Current map of gas/oil exploration and production concessions in Poland

Proximate gas shale resources in Poland: 1,3 to 5,3 bln m³

What is shale gas and how to recover it?

- Unconventional gas resource along with Tight Gas and Coalbed Methane (CBM)
- Low permeability reservoirs: 0.0001 - 0.01 md
- High organic content TOC > 1-2% wg.
- Sorption of gas on organic matter in micro and nano pores
- “Free gas” in macropores and fractures
- In order to produce gas stimulation is needed, the most common method is hydraulic fracturing (slickwater)
- Injection of proppant in order to sustain fracture
- Low production rates but longer life of a well (up to 30 years)
- Horizontal wells provide higher recovery

Assumptions and objectives of the project

### CBM vs. Shale Gas

<table>
<thead>
<tr>
<th></th>
<th>CBM</th>
<th>Shale gas</th>
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</thead>
<tbody>
<tr>
<td>Source</td>
<td>Coal acts as a source rock and as reservoir</td>
<td>Shale acts as a source rock and as reservoir</td>
</tr>
<tr>
<td>Trapping mechanism</td>
<td>Adsorption in coal matrix</td>
<td>Adsorption in matrix of organic matter</td>
</tr>
<tr>
<td>Porosity</td>
<td>Low &lt; 5-10 %</td>
<td>Low &lt; 5 %</td>
</tr>
<tr>
<td>Permeability</td>
<td>0.5 – 80 md</td>
<td>0.0001 – 0.01 md but significantly enhanced by hydraulic fracturing</td>
</tr>
</tbody>
</table>

### Objectives of the CO2SHALESTORE project:

1. assess the possibilities of CO₂ storage in gas bearing shales
2. investigate possibility of enhanced shale gas recovery by CO₂ injection

Research methodology

**Task 1 - CO₂ interactions with shale reservoirs**

- Acquirement of shale samples from exploratory wells
- Initial lab analysis: TOC, mineral composition, clay content, porosity, density, etc.
- Batch reactor tests with CO₂ under in-situ conditions (P,T)
- Secondary lab analysis: TOC, mineral composition, clay content, porosity, density, etc.
- Changes?
- CO₂ sorption experiments on shale samples

**Task 2 - Enhanced gas recovery from gas shales**

- Plug-flow experiments of CO₂ injection into shale saturated with methane under in-situ confining pressure and temperature (cores with artificial fractures)
- Shale swelling experiments with CH₄ and CO₂

RESULTS

Selection of samples for further experiments