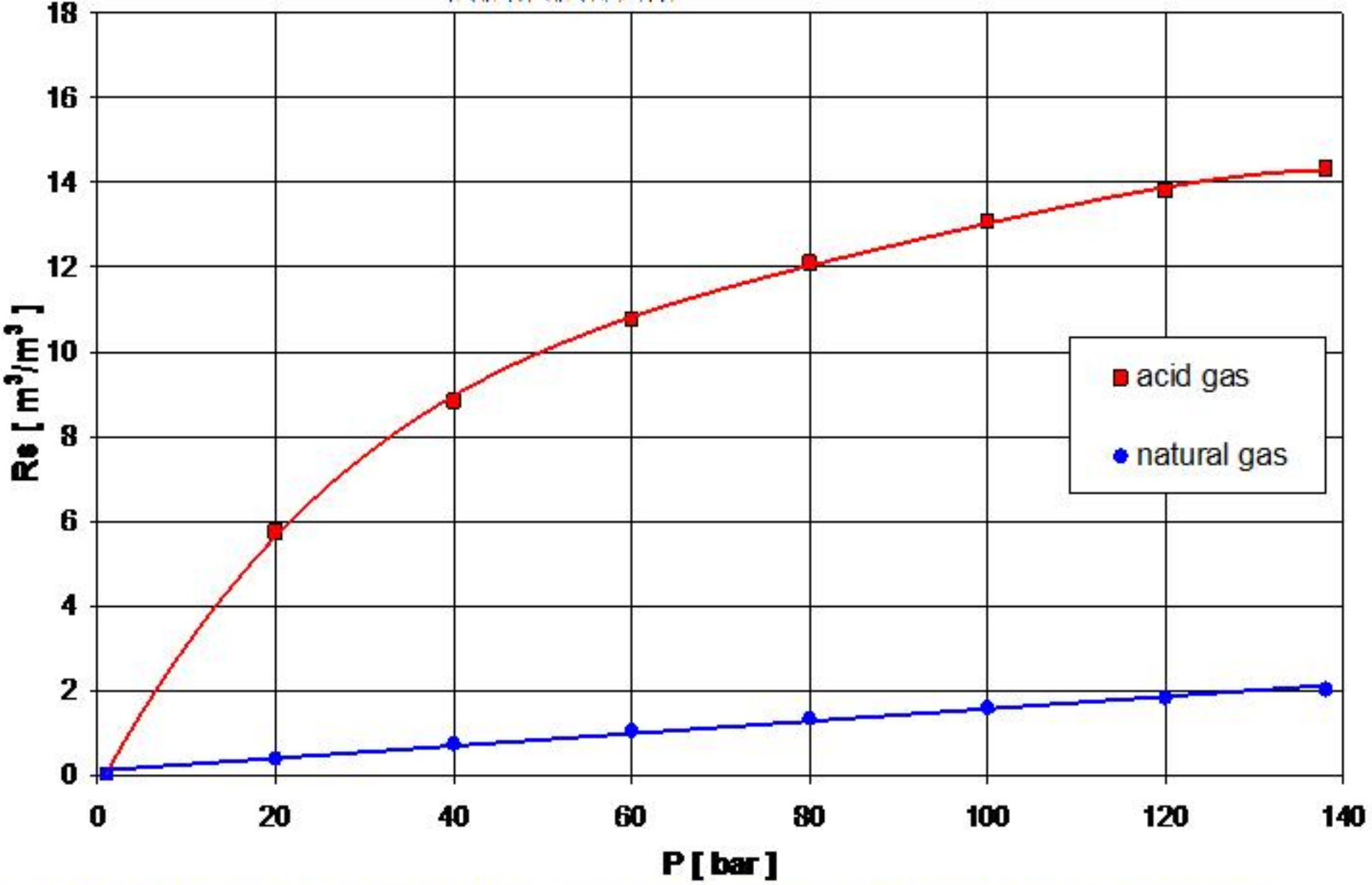
The picture of Borzecin old amine plant and acid gas injection installation




The picture of Borzecin new amine plant and acid gas injection installation

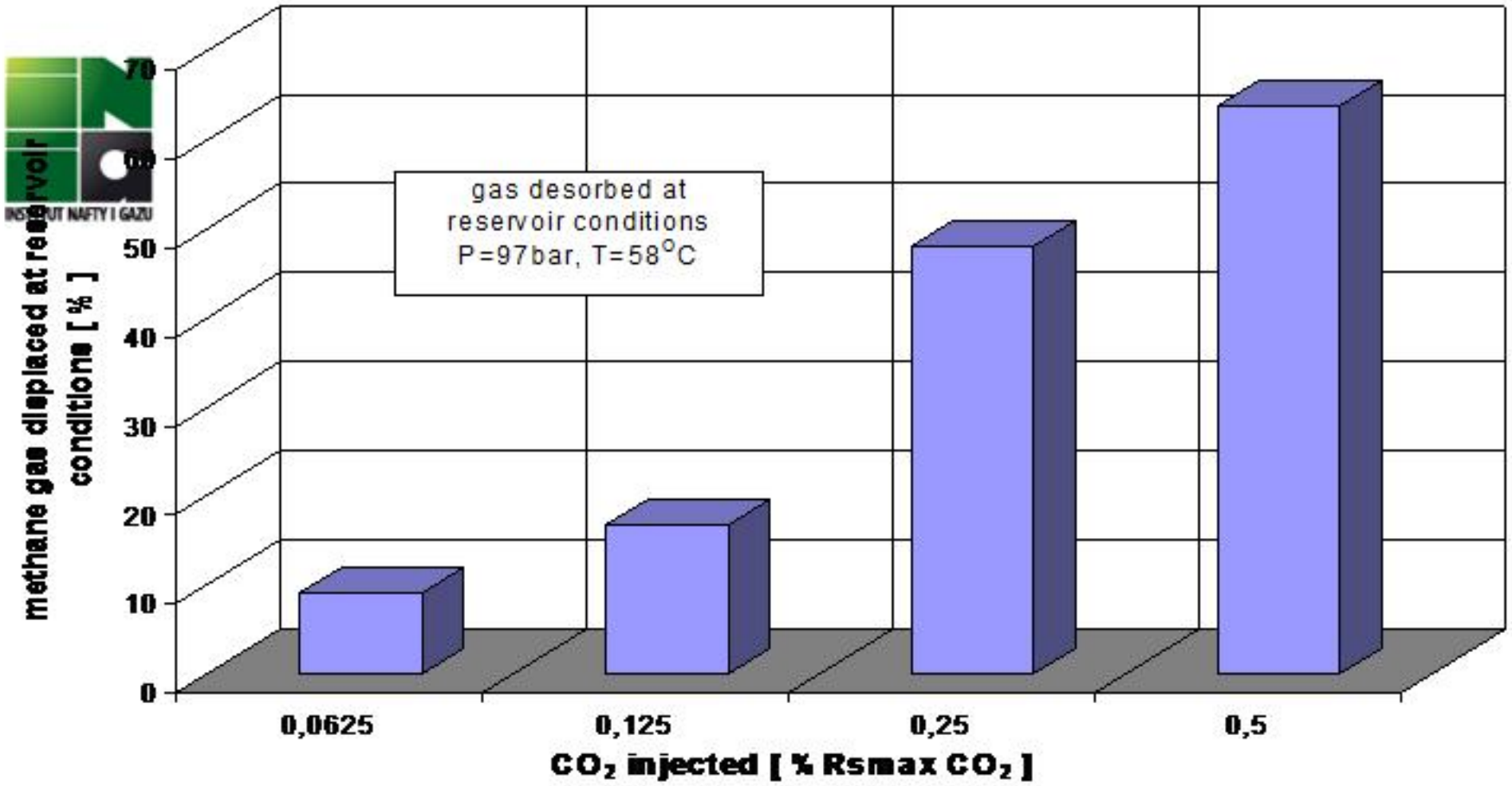
The view of 2-stage diaphragm compressor

The view of injection well Borzecin -28



The injected gas dissolves in the underlying water saturated by native gas

Solubility of acid gas is 9 times greater than solubility of native gas in res. cond.

