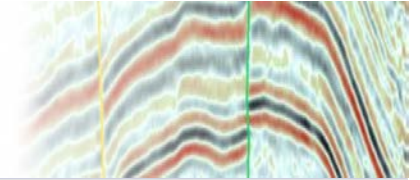


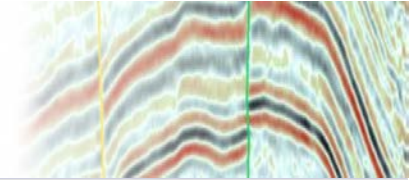
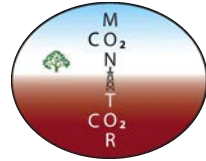
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5° Periodical meeting CO₂Monitor

Synthetic seismograms from the Sleipner injection site

Davide Gei, Stefano Picotti, Jose' Carcione



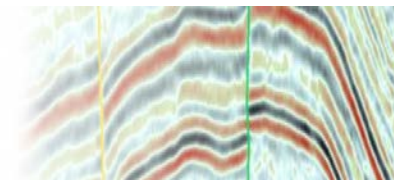
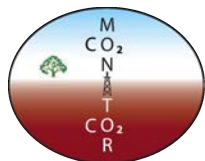
Objective

- Modelling of the reservoir (Utzira formation)

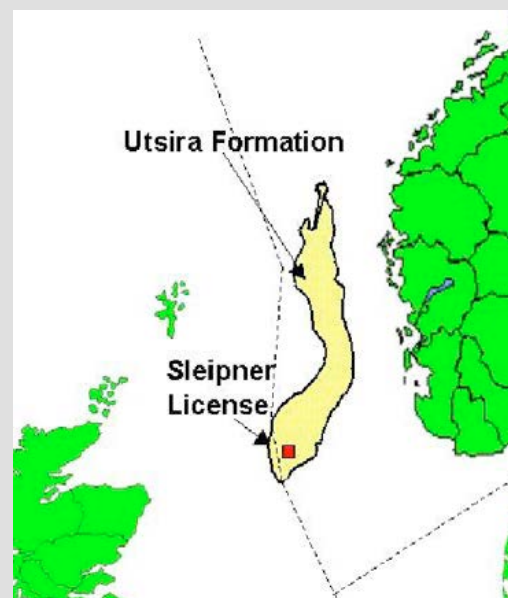
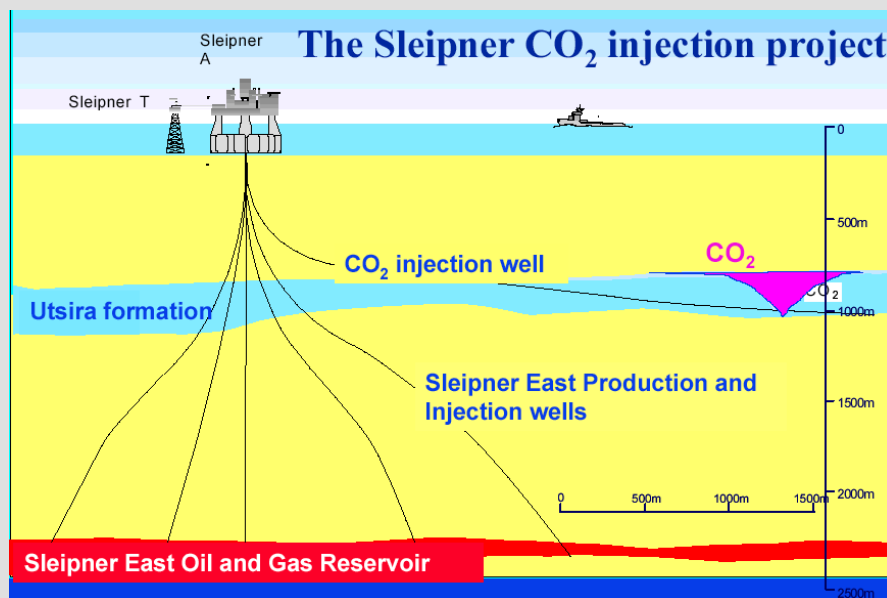
Carcione J.M., Gei G., Savioli G. B., Santos J. E., and Picotti S., 2013: A new petrophysical model and synthetic seismograms of the Utsira-Sand formation at the Sleipner field. In progress...

- Modelling of the overburden to study the sensitivity of the seismic method to leakage detection

Picotti S., Gei G., Carcione J.M., 2013: Leakage detection with seismic methods at the Sleipner field: a synthetic study. In progress...



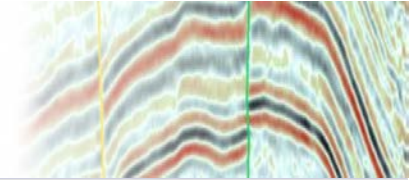
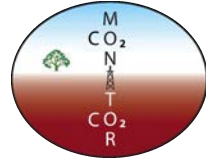
Sleipner injection site (North Sea)



