Ministry of the Environment

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NARODOWY FUNDUSZ OCHRONY ŚRODOWISKA I GOSPODARKI WODNEJ

POLISH NATIONAL PROGRAMME ON SAFE CO2 GEOLOGICAL STORAGE

Adam WÓJCICKI

Polsh Geological Institute

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THE PROGRAMME

In response to demands of national economy on future implementation of CO2 geological sequestration technologies in industrial scale (to be preceded by a testing phase of demonstration plants), Polish Ministry of Environment has launched a four-year (2008-2012) National Programme **„Assessment of formations and structures for safe CO2 geological storage, including monitoring plans”.** This is one of new tasks of the Polish Geological Institute (as State Geological Survey). PGI leads a consortium of organisations, specialized in geological-geophysical-reservoir studies (AGH, CMI, MEERI, O&GI, PBG). Cooperation with a number of industry stakeholders, as well as with European geological surveys and other organizations of relevant expertise is scheduled. Project duration: 10.2008-09.2012.

The goal of the programme (in connection with a Polish part of ETP ZEP Flagship Programme) is to collect and elaborate country-wide geo-information necessary for future decisions on exploration and storage permits (saline aquifers and other storage options), to be issued by Polish Ministry of Environment, according to the proposal of EU directive on geological storage of carbon dioxide (January 2008),.

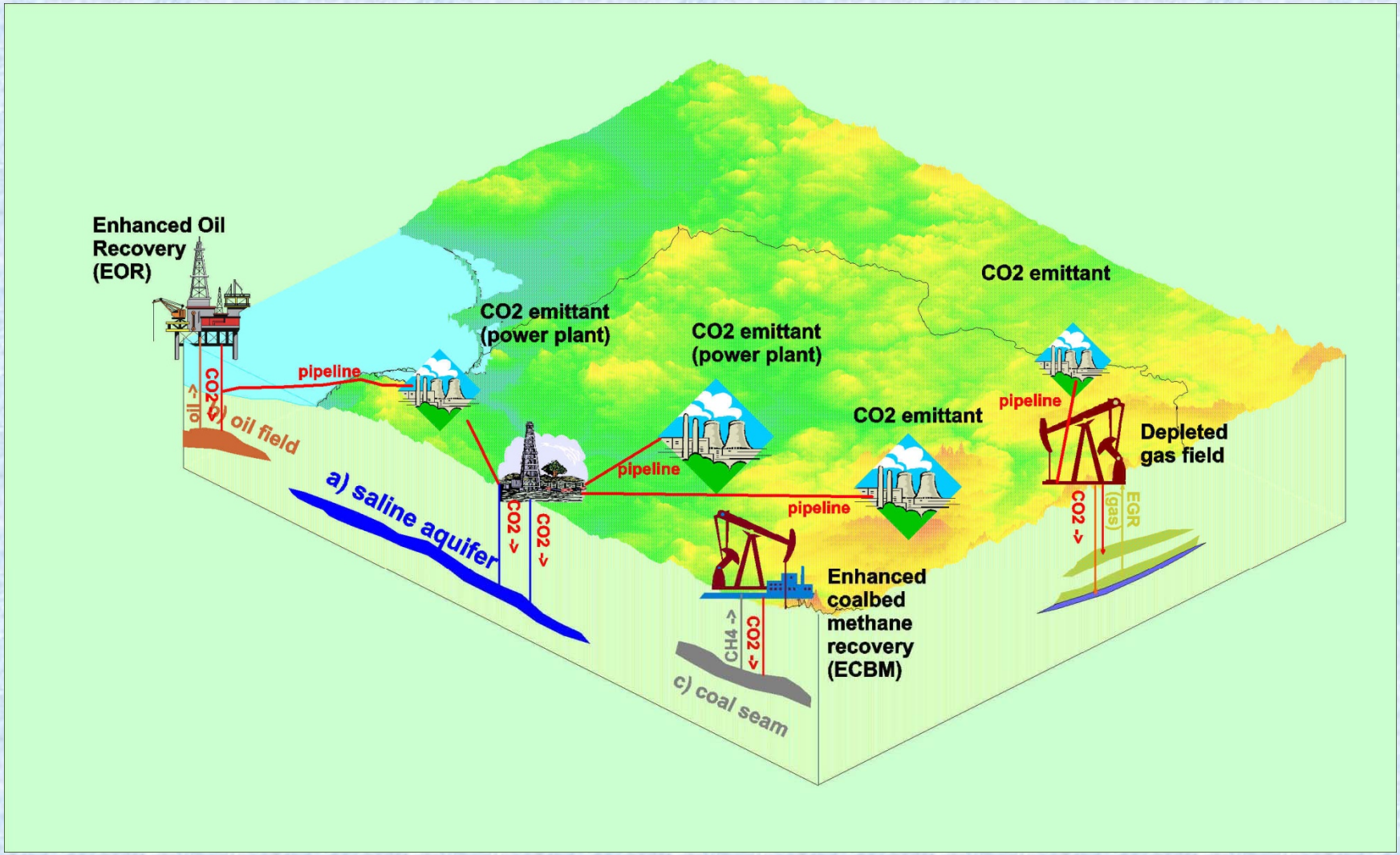
CO2 geological sequestration (definitions)

Carbon capture and storage (CCS)
= CO2 capture process + transport +
safe sequestration in geosphere

