Sleipner Case Study: Dynamic modeling
(ECLIPSE software)

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OBJECTIVES & METHODOLOGY

Select a heterogeneous reservoir X-section → Sensitivity analysis → Forecast simulation of long term CO2 storage → Upscaling to 3D model

Input data (Geological model) → Slice selection
- Reservoir model: J=70
- No of cells: 1,079,456
- Qave =10000 sm3/day

→ Sensitivity Analysis
- Heterogeneity
- K Anisotropy
- Rel. perm.

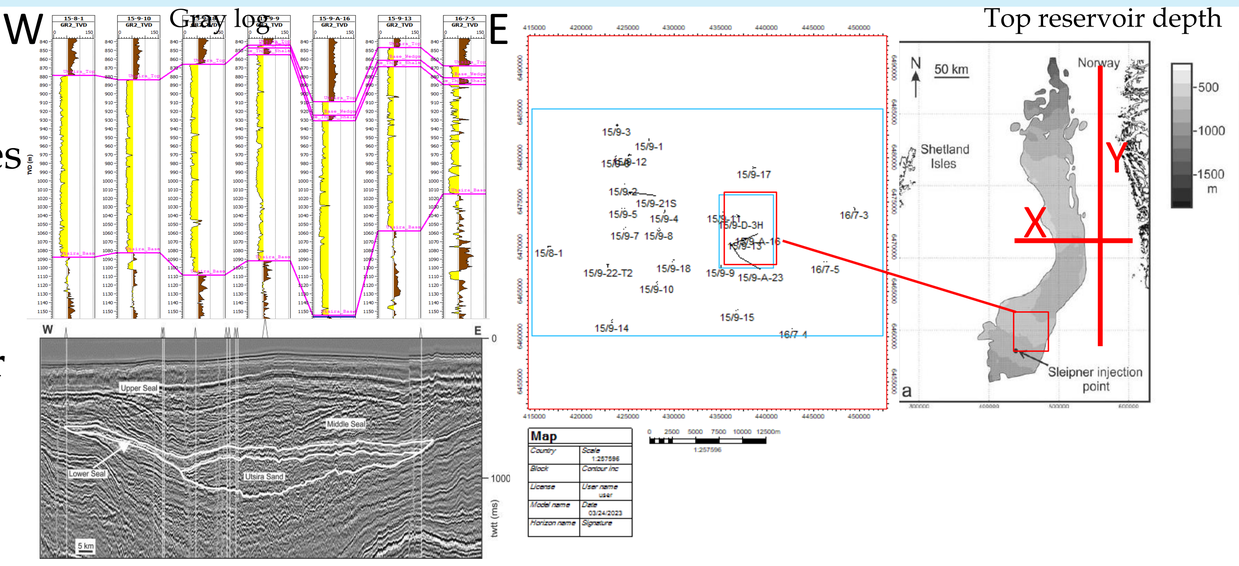
→ Data Analysis
- CO2 dissolution
- Flow distribution

GEOLOGY

- Reservoir: Utsira sand
- Age: Mio-Pliocene age
- Depositional environment: Graben with sand lobes
- Saline Aquifer (100%Sw)

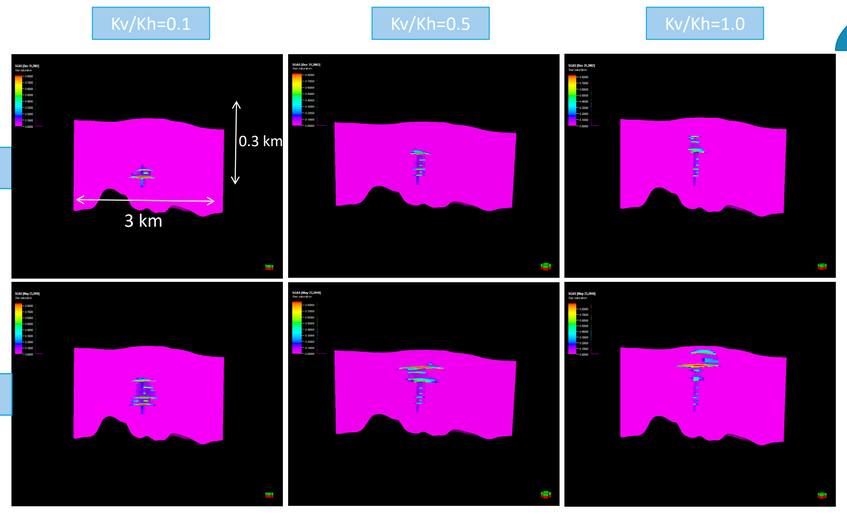
✓ Heterogeneities
✓ Mud diapirs → layer division parallel to reservoir top

- Reservoir range (X-Y-Z: 100-400~0.2km)