Thickness: 150-250 m

Average Depth: 950 m

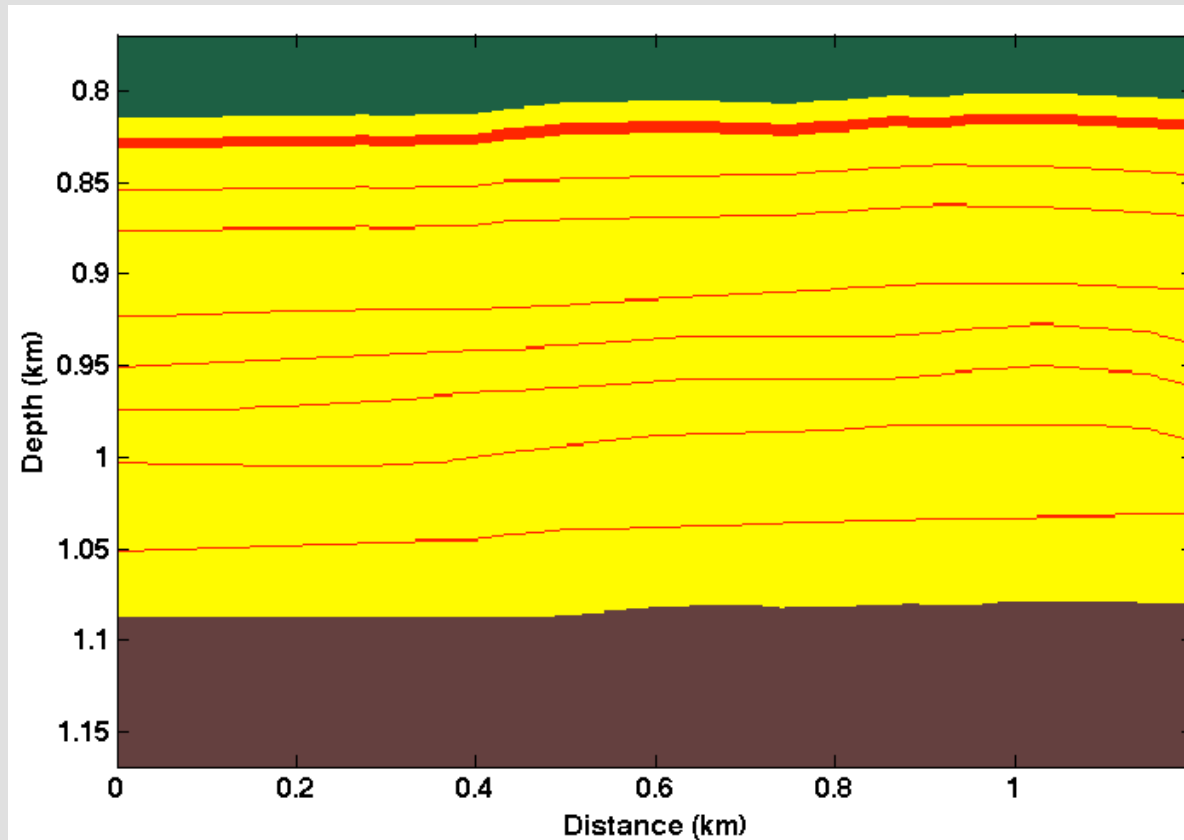
Geology: highly permeable unconsolidated sand with mudstone intra-layers 1 meter thick.

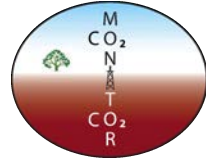


Reservoir (Utzira formation)

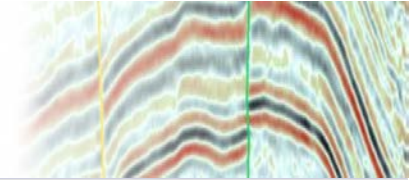
Petrophysical model → Fluid flow simulation → Saturation model

↓
Seismic modelling

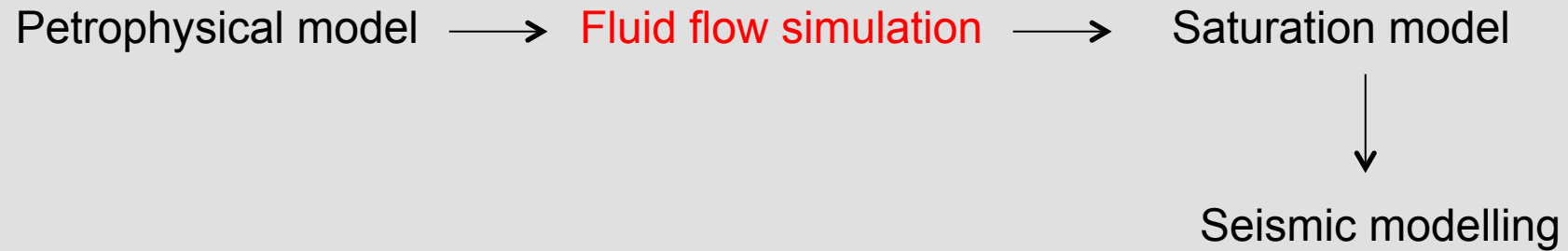




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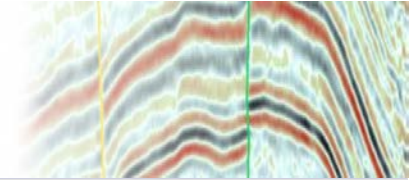
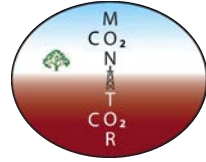


Reservoir (Utzira formation)



BOAST (Fluid flow simulator)

