

CO<sub>2</sub>GeoNet Open Forum, 24-25 April 2018, San Servolo Island, Venice Post-Open Forum workshop organised by *ENOS*, 26 April 2018: Storage site solutions: Monitoring and verification

# LEAKAGE DETECTION FROM WELL PRESSURE MONITORING

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### The challenge



Most of modern wells are equipped with Permanent Downhole Gauges (real-time pressure record)

Can we use pressure from PDGs to detect leakage out of the site?



















































## Conclusions



- Yes, we can use pressure from PDGs to detect leakage!
- The technology is universal: we can detect any changes in the wellreservoir system like (on example of CCUS):
  - Leakage through faults (both seismic / sub-seismic) and legacy wells
  - (Dis-) Appearance of flow barriers and conductive channels
  - Well performance and CO<sub>2</sub> plume size
  - •
- Wide applications: CCUS, Petroleum, Thermal, ...



# **THANK YOU FOR YOUR ATTENTION!**

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# REDUCED COMPLEXITY MODELLING OF LEAKAGE THROUGH FAULTS

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## **Overview of Model Concept**



**Quick and efficient numerical simulations** are required for risk analysis and characterisation of CO<sub>2</sub> storage sites.

**Vertical equilibrium (VE)** modelling is an efficient form of **reduced complexity modelling**. It exploits the fact that in typical  $CO_2$  storage scenarios  $CO_2$  floats on resident brine due to buoyancy. This allows us to reduce the explicitly represented dimensions from 3 to 2.

Horizontal flow is modelled numerically and the vertical configuration of fluids is reconstructed analytically. **Leakage through fault zones** includes a vertical component of flow. Current VE formulations do not account for this.

We are developing an analytical solution for fault zone leakage which is then included in VE models.



## **Overview of Model Concept**



**Fine scale simulations** are being used to model two-phase leakage of  $CO_2$  and brine through a fault zone.

Results are used to develop an **explicit model** relating fault geometry, total fault leakage rate and  $CO_2$  layer thickness with  $CO_2$  leakage rate through the fault.

This leakage rate can then be included as **sub-grid scale source term** in the VE modelling framework.

The model is applied to representative models of Hontomin and Sulcis Fault Lab.





# Illustration of Model Concept of Vertical Equilibrium









# Enabling Onshore CO, Storage

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