EAGE

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GEOTHERMAL ENERGY CONFERENCE

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PANterra GEOCONSULTANTS

THE ROLE OF SEDIMENTOLOGY IN HETEROGENEOUS SHALLOW GEOTHERMAL RESERVOIRS – THE BRUSSELS SAND MEMBER

By Sven McCarthy (PanTerra)

OUTLINE
of this talk

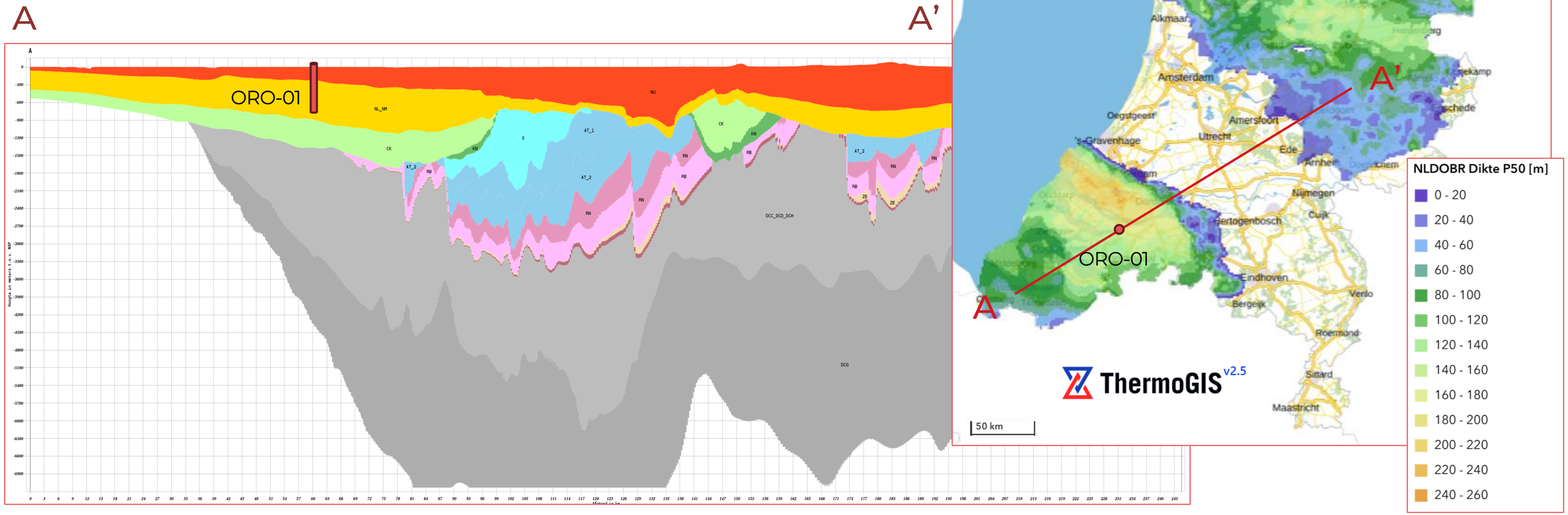
- Why the Brussels Sand
- The Oranjeoord (ORO-01) Well
- Sedimentological characteristics
- Reservoir quality
- Conclusions & considerations

Roelants Quarry (BEL) – Oligocene Kerkom Sands topped by Boom Clay

WHY THE BRUSSELS SAND MEMBER

‘a classic shaly sand’