In progress

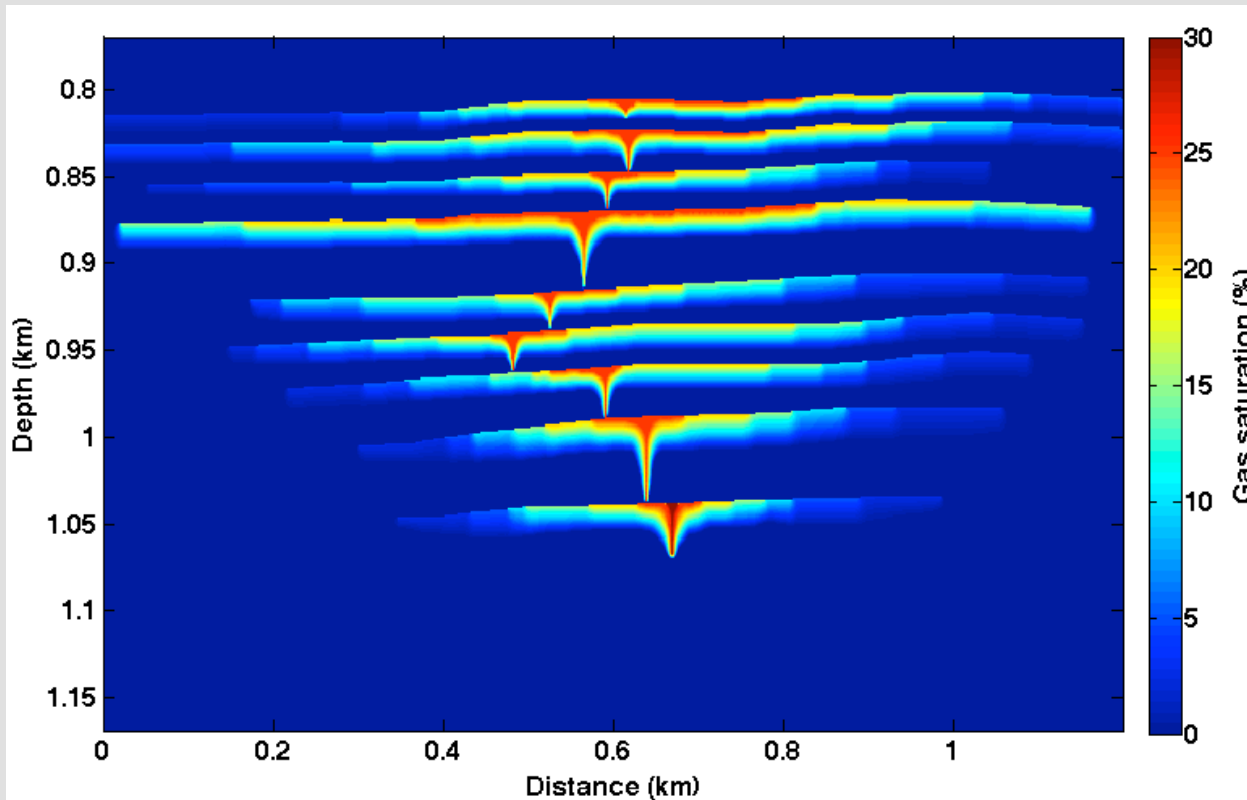


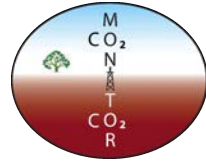
Reservoir (Utzira formation)

Petrophysical model → Fluid flow simulation → Saturation model

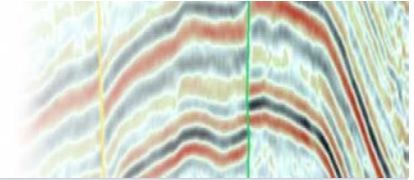


Seismic modelling



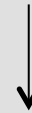


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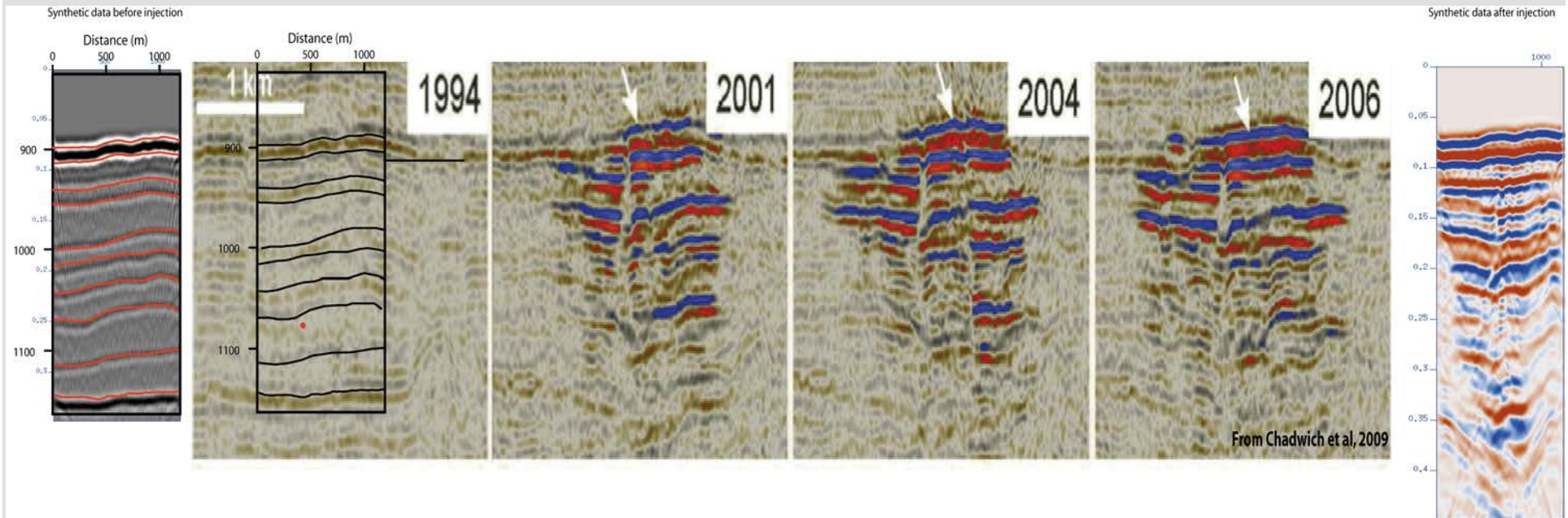


Reservoir (Utzira formation)

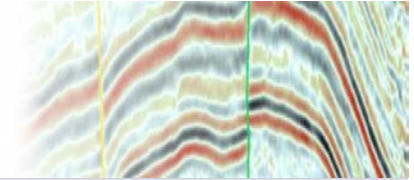
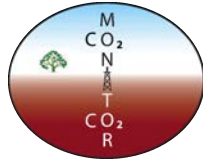
Petrophysical model → Fluid flow simulation → Saturation model