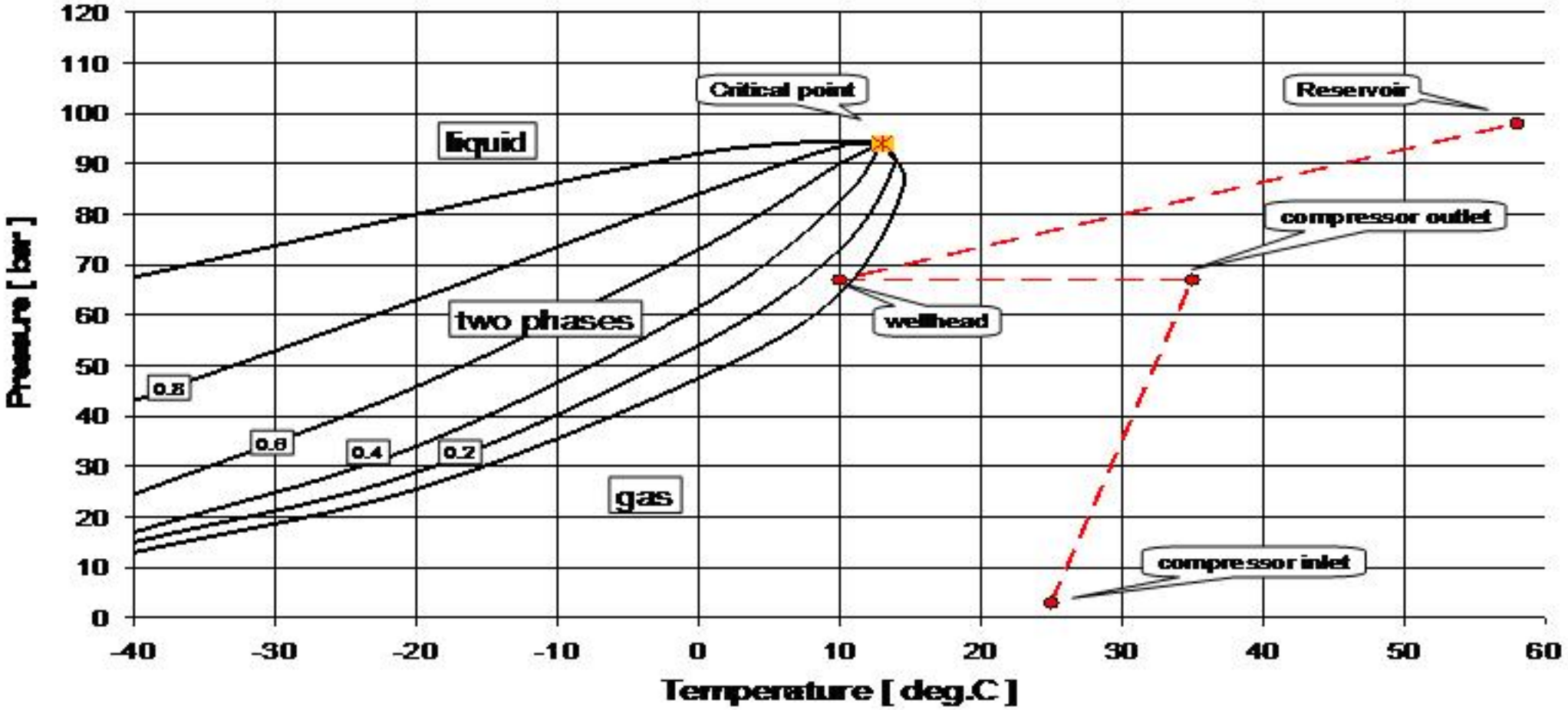


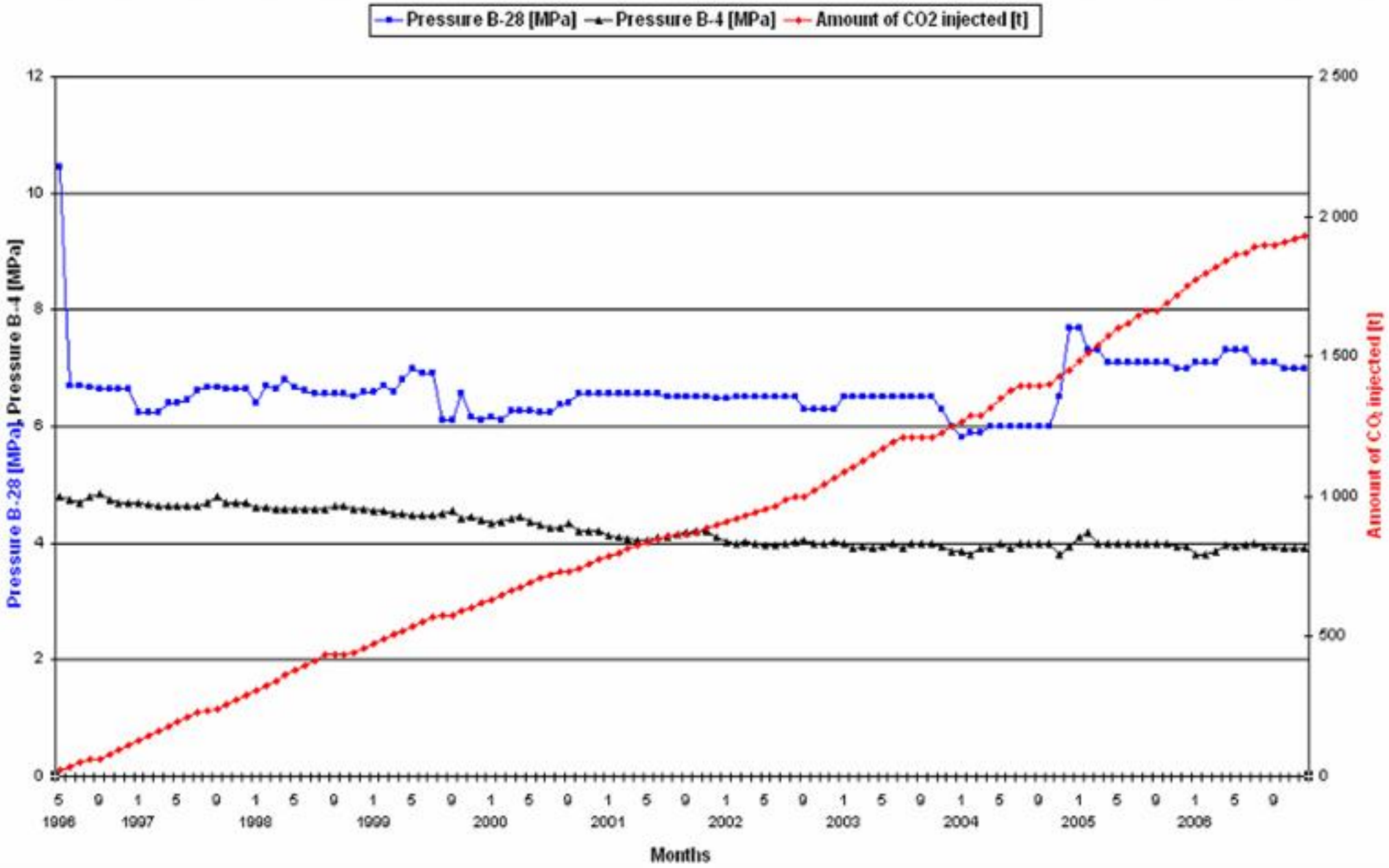
The PVT test resultes indicated that volume of methane gas displaced from reservoir water is in direct proportion to volume of CO_2 injected into the water zone

Such a displacement process allows to replenish the cap gas (about it I will talk in the nex part of Our presentation)

Phase transmission diagram for acid gas compression and injection stage for Borzecin

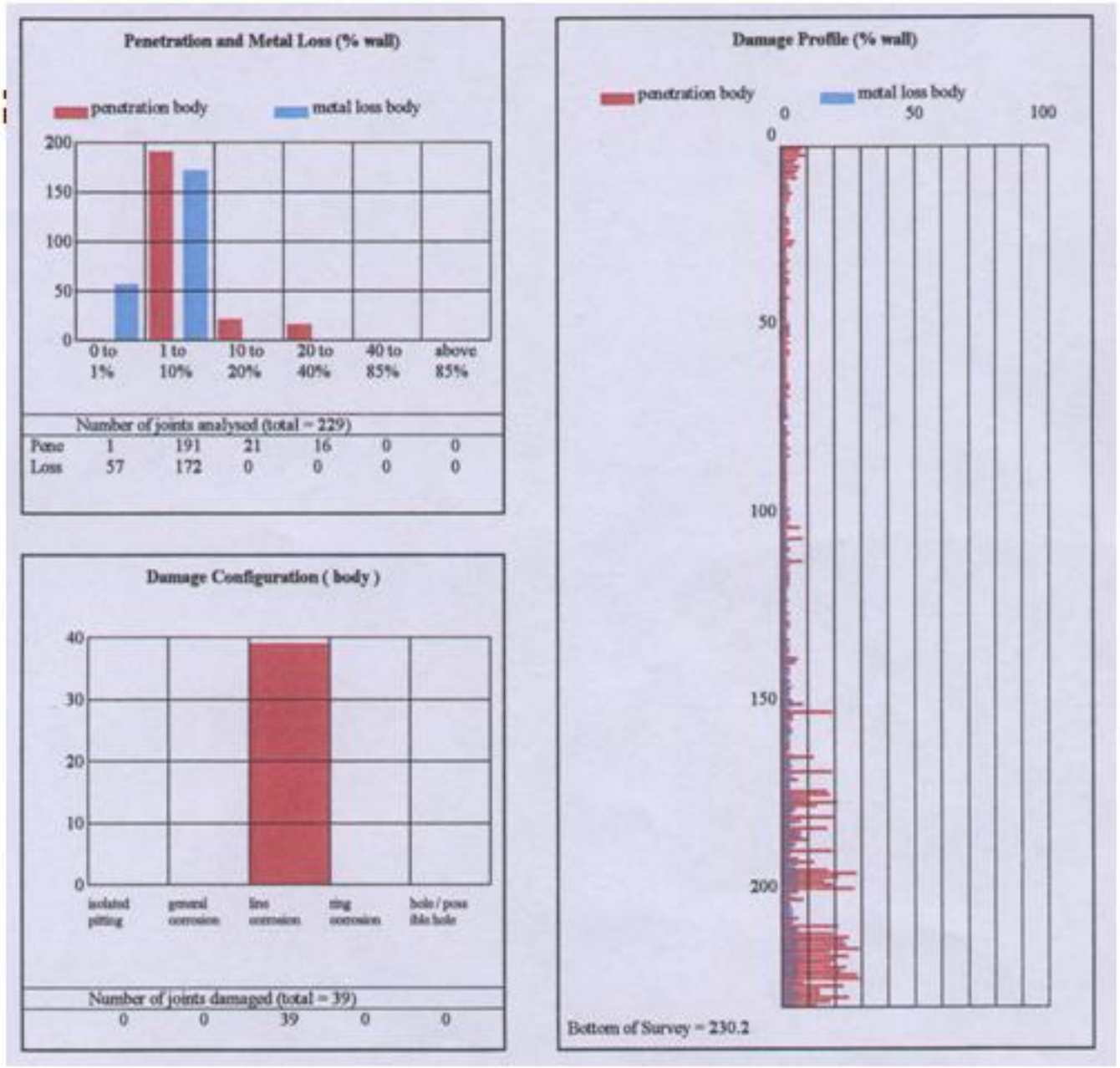
The injected gas remains in a gaseous phase for all temperatures and pressure involved