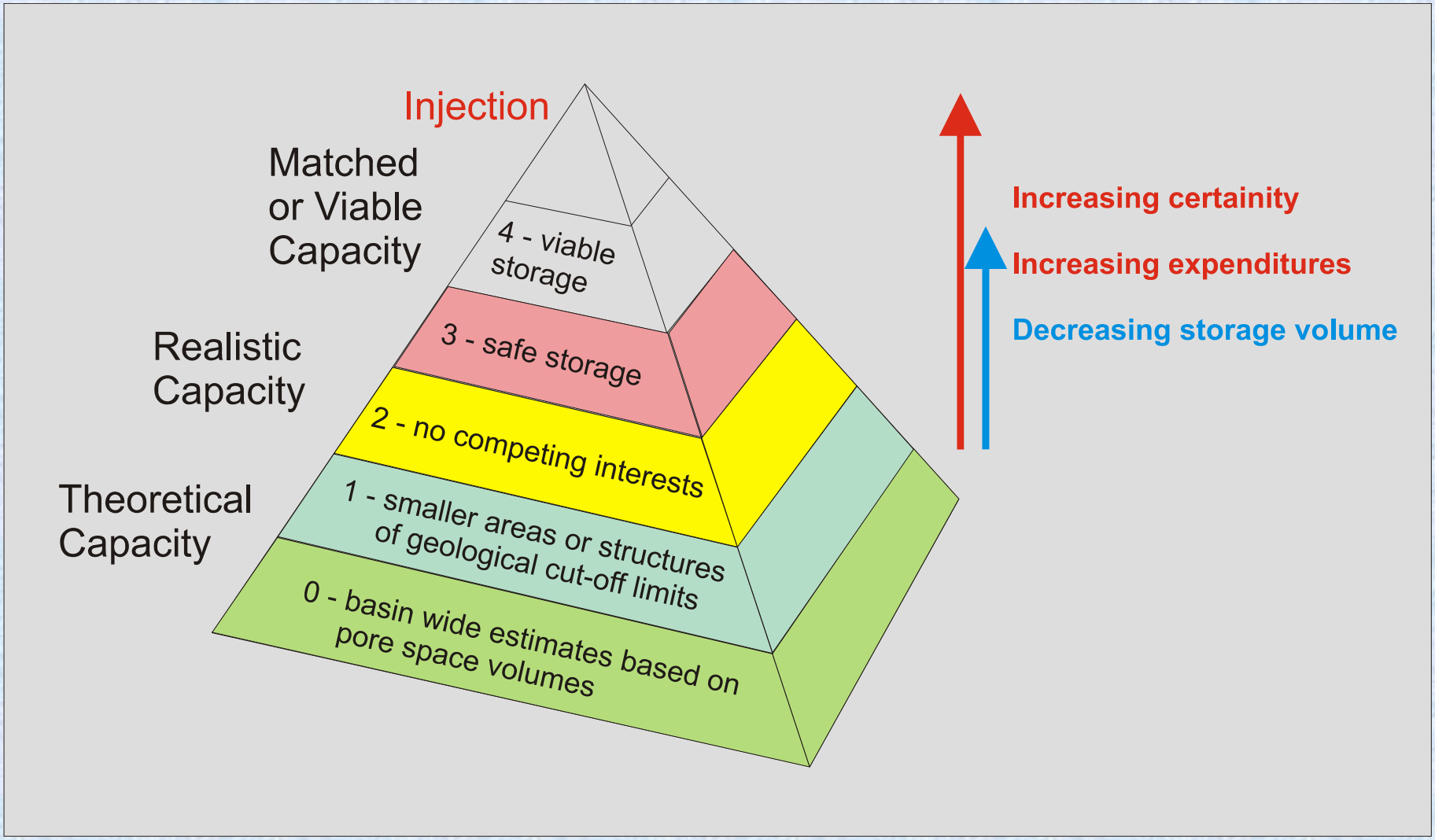
Geological sequestration of CO2 (from fossil fuel combustion) - safe storage within deep geological systems and structures (carbon geological storage - CGS) for at least thousands of years:

- within saline aquifers (of the biggest potential but usually insufficiently explored),
- within depleted hydrocarbon fields (with a possibility of EOR, EGR),
- in deep, un-mineable coal seams containing methane (with a possibility of ECBM)

CO2 geological sequestration (an idea)