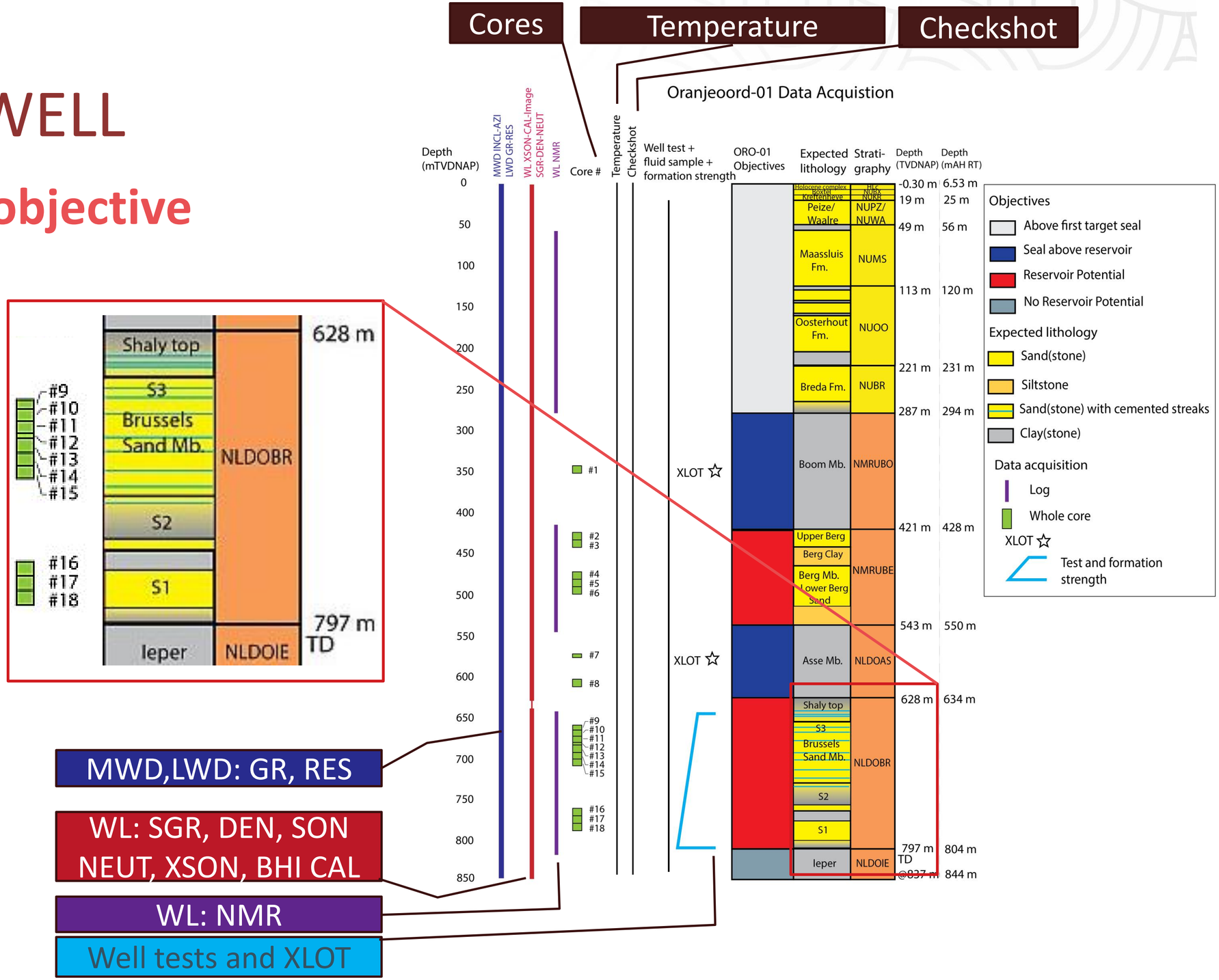
- Shallow subsurface layer at 200-1200 m depth
- One of few candidates for geothermal in SW of NL
- Little data despite numerous wells in the area