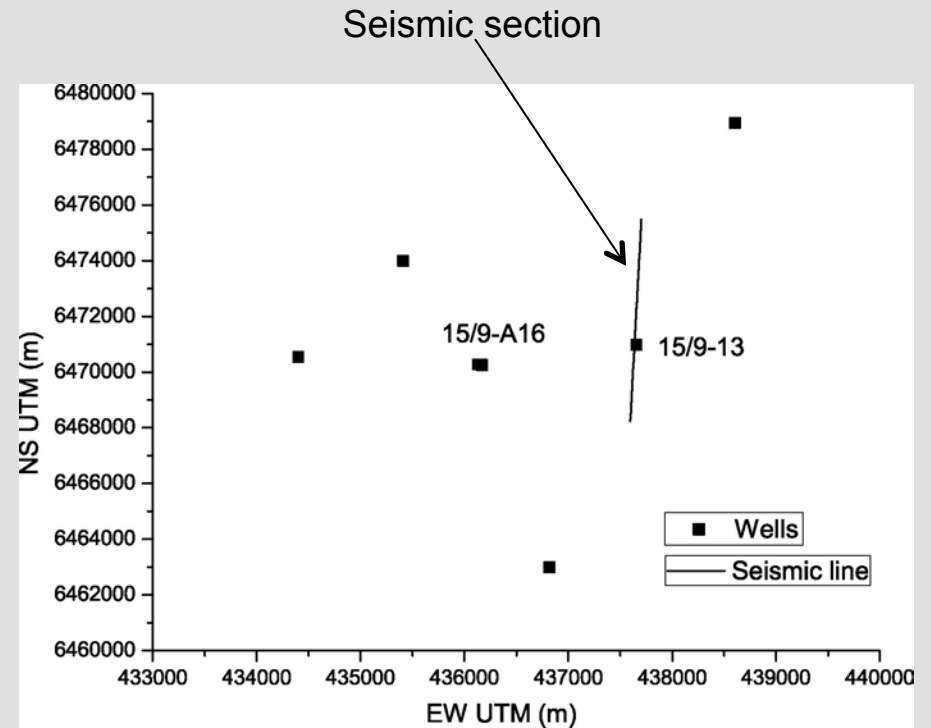
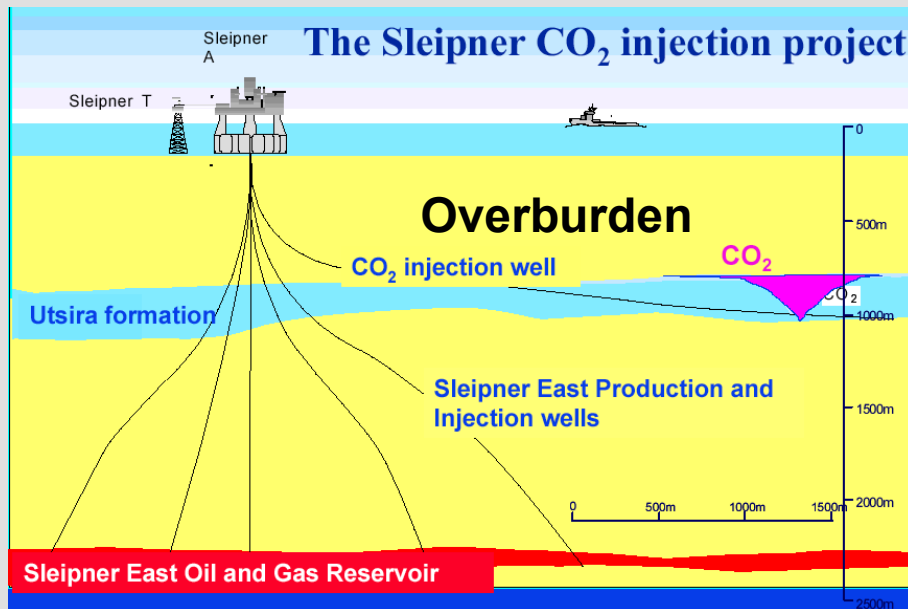
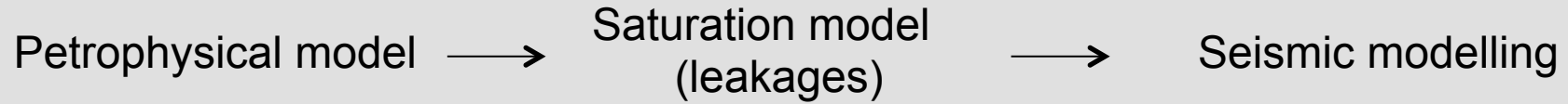
Seismic modelling

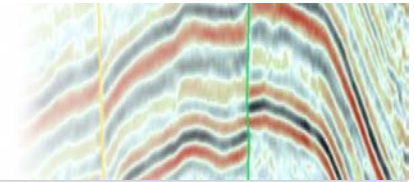
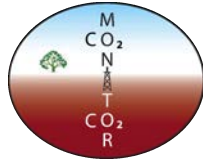