The changes of reservoir parameters (POGC).

The drop of injection pressure from 10.4 MPa to 6.6 MPa was recorded after injection of 18 thousands of scum



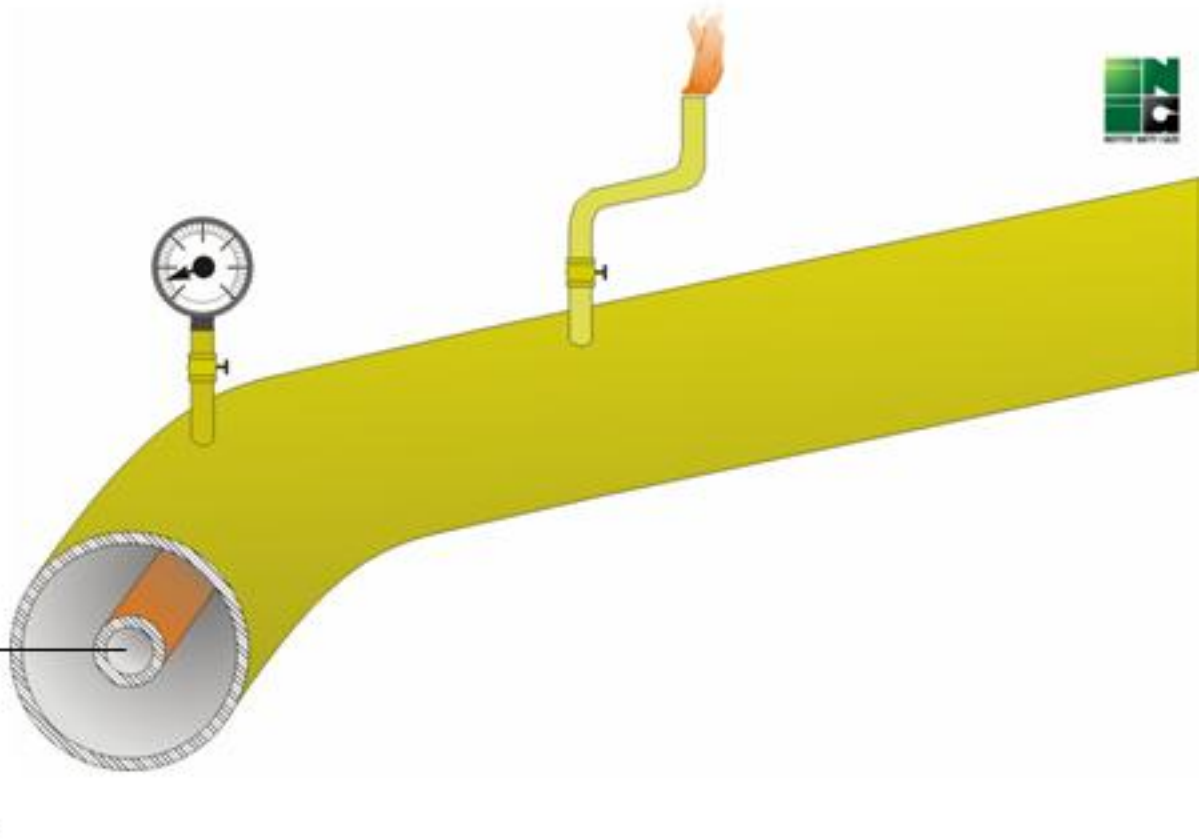
The condition of downhole pipes was evaluated using Sondex Multi Finger Memory (POGC)

The MEA vapors which are present in injected gas inhibits corrosion proces

The risks of leakage CO_2 and H_2S during transport and injection

Safety devices

1 km transmission line from compressor station to the well site is cased and vented to the flare with continuous pressure monitoring