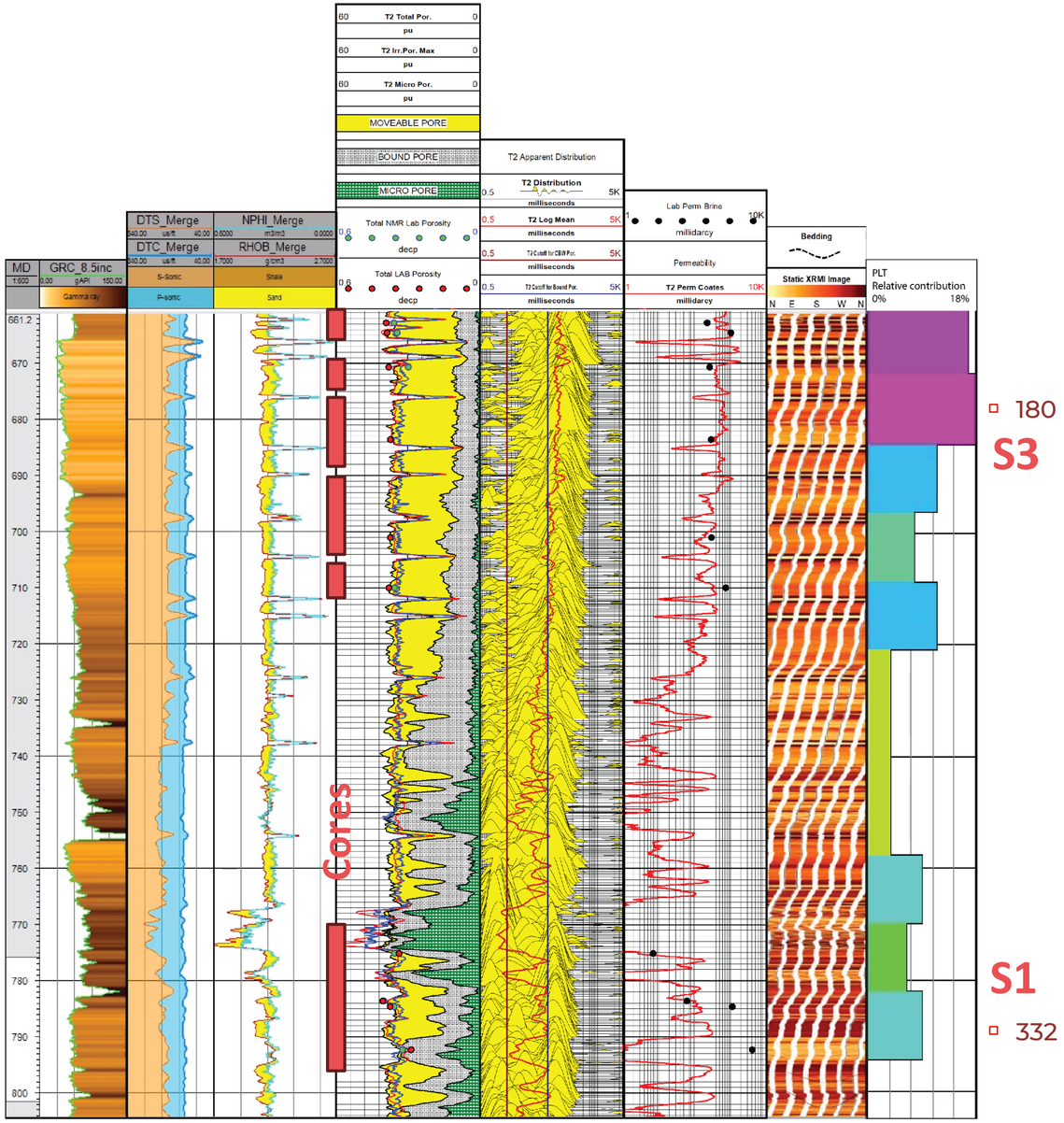
THE ORO-01 WELL

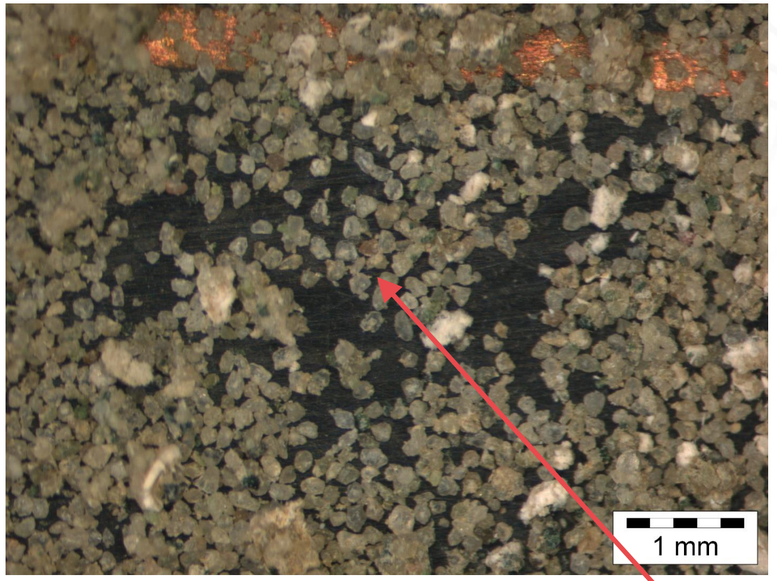
Data acquisition objective