WORK IN PROGRESS

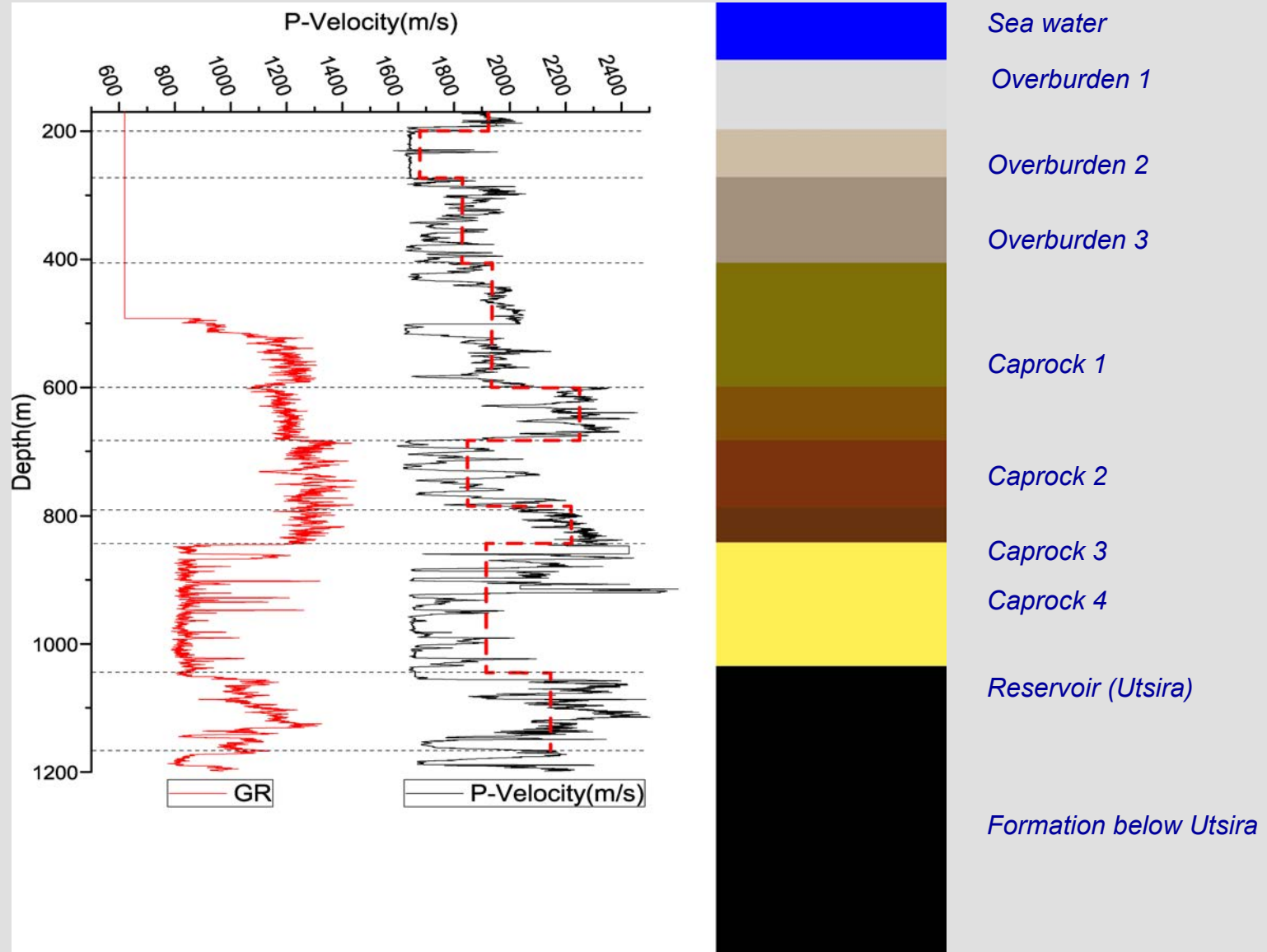


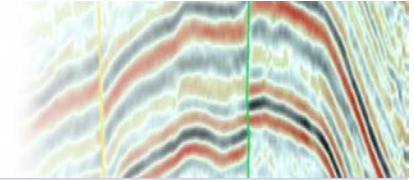
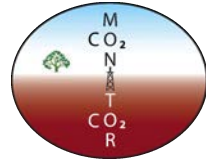
Overburden



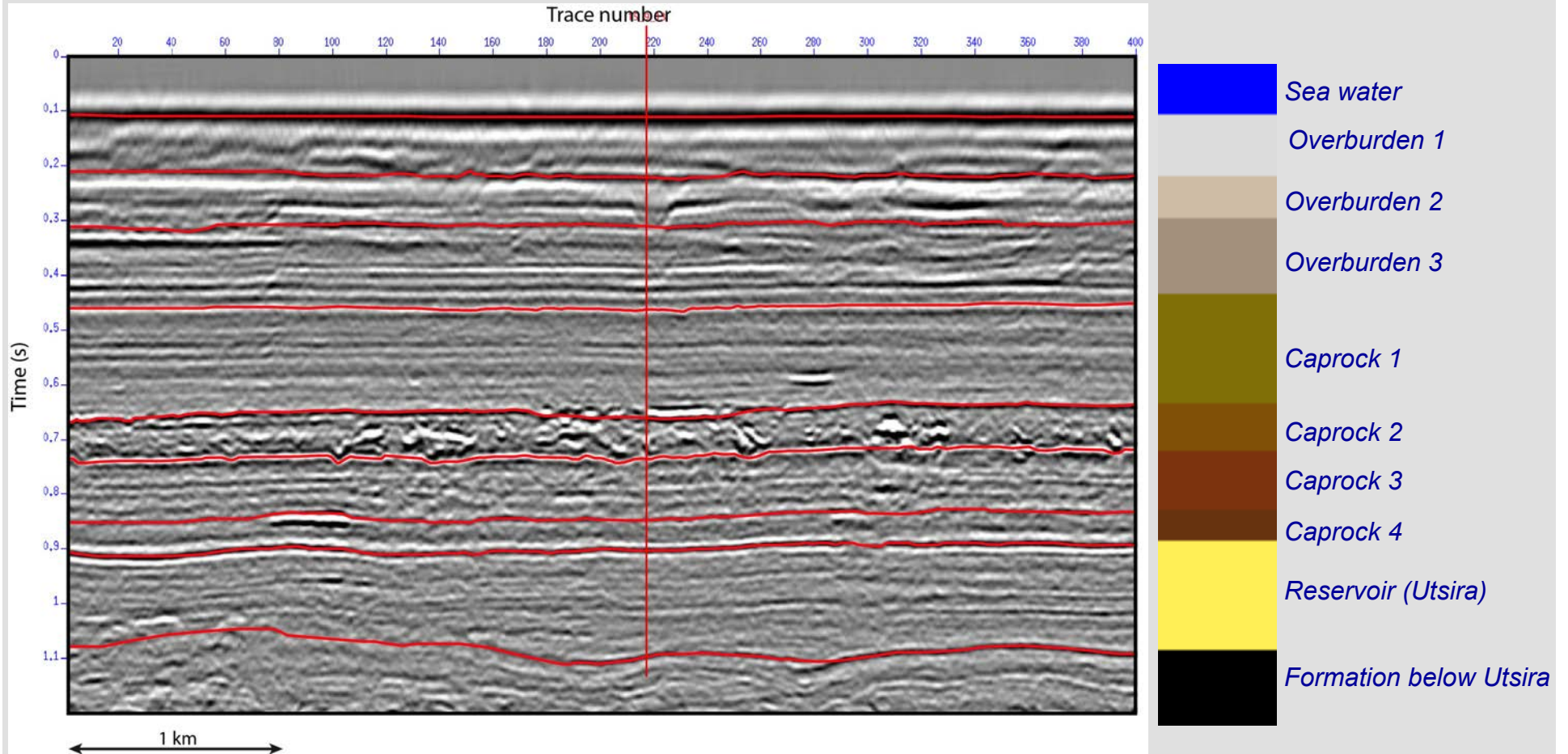


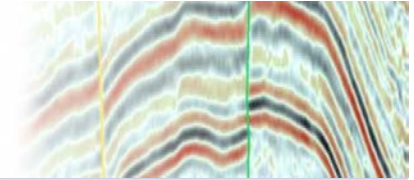
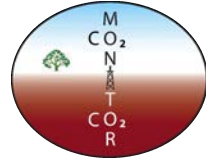
Overburden (geological – petrophysical model)