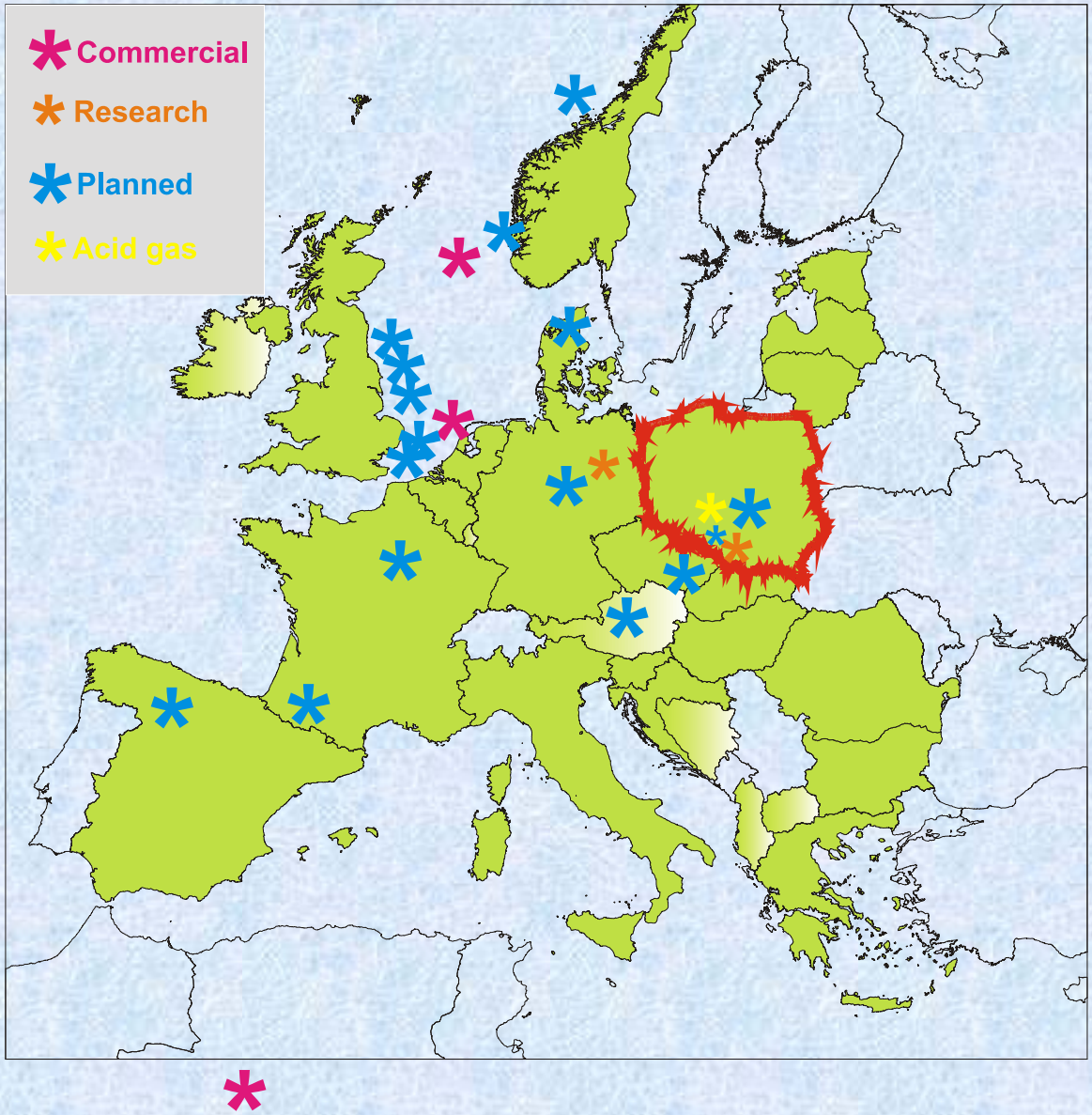


CO2 geological sequestration pyramid



CO2 storage capacity pyramid (refers mostly to saline aquifers)

Ongoing and planned CO2 storage projects in Europe



-POLAND
-R&D project at Borzęcin gas field (EGR using acidic gas = 60% CO2, since 1995) - CO2-ECBM EU FP projects RECOPOL
- MOVECBM (since 2001);
- two projects under the EU Flagship Programme are planned

For much of Europe (green colour) basic knowledge on CO2 geological storage possibilities has been compiled under EU and national projects, but such knowledge is not sufficient to decide where exactly CO2 can be safely stored. Such detailed knowledge is required for exploration and storage permits to be granted.

Preliminary estimation of CO2 storage capacity for Poland

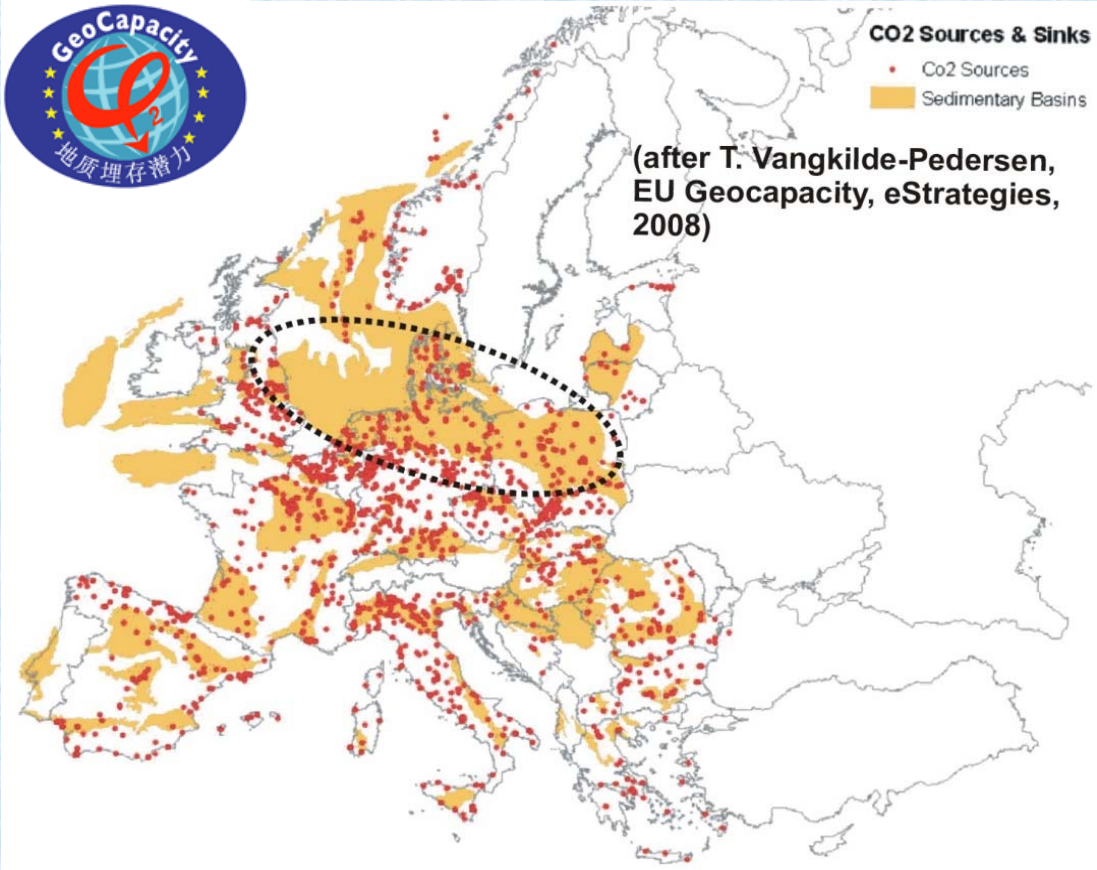
Type	*Storage potential, Mt*
Saline aquifers CASTOR ***Saline aquifers EU GeoCapacity (MEERI)*** *upper limit for Cr1, J1, T, and other formations*	**3 752** ***4 701*** *90 000*
Hydrocarbon fields (31 structures)	**764**
Coal seams (selected CBM fields at depth of 1-2 km) *Coal seams within Polish SCB at depth of 1-2 km*	**415** *1 254*
SUM *SUM*	**~6 – 7 Gt** *~92 Gt*

Regional aquifers (Cr1, J1 and T) make the biggest volume of country storage capacity. Their huge potential, counted in Gtonnes, enables storing emissions of big power plants and other industrial installations for decades,

Hydrocarbon fields (of rather small capacity) are of a local importance. These are mostly gas fields with a few suitable oil fields.