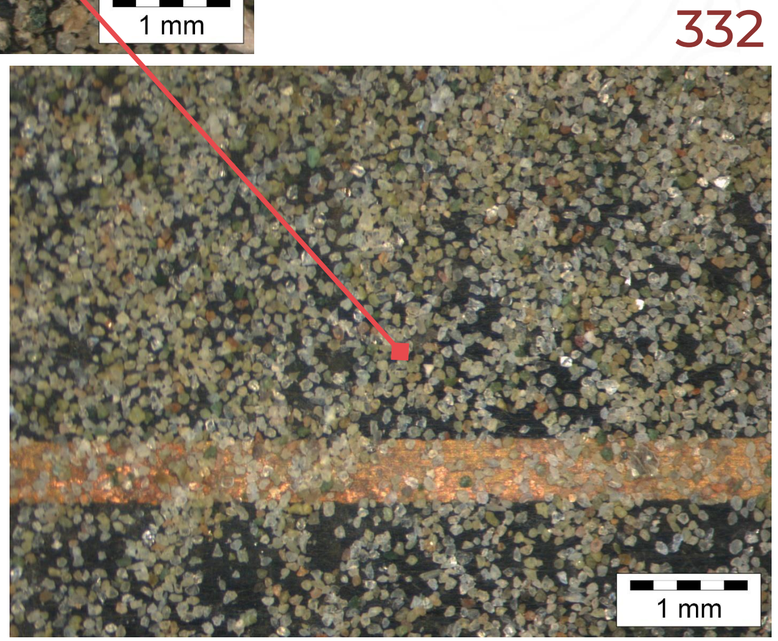
- 159 m Brussels Sand
- High average porosity 35%
- Cored sections Brussels Sand S3 and S1