Overburden





Overburden – rock physics

P-wave velocity (V_P): from sonic log

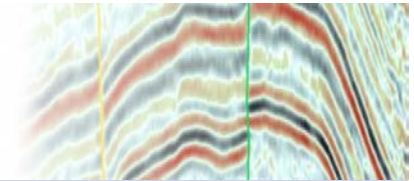
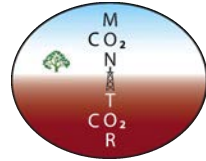
S-wave velocity: from V_P (Poisson's medium)

$$V_S = V_P / \sqrt{3}$$

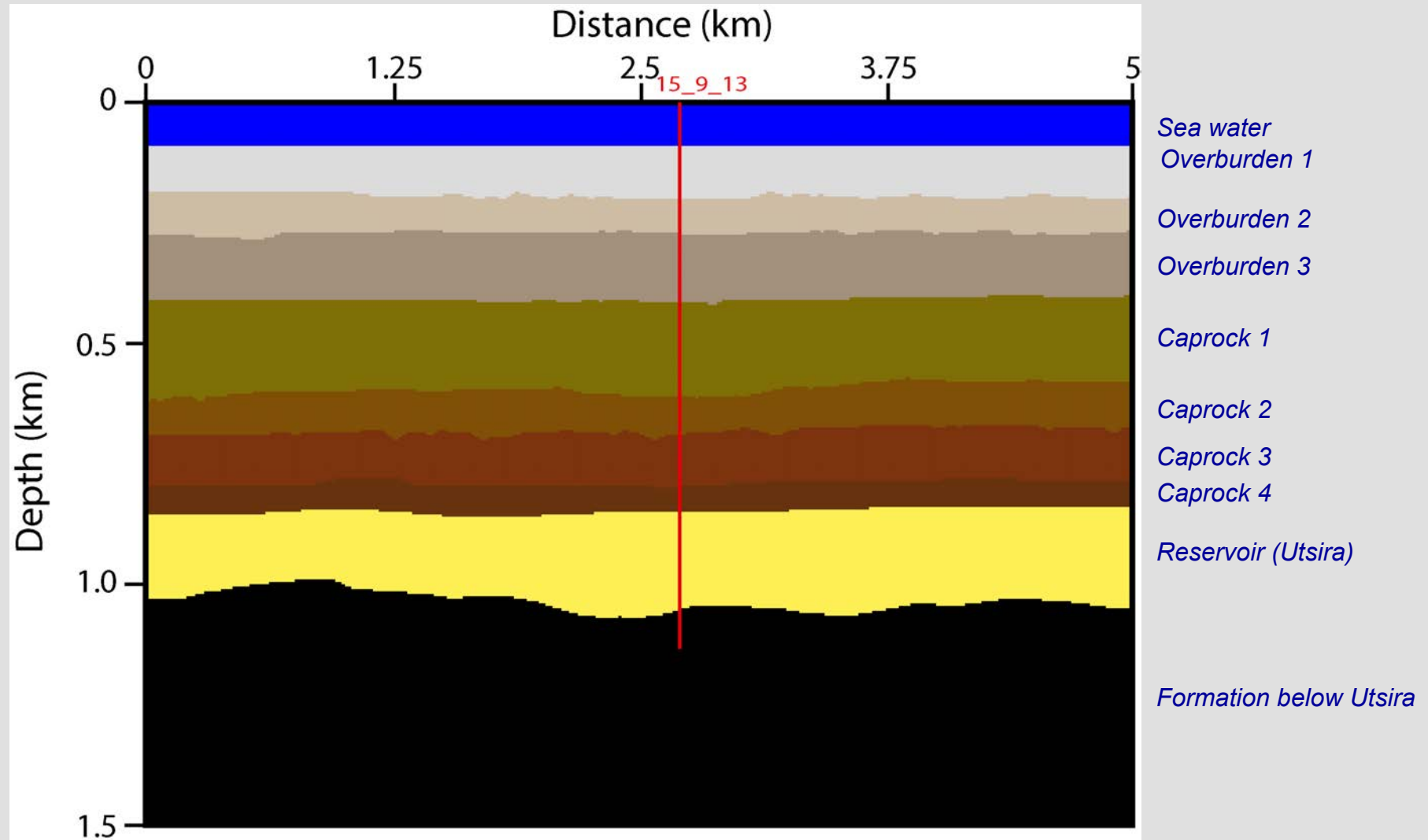
Density: from V_P (Gardner's rule)

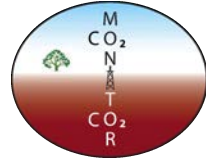
$$\rho = 1.74 V_P^{0.25}$$

Quality factors: ∞ (elastic media)