Methane-bearing coal seams are quite common in the Silesian Coal Basin and possibly have a potential to store emissions of some industrial installations. However, this is a sensitive issue because of safety of coal underground exploitation and conflicts with coal gasification.

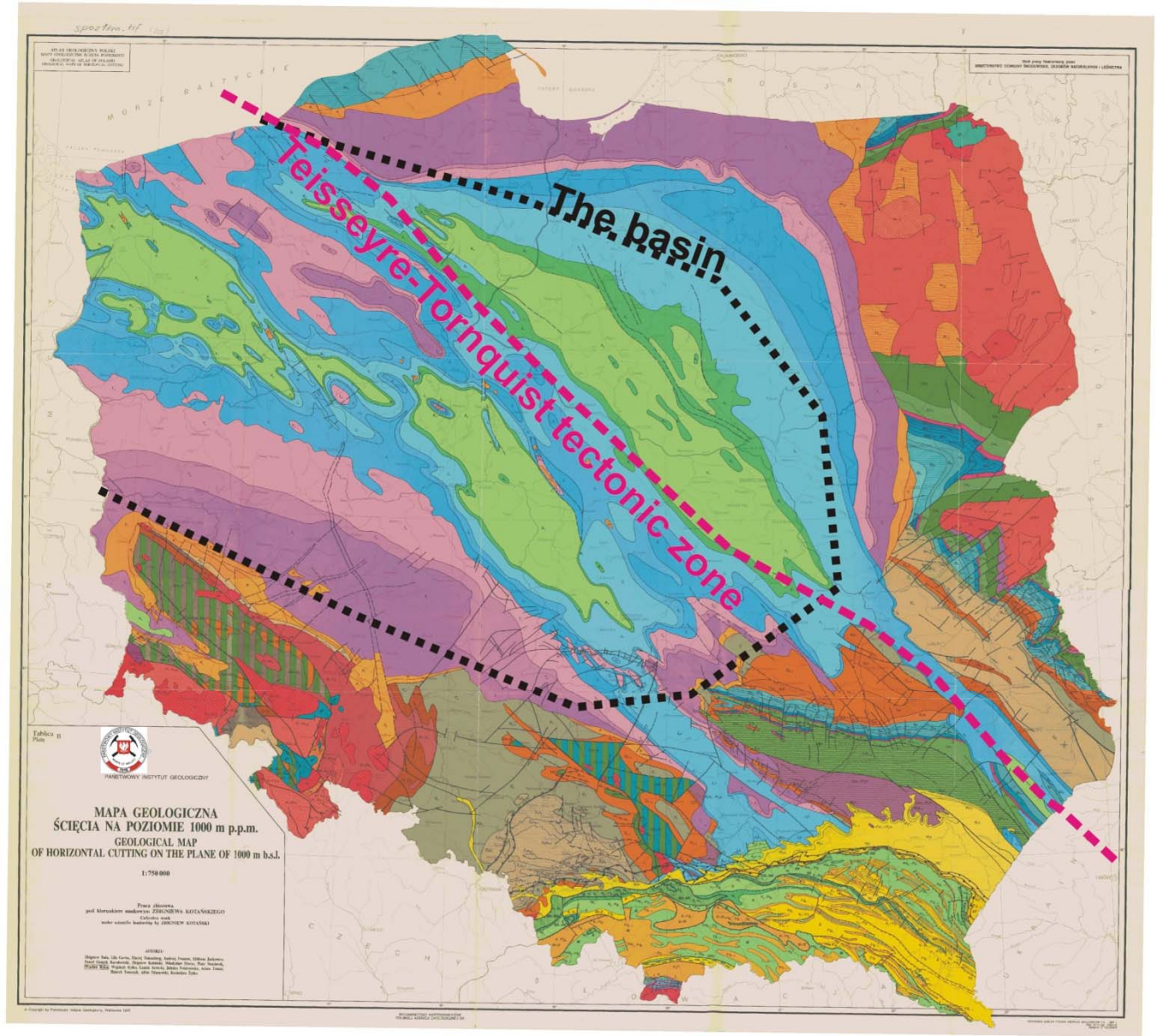
Distribution of sedimentary basins potentially suitable for the CO2 storage



Central European Permian-Mezozoic basin (outlined), is the biggest European sedimentary basin - it extends from England to Poland across the North Sea, Netherlands, Denmark and Germany. Polish territory belongs to the eastern arm of this vast basin.