CORE LOGGING – FIRST IMPRESSIONS

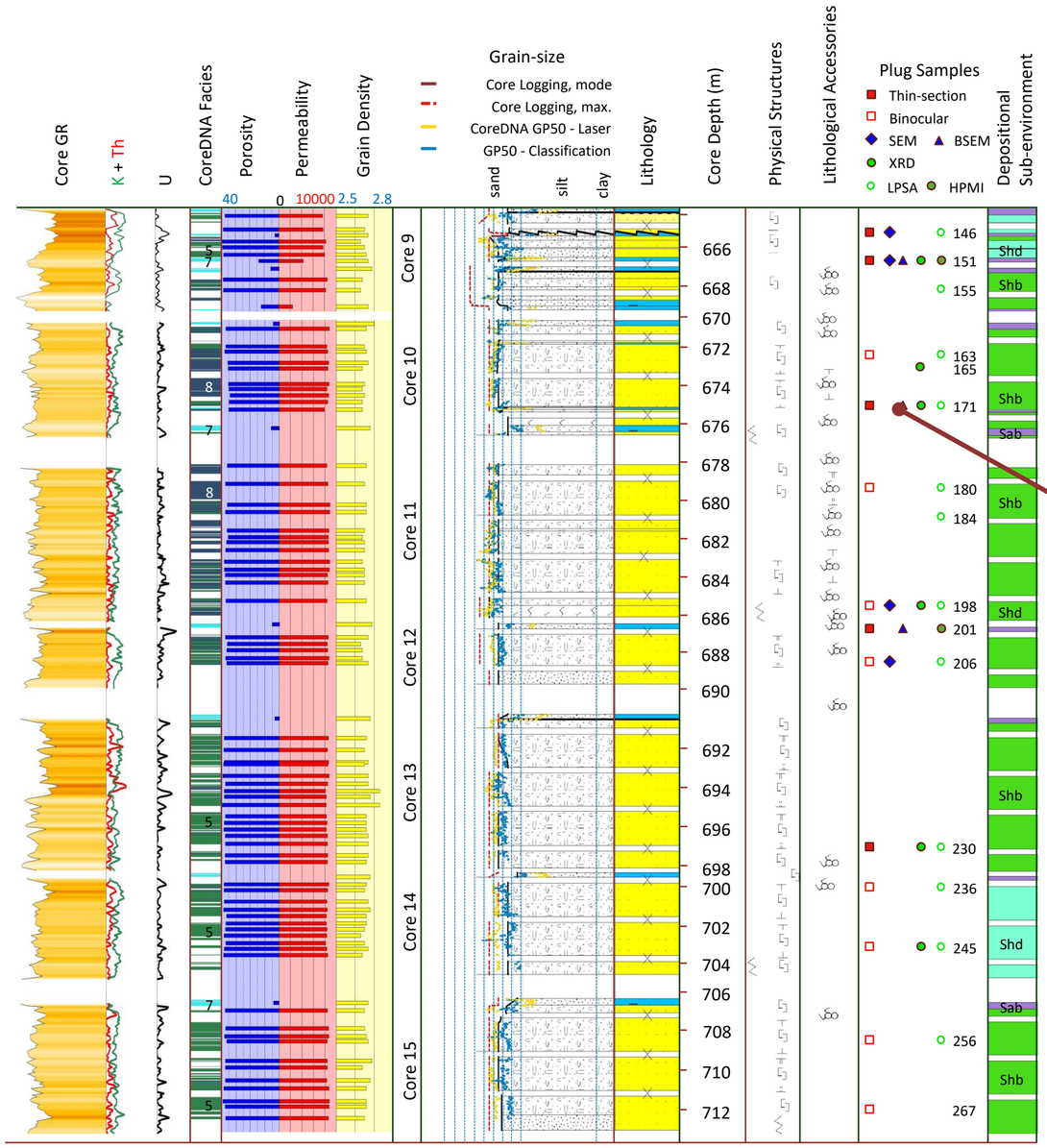




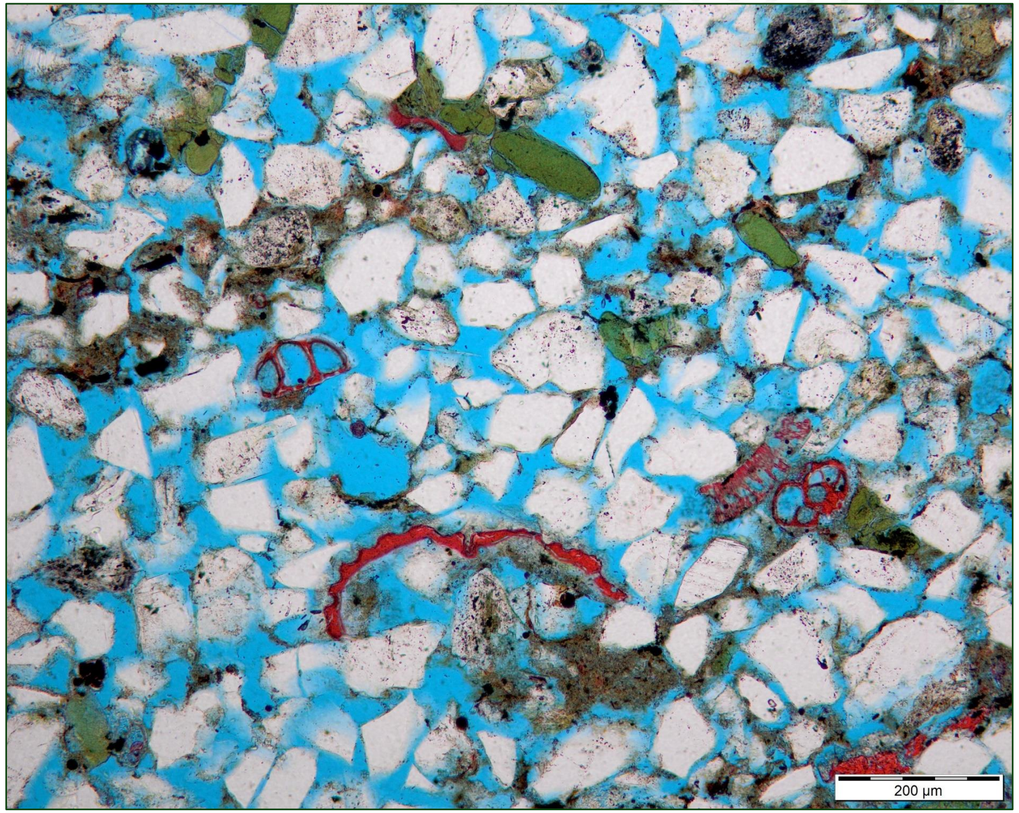


- Contrasting character Brussels Sand S3 and S1
- Overall coarsening-upward
- Poor GR control by clay
- Density and res. log spikes linked to calcite-cemented layers
- NMR linked well to perme-ability