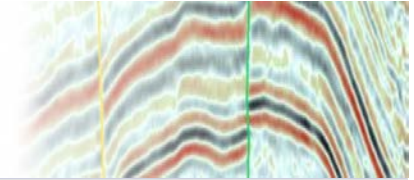


Overburden – Geological model

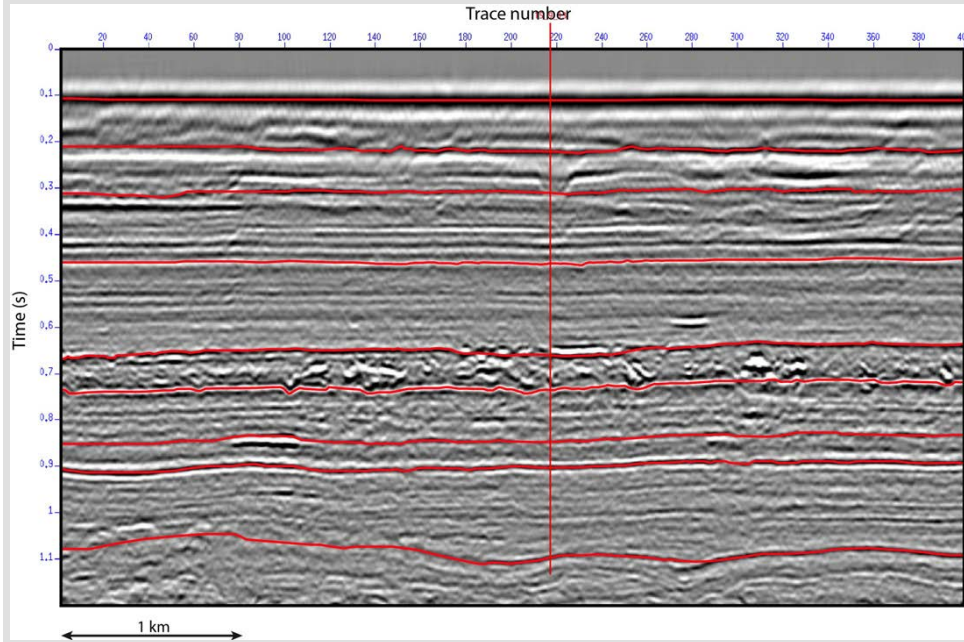




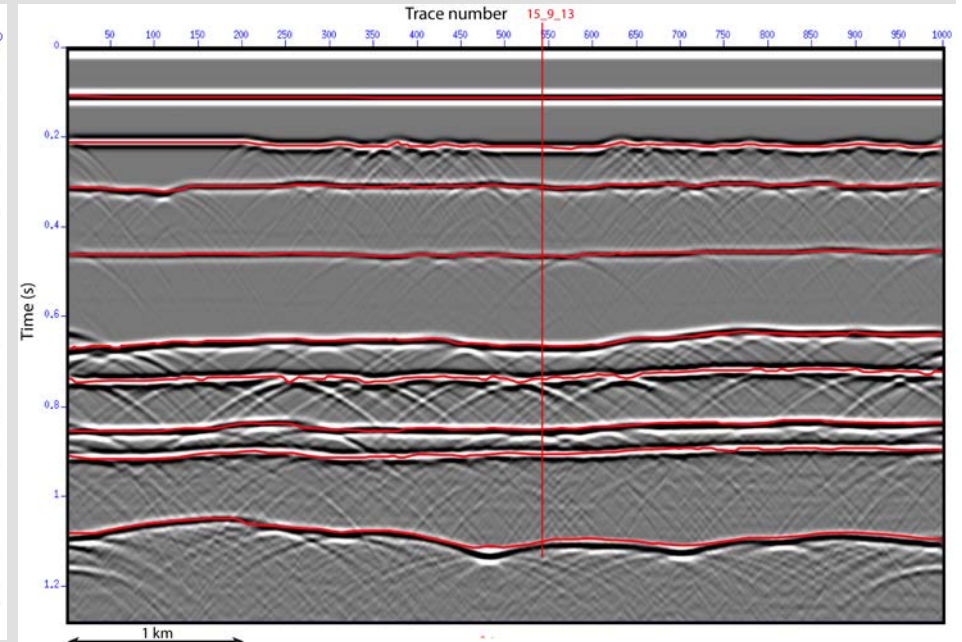
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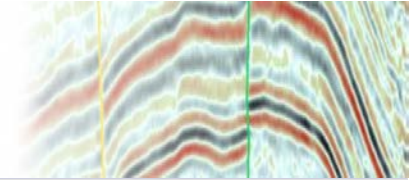
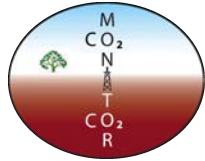
Overburden (Pre injection)