Main European sedimentary basins (after FP6 EU GeoCapacity project)

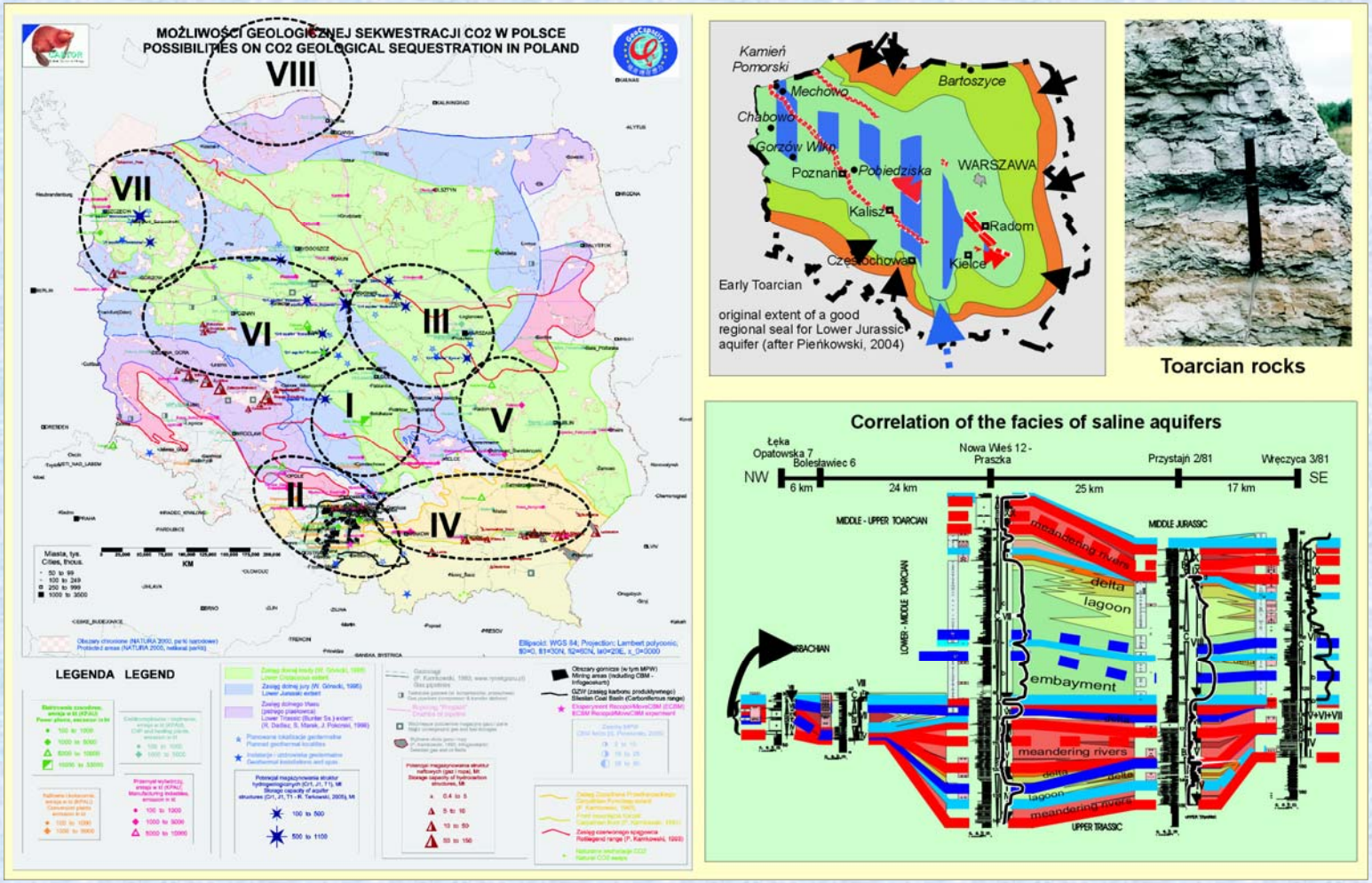
Geological structure of the Polish Basin



Plane section at a depth z=1 km

Saline aquifers of the Polish part of the Permian-Mezozoic basin (outlined), such as: Lower Jurassic (deep blue), Triassic (purple) and to a lesser extent, Lower Cretaceous (dark-green), are likely good reservoirs for safe CO2 storage. They are particularly useful for the needs of large industrial installations.