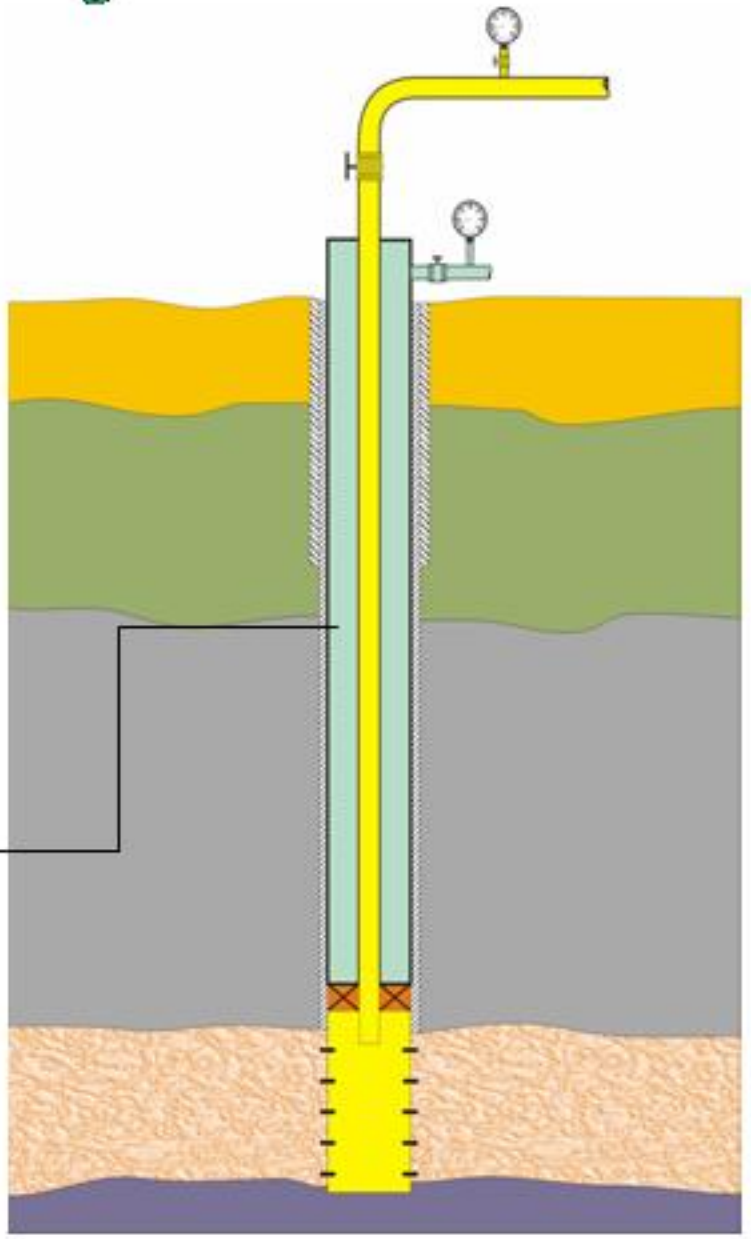


acid gas

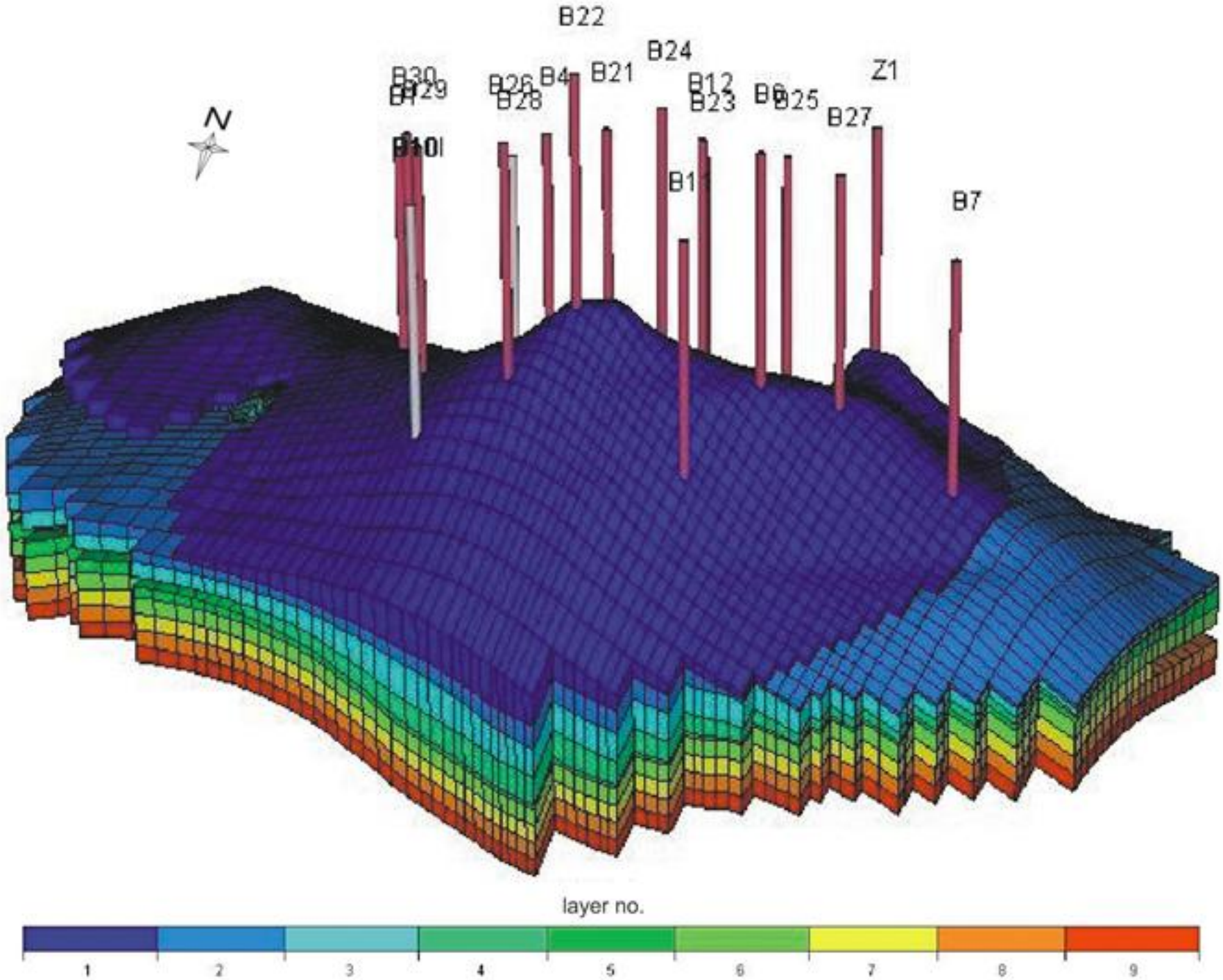
The risks of leakage CO_2 and H_2S during transport and injection

Safety devices

In the worst case scenerio, such as a blowout of the injection well, the acid gas should be automatically ignited
In the injector tubing/casing annulus is filled with a corrosion inhibiting fluid.