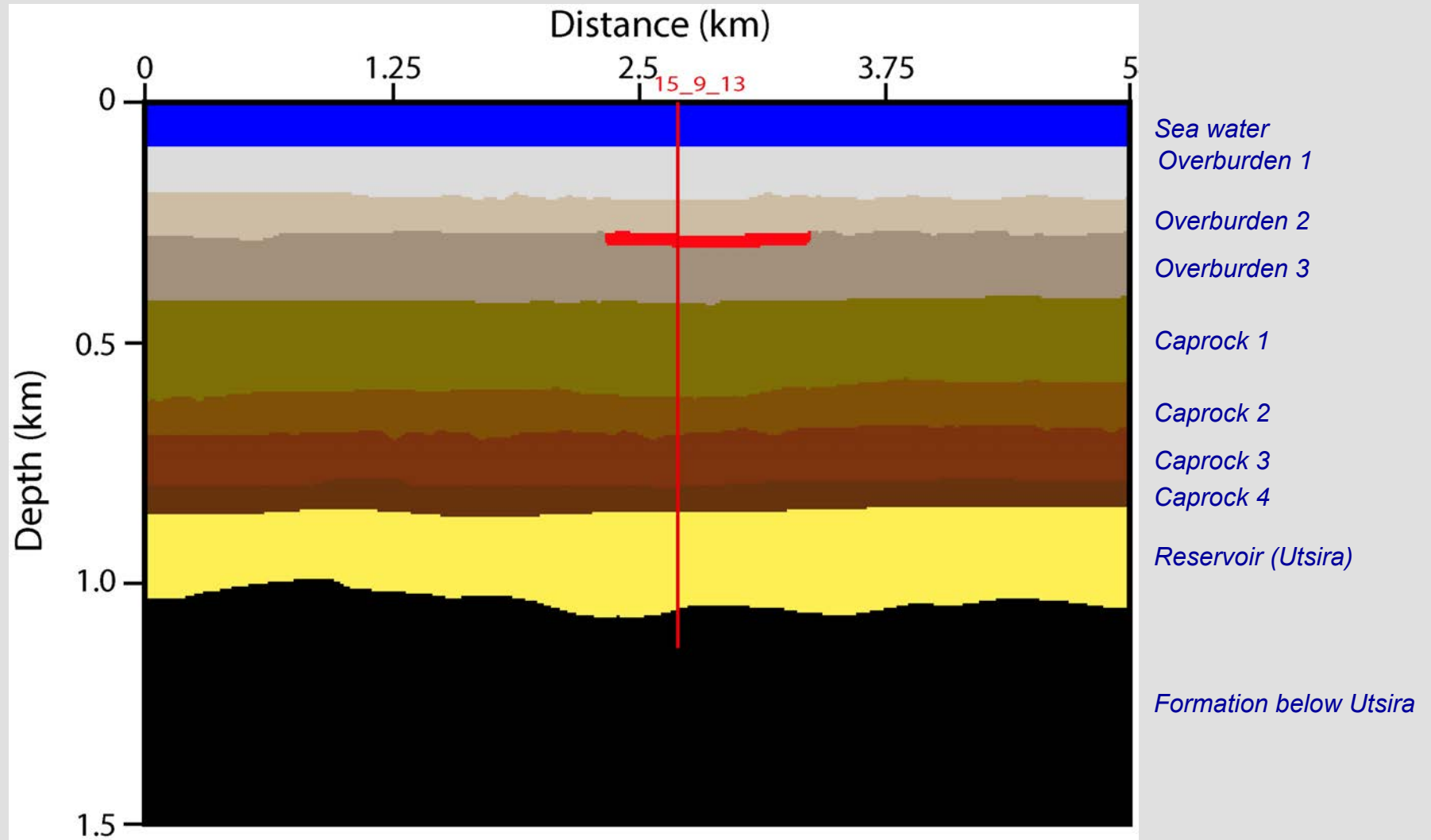
Real seismic section

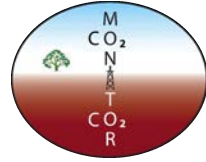


Synthetic seismic section

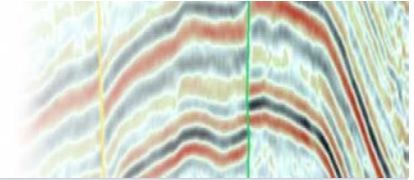


Overburden – Leakage

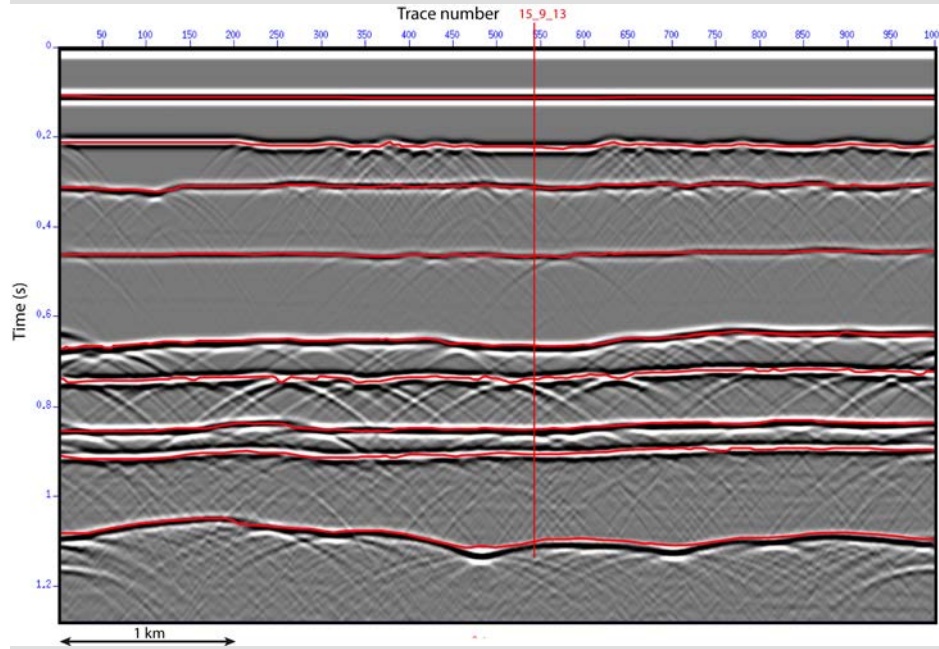




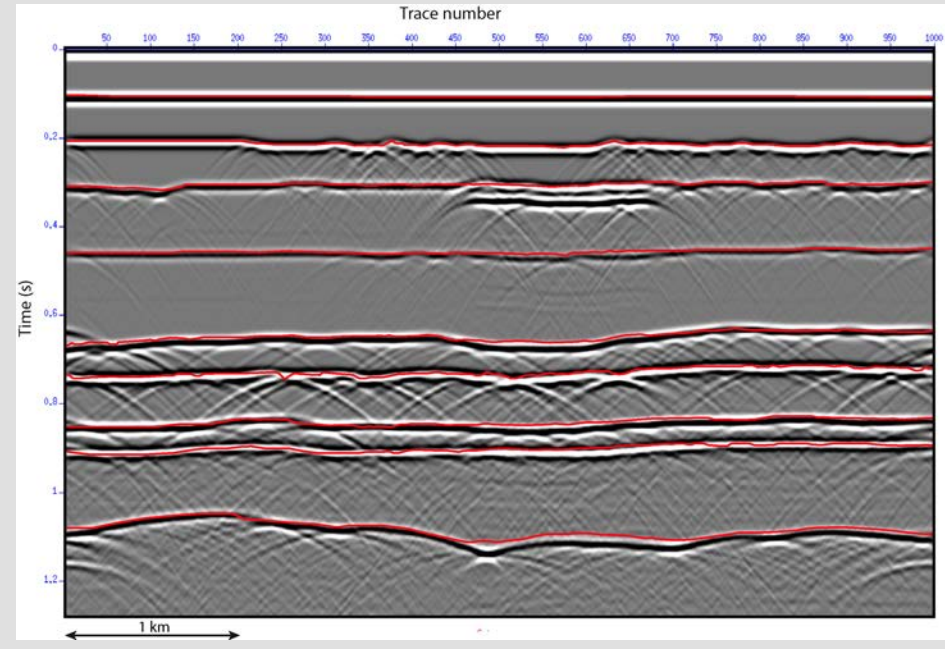
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Overburden



Synthetic seismic section pre-leakage



Synthetic seismic section post-leakage