The scope of the programme

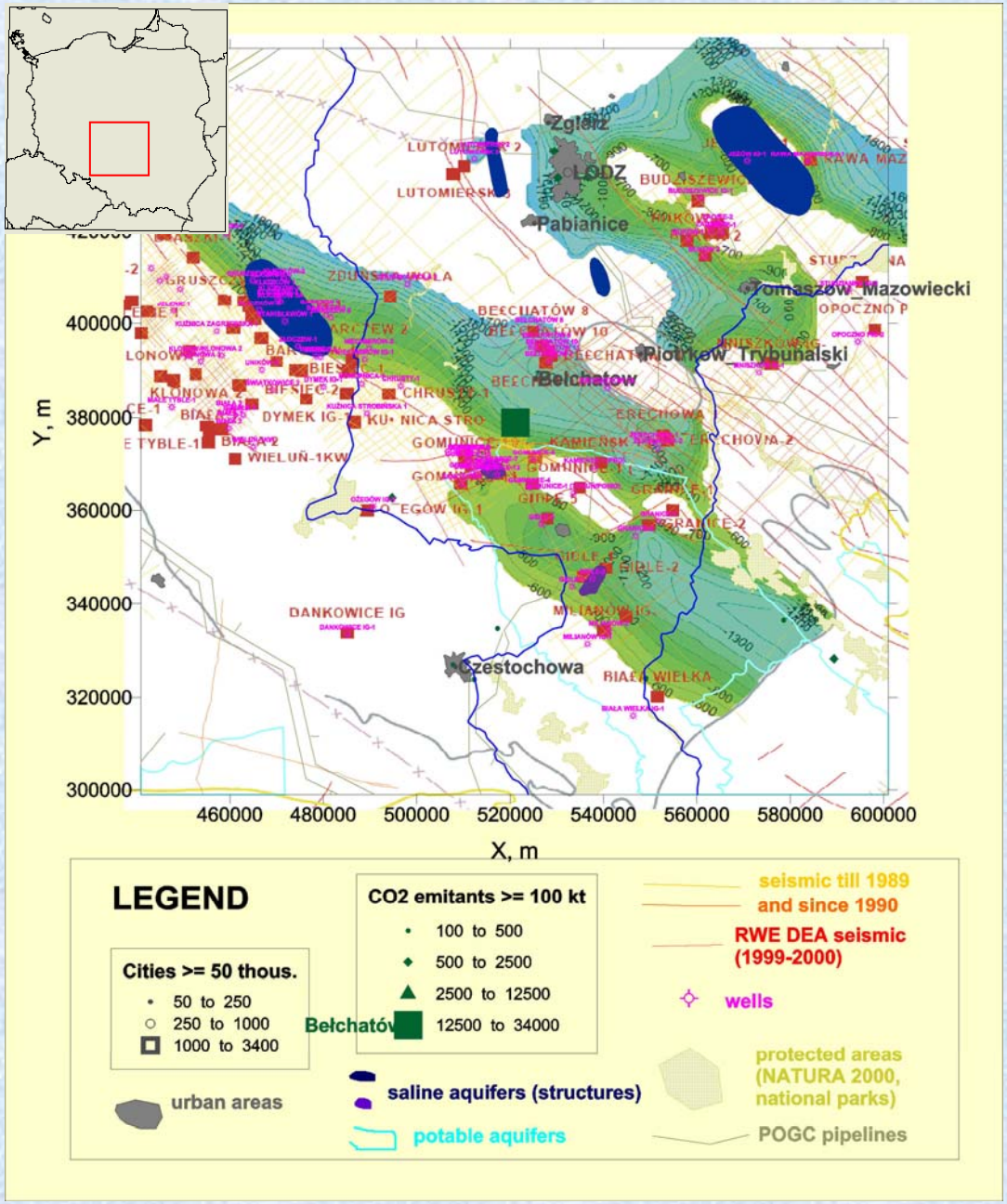


The programme covers territory of Poland, including Polish Baltic economic zone. In 8 areas more thorough studies of facies of saline aquifers will be conducted, in order to select **objects suitable for safe CO2 storage;** similarly, hydrocarbon fields and coal beds in the country will be studied. For five selected storage sites (3 in saline aquifers and two other) **detailed analyses** (according to the Directive on geological storage of CO2) will be performed, followed by **monitoring programmes**.

The detailed scope of the Project

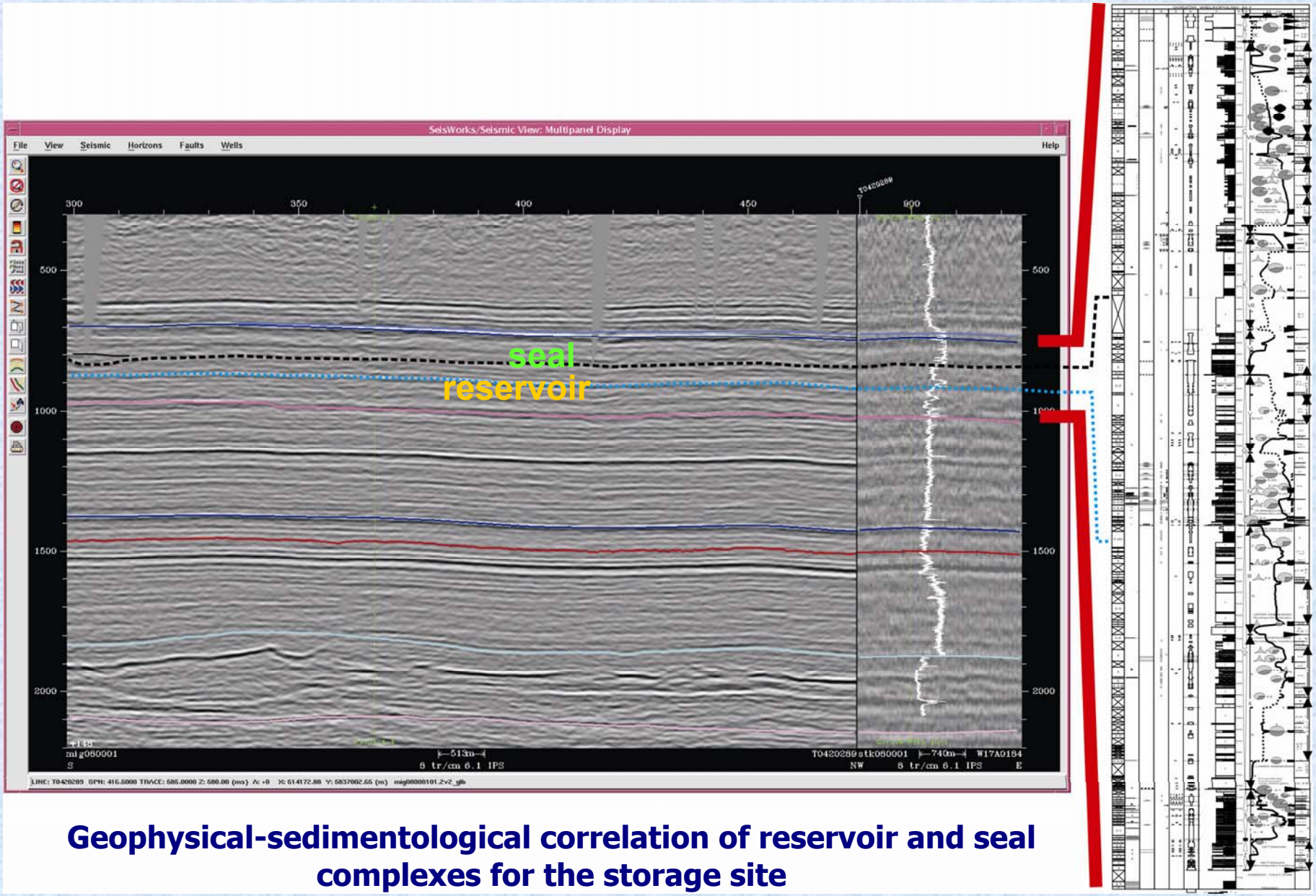
- characterisation of formations and structures suitable for geological storage of CO_2
- elaboration (update) of CO_2 sequestration capacity for Poland
- elaboration of 3-D models of reservoir and sealing facies
- analysis of tectonic zones
- petrological and petrophysical laboratory analyses of rock samples
- hydrogeological characterisation of aquifers and properties of reservoir fluids
- determining areas excluded from the viewpoint of CO_2 sequestration
- 3-D models of sequestration systems, zones and structures of optimal properties
- assessment of propagation of injected CO_2 within reservoir fluids for selected areas
- elaborating databases
- recommending of localisation of CO_2 storage sites
- public acceptance of CO_2 storage
- coordination, contacts with partners beyond the consortium, dissemination of results, project website, data standardisation and quality control
- collection of detailed geological, geophysical, hydrogeological, reservoir and geomechanical data
- building detailed static geological earth models for the storage complexes
- dynamic simulations of CO_2 injection processes (incl. leakages) within the storage complexes
- risk assessment for CO_2 geological storage
- establishing of the baseline monitoring plan for the storage site, and assumptions for operational and post-closure monitoring