SEDIMENTOLOGICAL CHARACTERISTICS

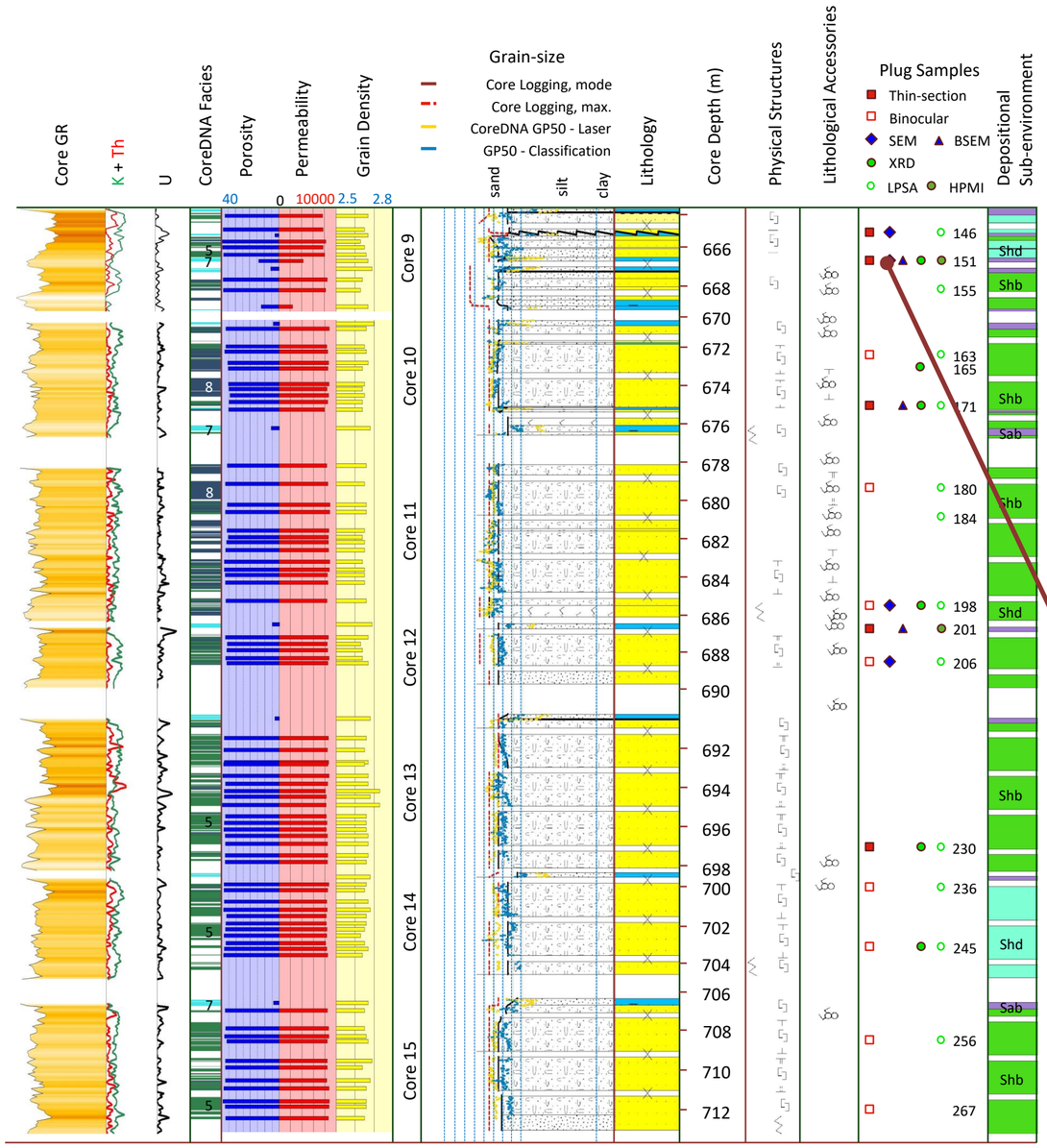


Brussels Sand S3

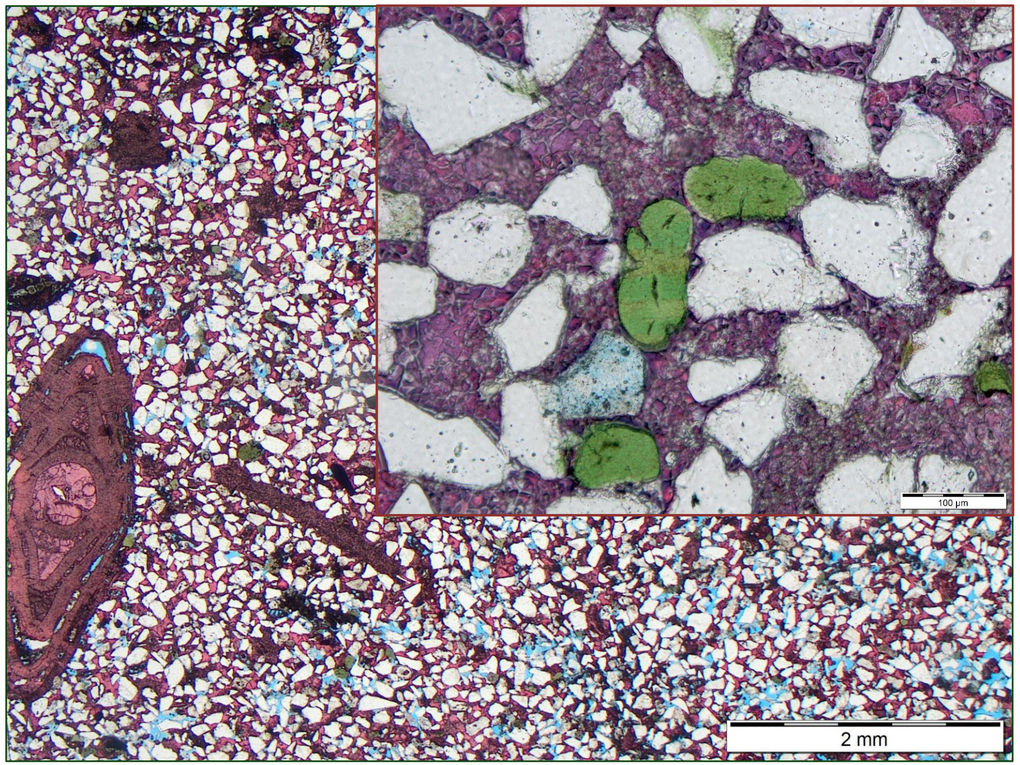


- Dominant sand facies - homogeneous, fine (lower) sand, sparse detrital clay
- Coarsening-upward trends