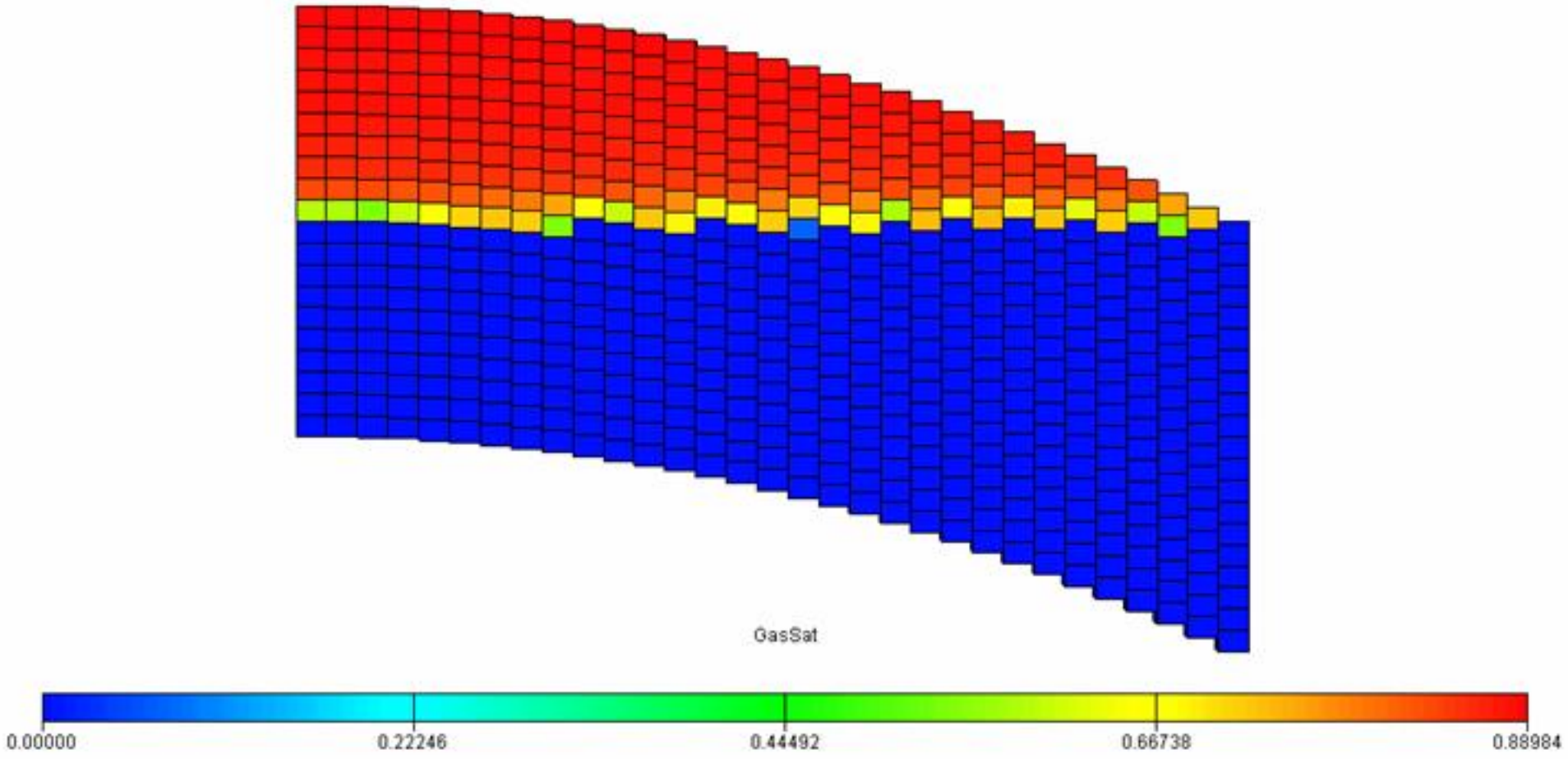


Perspective view of Borzęcin Structure Model

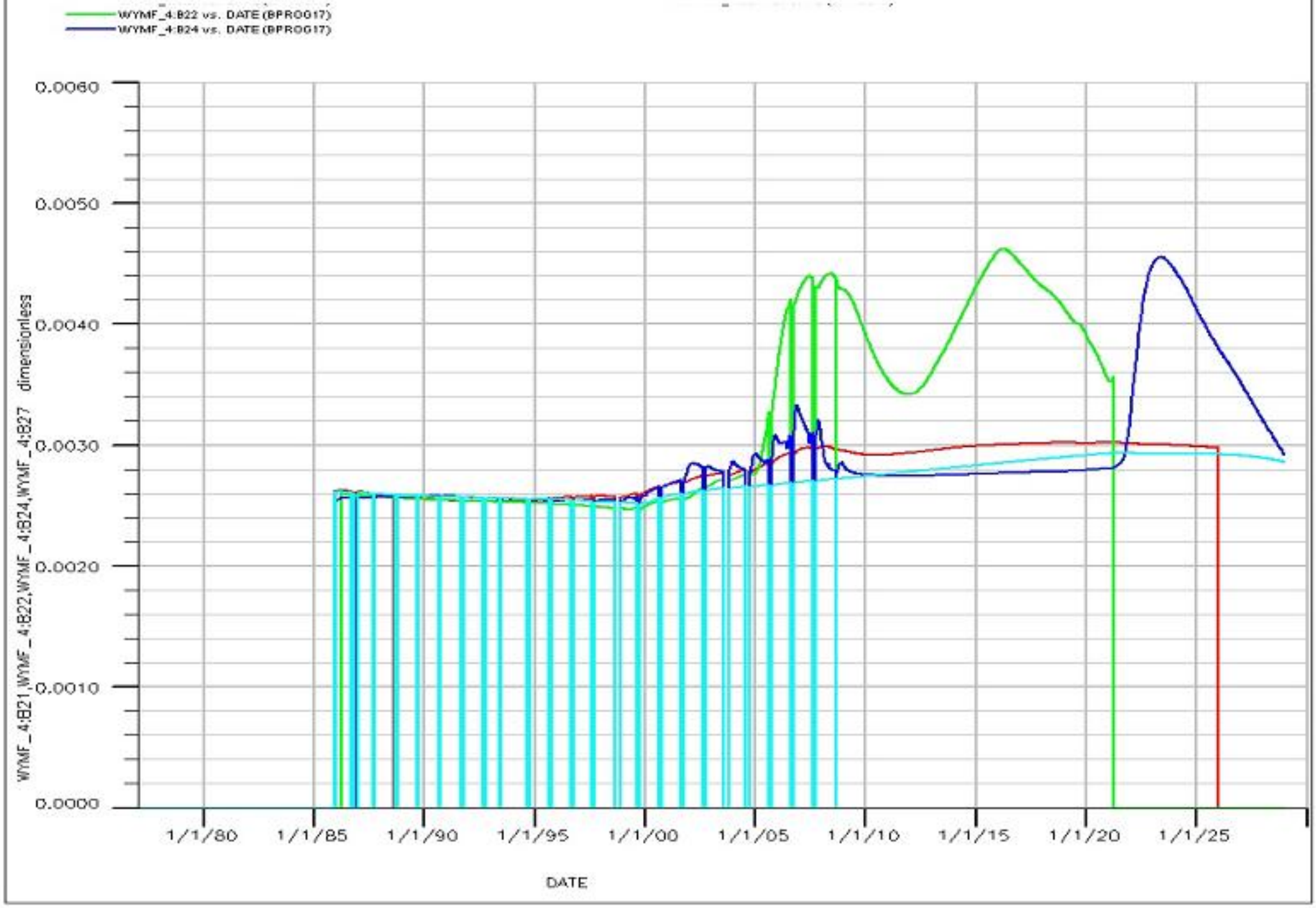


Injected gas migration model in gas-water system.
Variation of gas saturation distribution with injection time

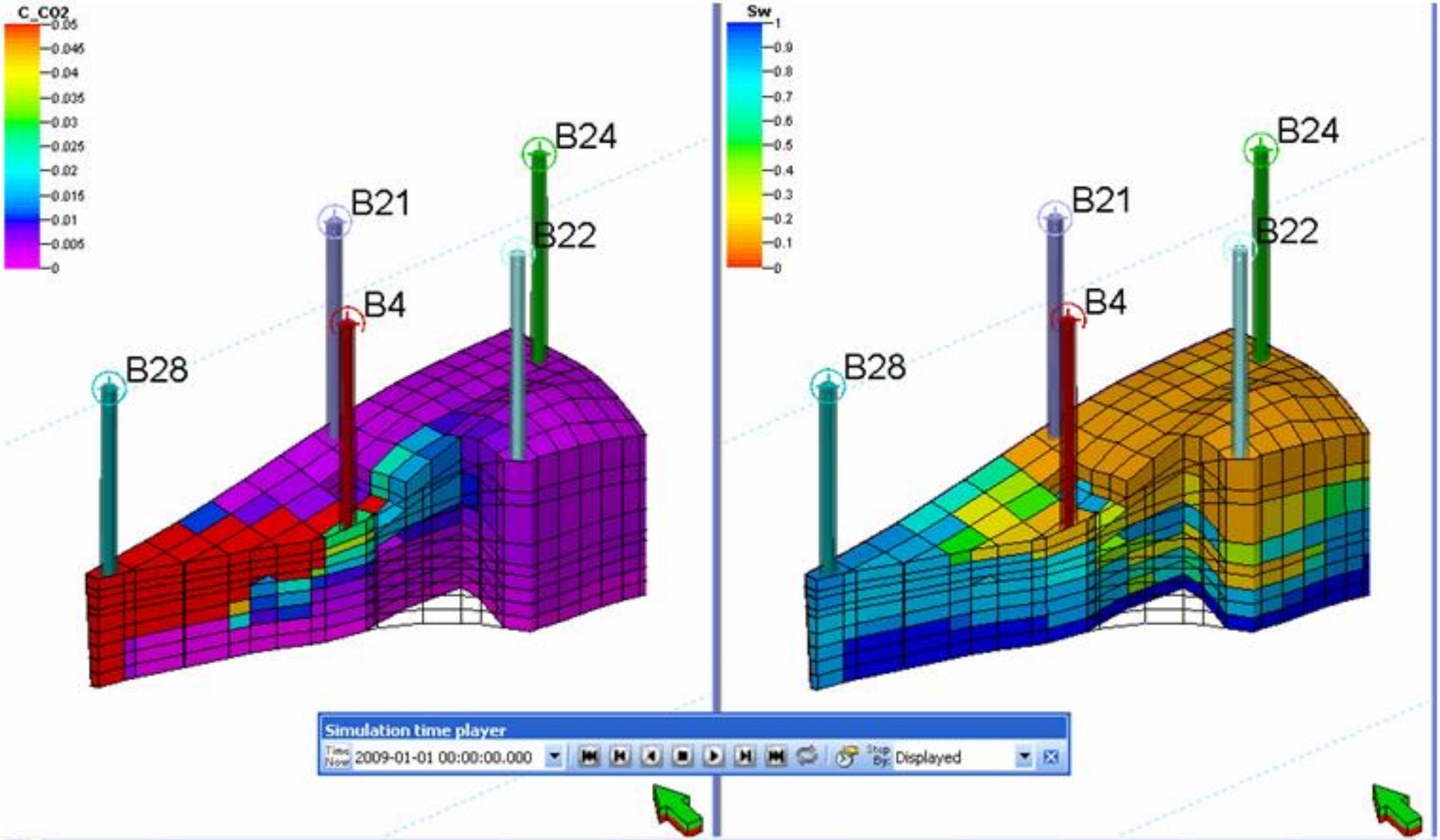
Not horizontal but veritcal migration of acid gas in water phase take place



Borzęcin Gas Reservoir. Production Forecast. CO_2 Concentration in Produced Gas Wells: B-21, B-22, B-24, B-27



Injected gas migration and water encroachment in Borzęcin structure. Variation of CO_2 concentration distribution with injection time. Prediction



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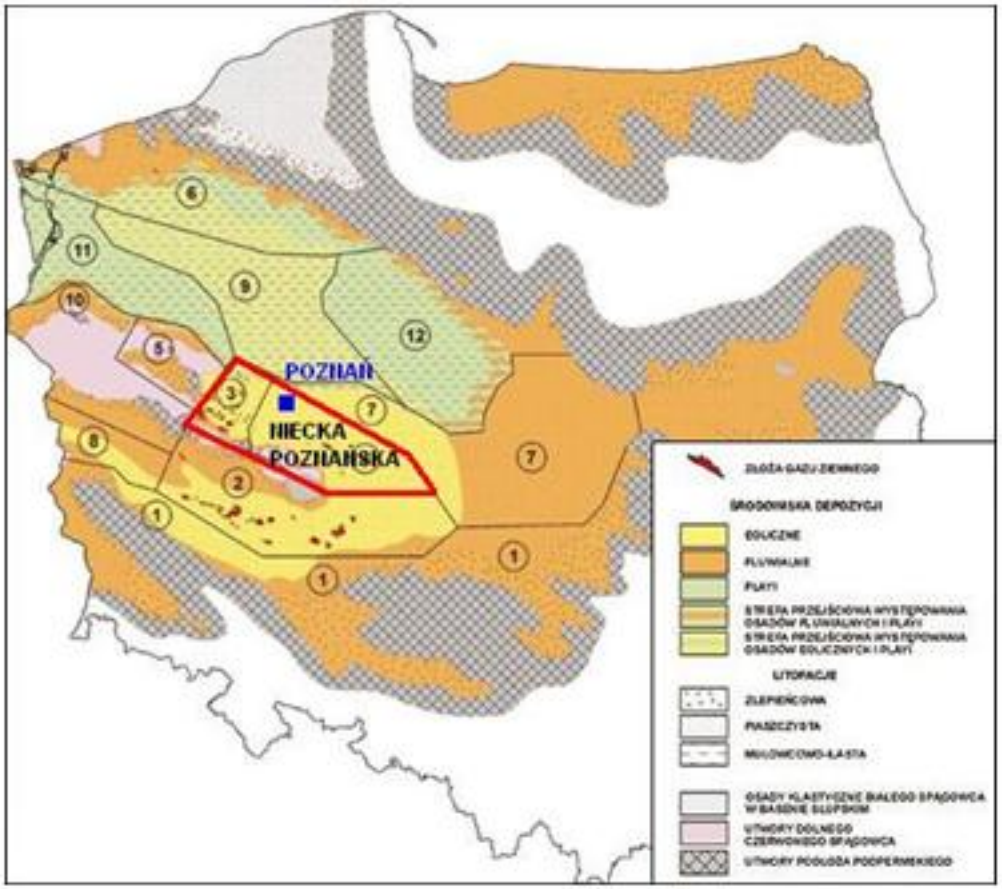
NEW POTENTIAL PROJECTS IN POLISH OIL INDUSTRY

Recovery of unconventional gases naturally saturated megaaquifers in the sequestration projects of CO_2