Works for area I - 1st Polish demo project



- formations and objects suitable for CO2 geological storage in area I are characterised (dark blue and violet areas mean known objects to be verified)
- these are saline aquifers of Lower (and Middle) Jurassic and Upper (and Lower) Triassic sandstones
- in March 2009 the most suitable object (and likely a backup one) is selected
- for the demo Bełchatów plant it is expected 1.7 Mt/yr of CO2 sequestered (the proposal to ETP ZEP is submitted by PGE Bełchatów and Alstom)
-then the selected site is (pre)characterised and the baseline monitoring is designed
- fields works start by the end of 2009

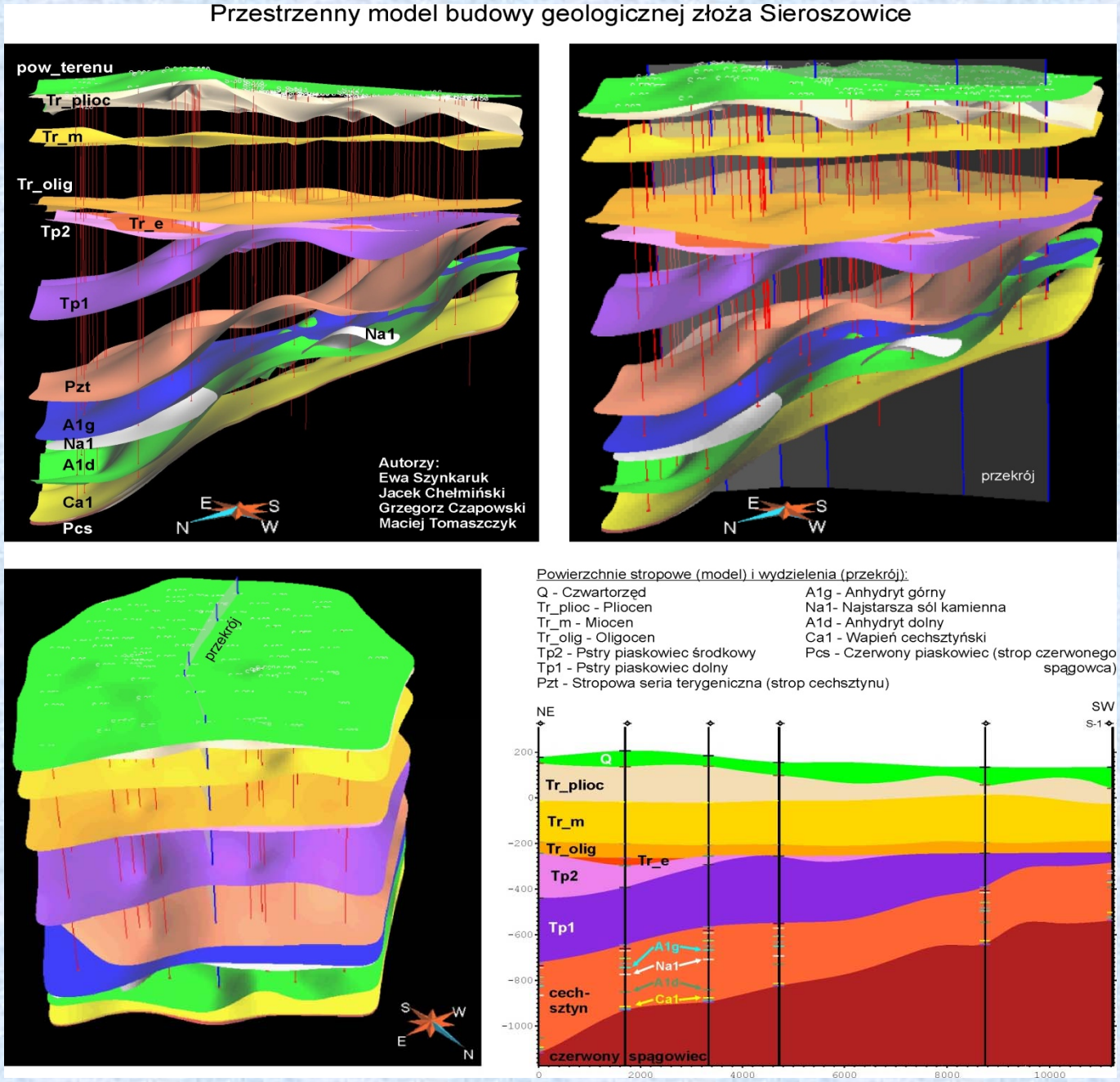
Building of static models of the storage site