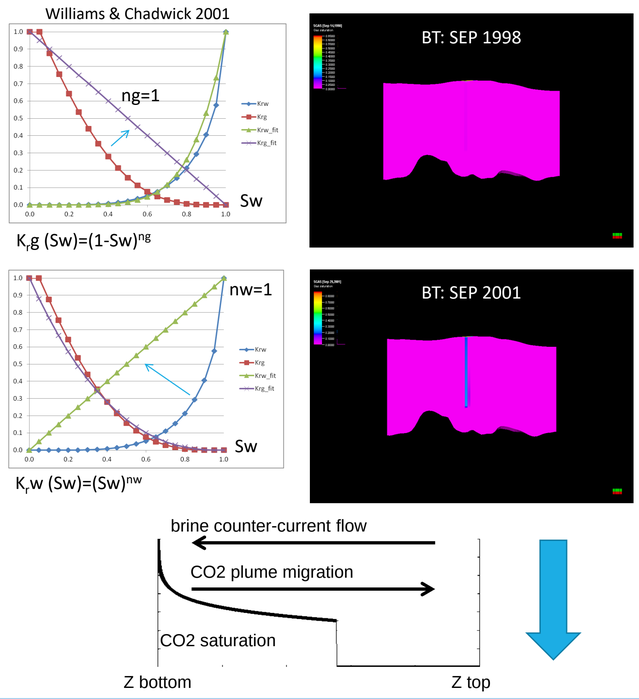


SENSITIVITY ANALYSIS – Gas Saturation over time

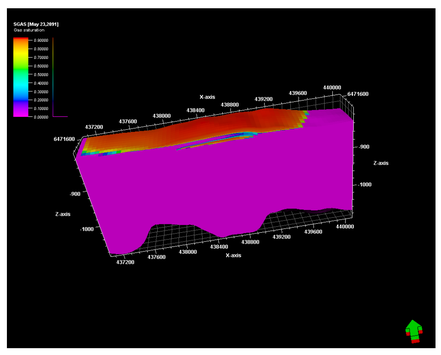
A) PERMEABILITY ANISOTROPY
homogeneous model (K_{h_av}=2800 mD, $Phi_{\_av}$=0.29)



B) RELATIVE PERMEABILITIES
homogeneous model (K_{h_av}=2800 mD, $Phi_{\_av}$=0.29)

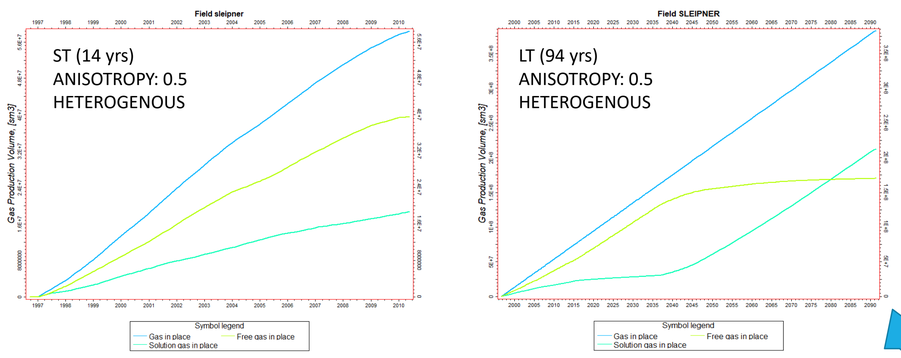


E) 3D MODELING



9 slices (Reservoir model: J=66-74)
Dimensions: 61*112*158
Number of cells: 9,715,104

D) LONG TERM_*heterogeneous model*

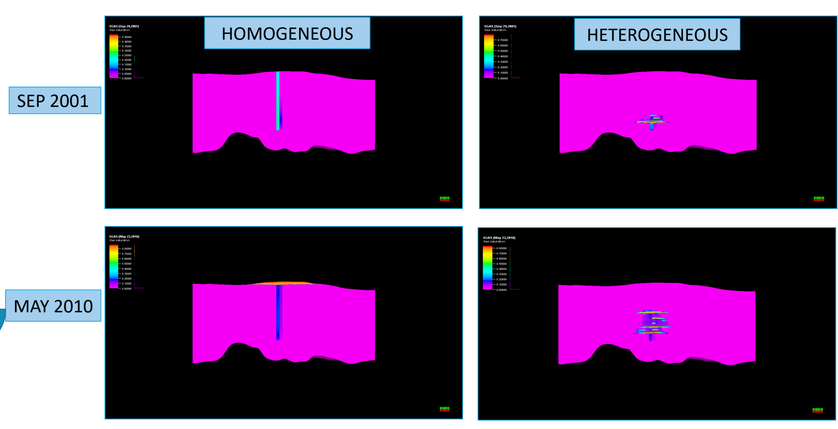


Breakthrough Timepoint: DEC 2015

GAS VOLUMES

Case	Total Inj. Vol.	Dissolved CO_2	Free gas
HETER Kv/Kh=0,1	6.00E07	1.70E07	4.30E07
HETER Kv/Kh=0,5	6.00E07	1.95E07	4.05E07
HETER Kv/Kh=1	6.00E07	1.95E07	4.05E07
HETER Kv/Kh=0,1, ng=1	6.00E07	2.80E07	3.20E07
HOMO Kv/Kh=0,1	6.00E07	0.90E07	4.80E07
HOMO ng=1	6.00E07	1.10E07	4.60E07
HOMO nw=1	6.00E07	0.90E07	4.80E07

C) PERMEABILITY HETEROGENEITY



DISCUSSION

•Moving from permeability anisotropy towards isotropic state, heterogeneity has lower impact on CO2 flow.

•Homogeneous (ng=1) shows very low gas saturation values because there is a counter current flow of brine downwards

•Heterogeneity enhances CO2 solubility in brine.

•When relative permeability to gas decreases, CO2 dissolution in brine is increased.