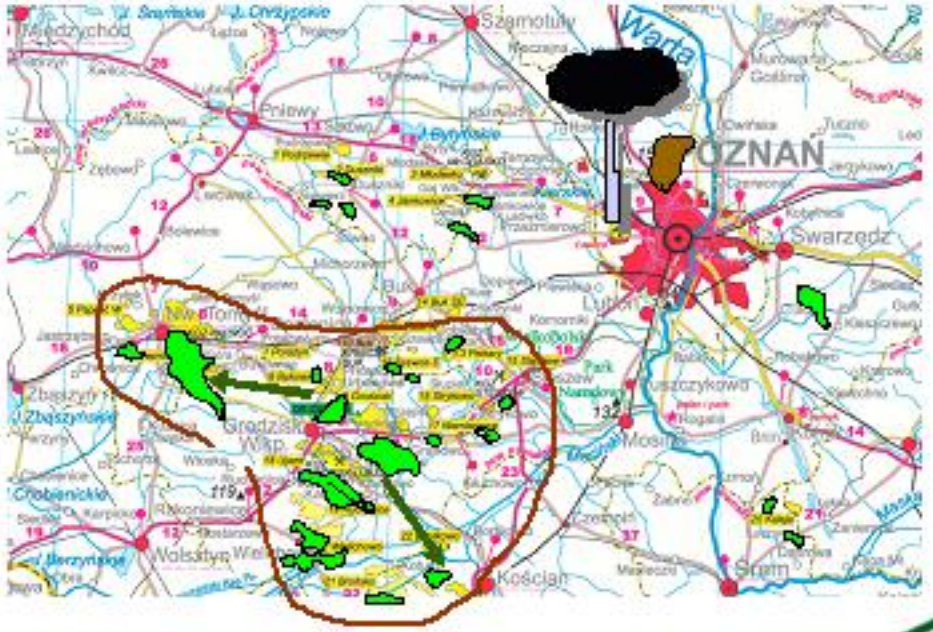
EOR and CO_2 sequestration in Nosówka oil reservoir

Permian structure of Poznań Trought megaaquifers represents a great potential for long-term underground storage of CO_2 on 5000 km^2 area.

The aquifer is naturaly saturated by native hydrocarbon gases and its tightnees is confirmed by the presence of many local gas accumlations in top area of the structure



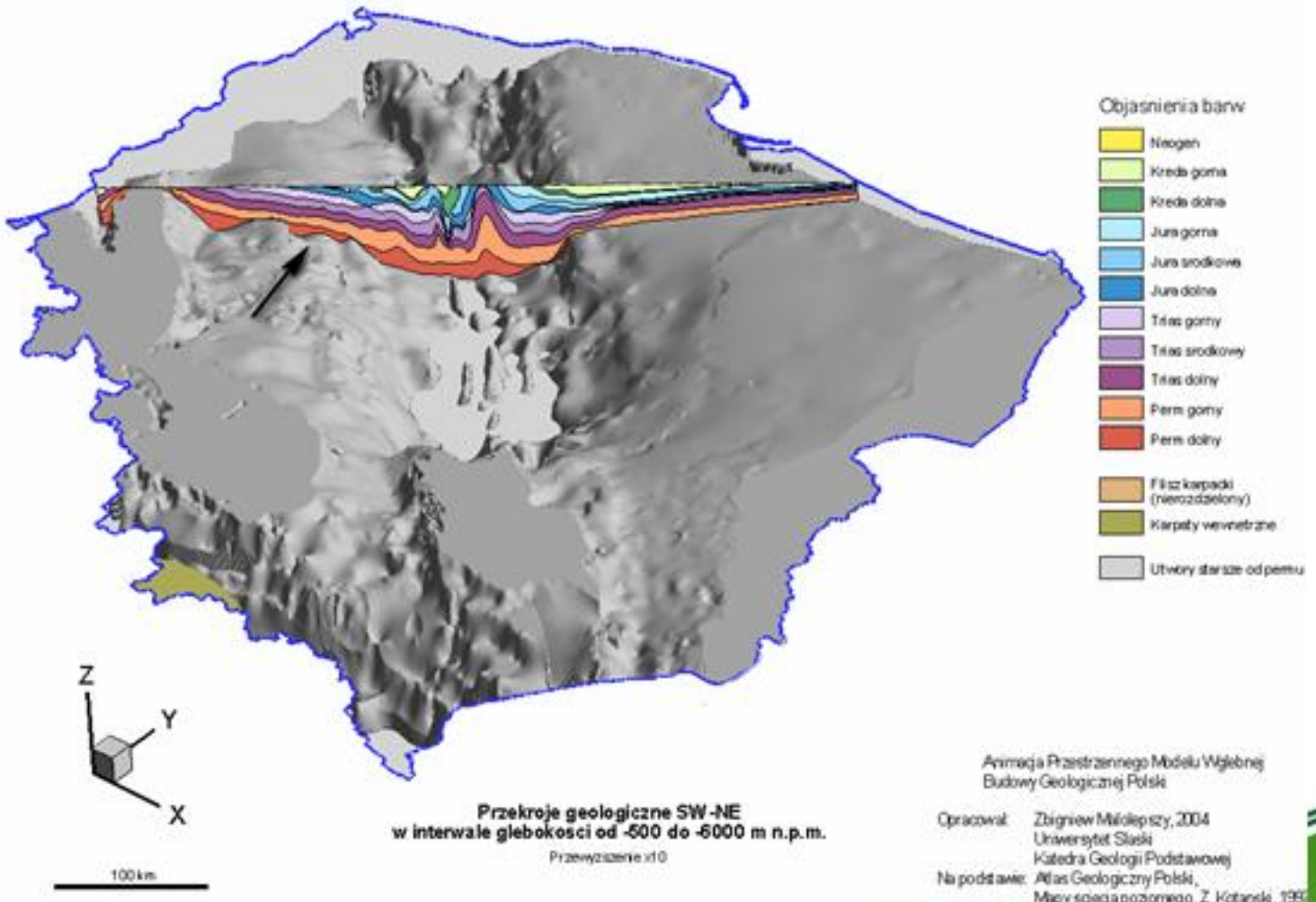
Niecka poznańska na tle mapy paleogeograficznej podłoża głównego czerwonego spągowca



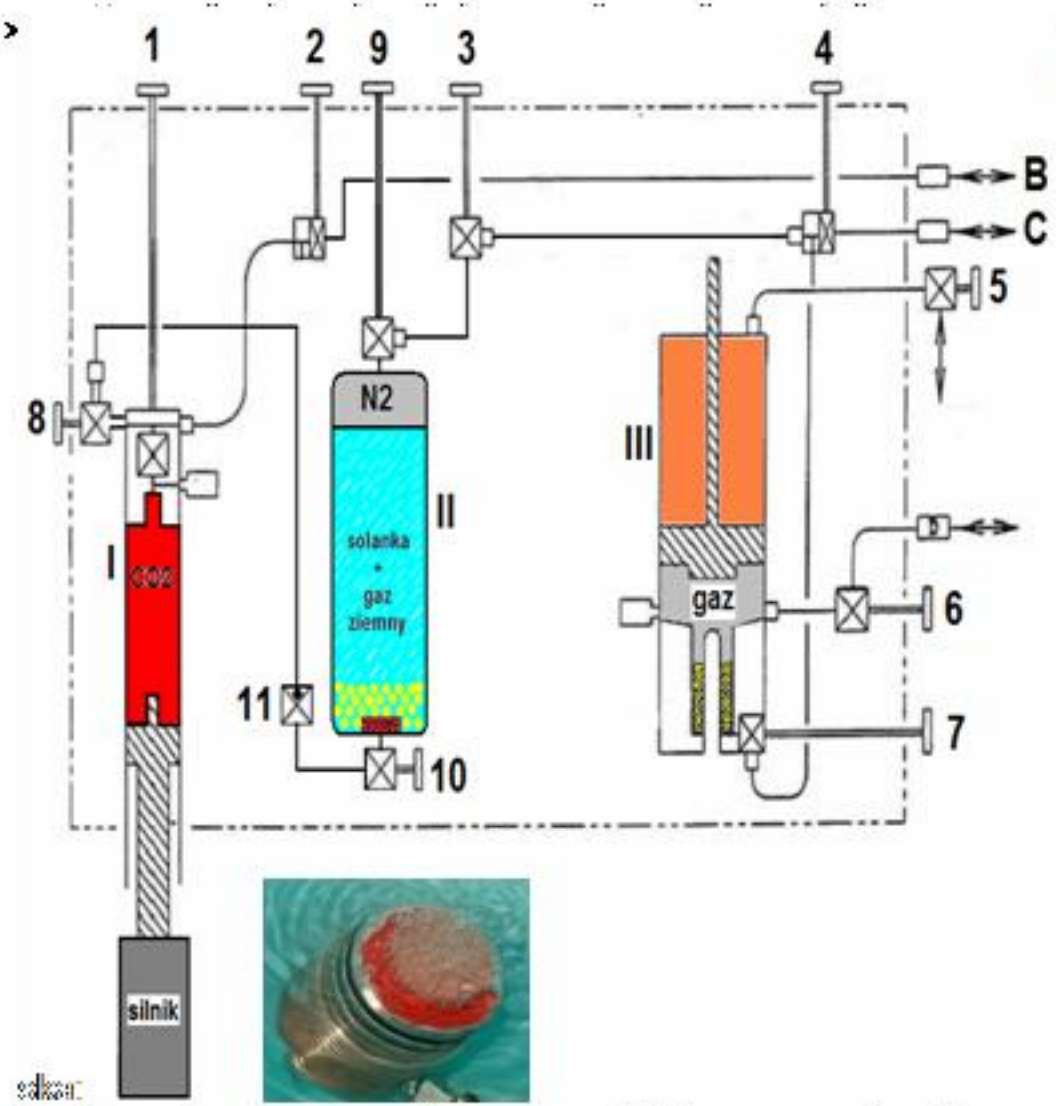
Złoża gazowe powiatu w kontekście budowy geologicznej struktury mezozoicznej