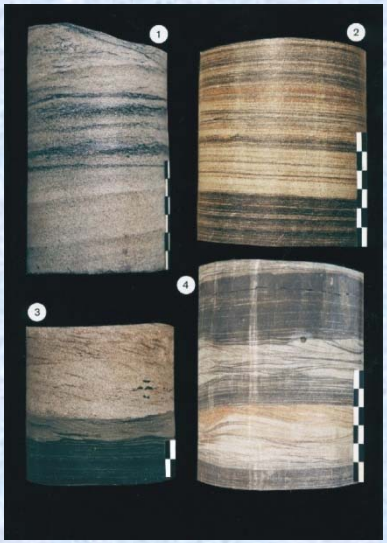


Geophysical-sedimentological correlation of reservoir and seal complexes for the storage site

3D static structural models, with rock and fluid properties

real rock samples





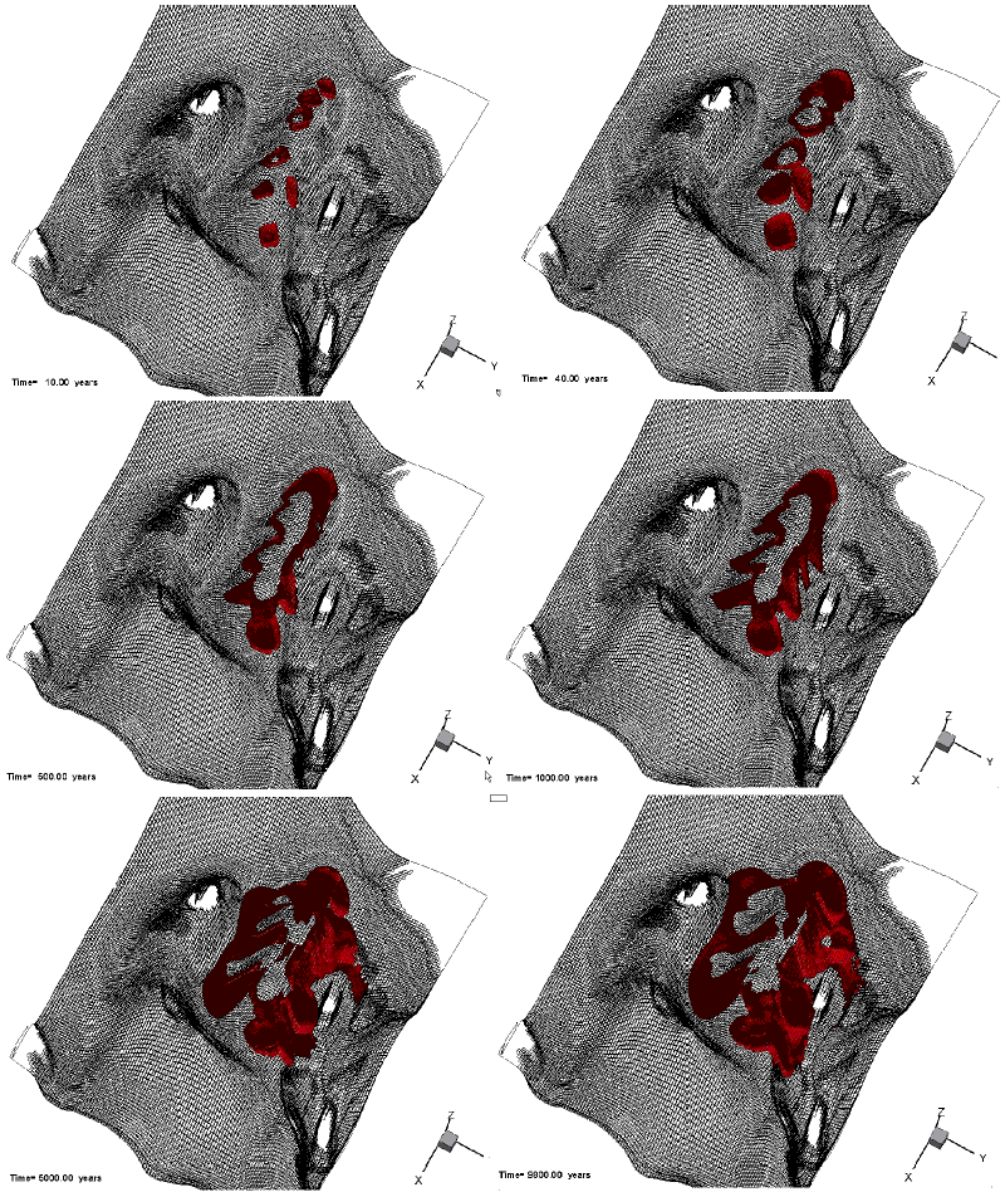


Figure 4.26_Schweinrich long term simulation: Simulated migration of CO_2-saturated formation water over 10000 years. Note the great portion of dissolved CO_2 (red) leaving the structural trap. Accordingly, the total area affected by dissolved CO_2 is much larger than the anticlinal structure itself.

Modelling of CO2 migration (after CO2STORE manual – Schweinrich example)

It is expected an area of up to 30 x 30 km should be investigated, so knowledge on reservoir properties of neighbouring geological formations is essential.

Further steps

Works under the National Programme for the site within area I

- Risk analysis

- geological risks
- reservoir risks
- long term fate of CO2 (leaking)
- impact on society and humans
- public opposition
- impact on health of humans (if applies)

- Monitoring programme

(after experiences of Ketzin, Kaniów, Lacq, Sleipner, Snohvit, Vedsted, Weyburn, etc):

- geophysical (seismic, gravity, electromagnetic)
- geochemical
- biomonitoring

Works under the National Programme for area II

Works under the National Programme for the site within area II

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Baseline monitoring for the site within area I (PGE Bełchatów funding - not a part of the National Programme)