Geological cross-section throught Poznań mega-aquifer

Solubility of natural gas in formation brine is about 2.5 Sm^3 / m^3.
So it is calculated that gas reservs in megastructure can reach 120 x 10^9 Sm^3 on 5000 km^2 area



Przekroje geologiczne SW-NE



Laboratory and modeling studies performed in Oil and Gas Insitute have confirmed that it's possible to displace the hydrocarbon gases dissolved in aquifer water by CO_2 directly injected into botim water of megastructure.

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Nosówka – partially depleted oil reservoir – CO_2 sequestration and EOR production

Geological model – Carpathian Flysch region, Carbonate formations: limestone & dolomitic limestone, structure confind by system of faults, no active aquifers

3-phase fluid interactions (oil, gas, CO_2) by Soave-Redich-Kwong EOS

Simulation Model calibrated w/r 20 years' production (production rates, bhp's, gas oil ratios)

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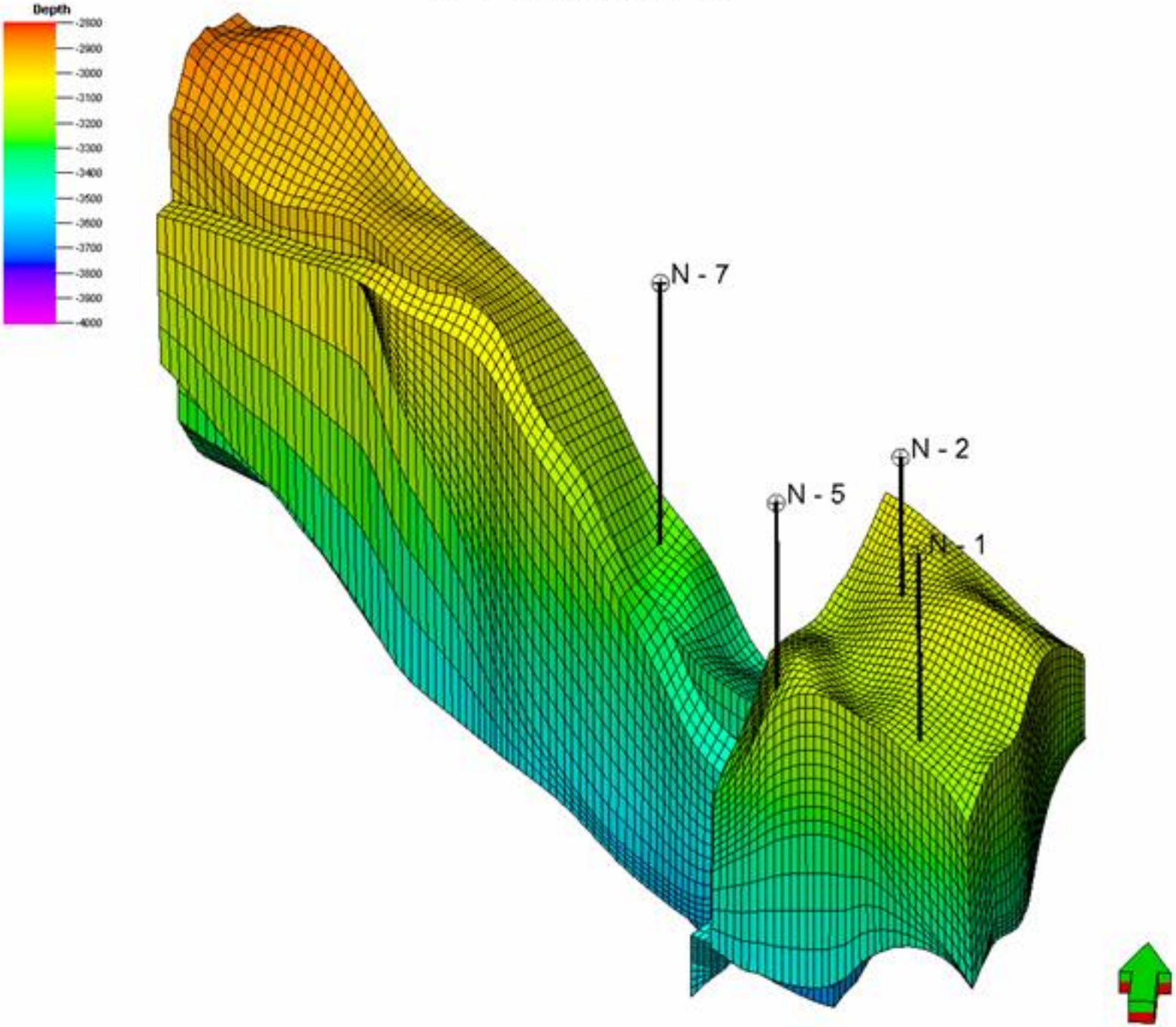
Perspective view of the Nosówka Structure Model



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CO_2 sequestration and EOR simulations

1. sequential conversion of producers into injectors
2. injection before production + final injection (most effective)

results

oil production total, OPT = 488 x 10^3 Nm^3 (increase of recovery coef. by 17%p of OOIP)

total CO_2 injection, GIT = 285 x 10^6 Nm^3

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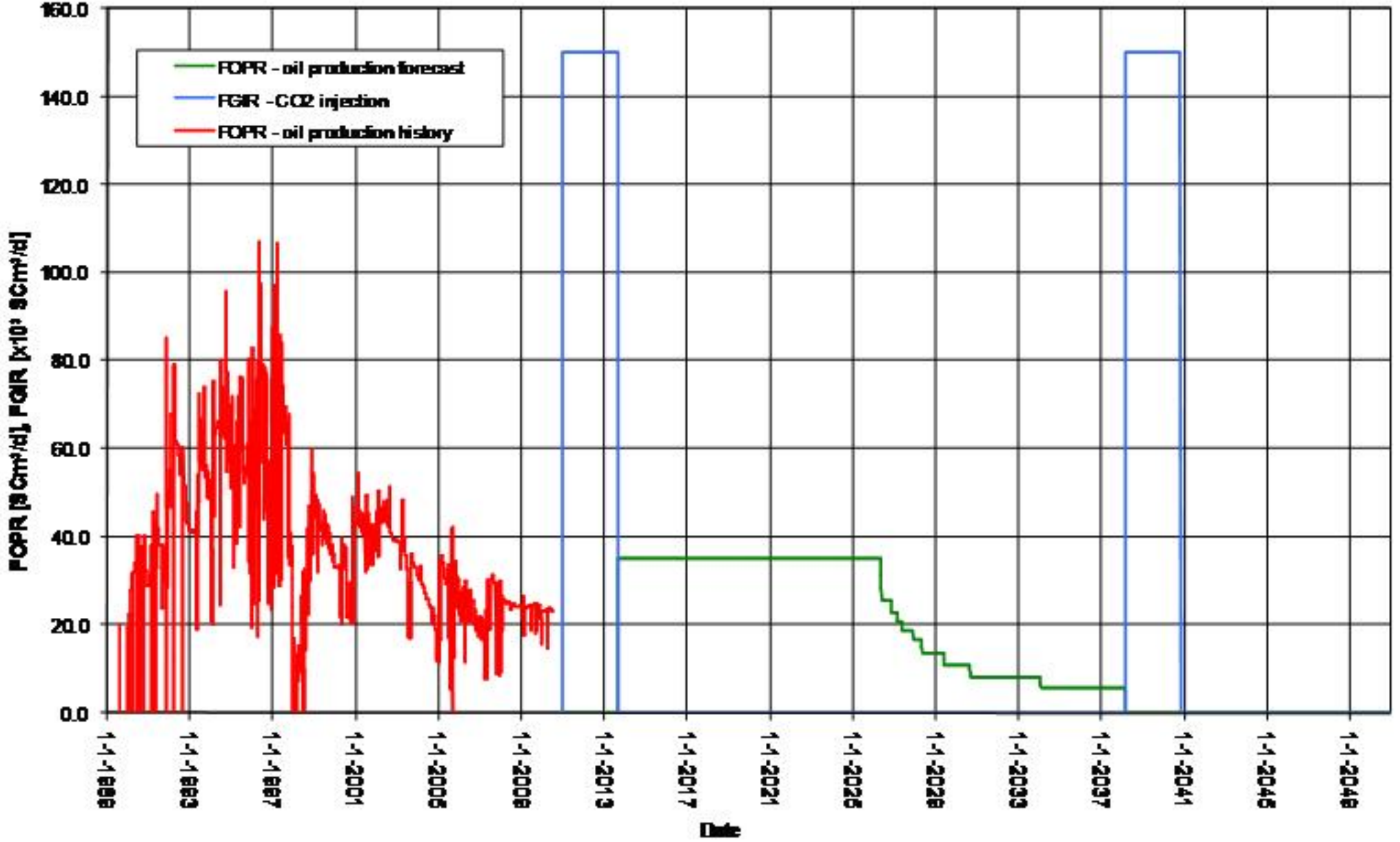
CO_2 injection into Nosówka oil reservoir.

Oil production rate, CO_2 injection rate,



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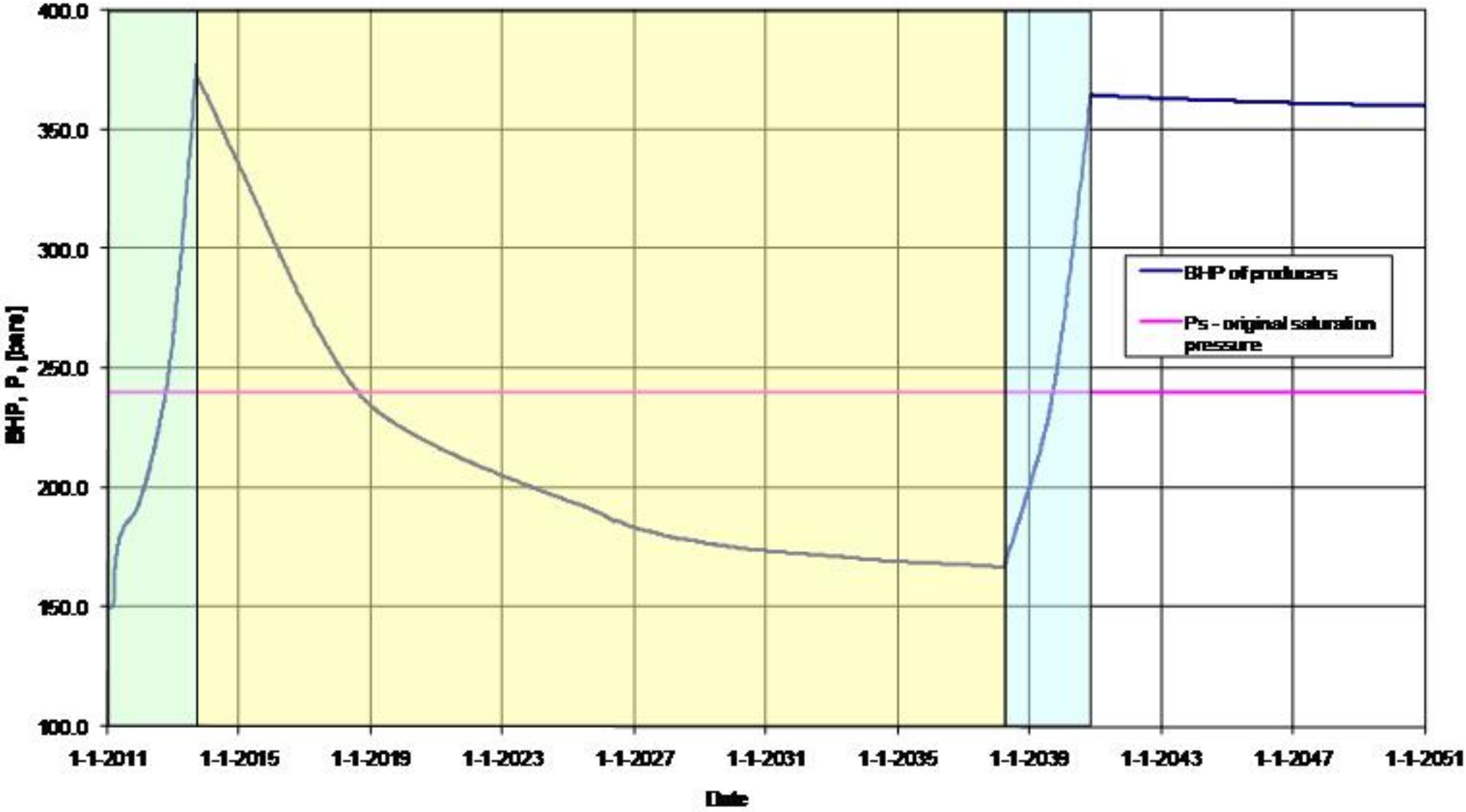
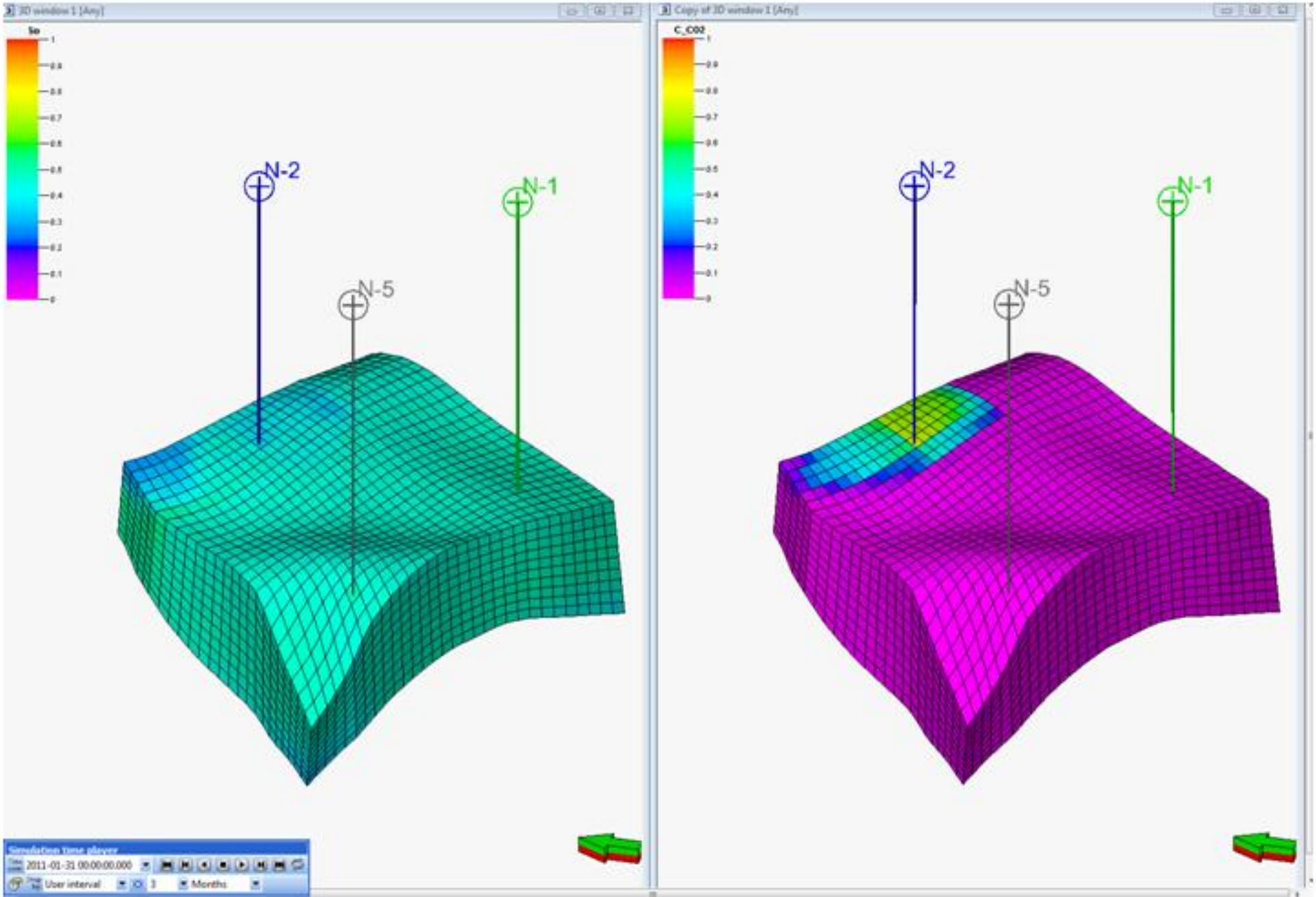
CO_2 injection into Nosówka oil reservoir.

Bottom hole pressure of producers, BHP vs original saturation pressure, Ps



CO_2 injection into Nosówka oil reservoir. Distribution of oil saturation, So, and CO_2 concentration in liquid phase C_{CO2} - general view



Summary and Conclusion

1. 15-years experience of acid gas injection into Borzęcin structure confirmed practical feasibility of acid gas storage in continuously producing gas reservoir
2. Methan displacement process by CO_2 injection into Poznan Trought aquifer saturated by native gas allows to replenish the gas bearing zones
3. EOR and CO_2 sequestration in Nosówka reservoir allows to recover 64 % of OOIP