SEDIMENTOLOGICAL CHARACTERISTICS



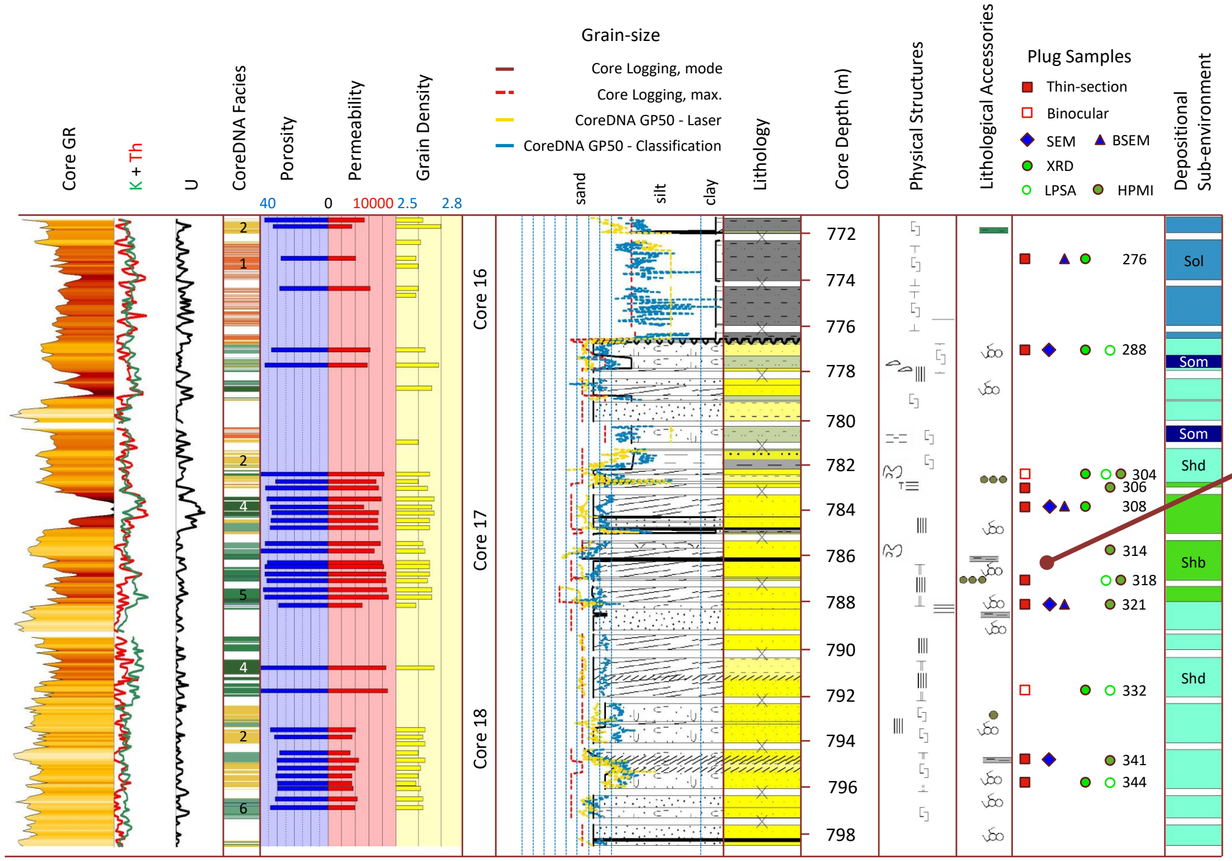
Brussels Sand S3

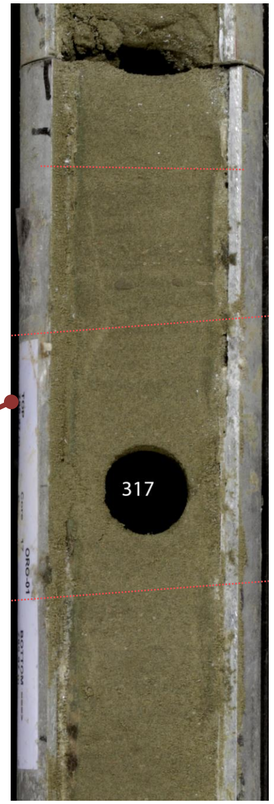


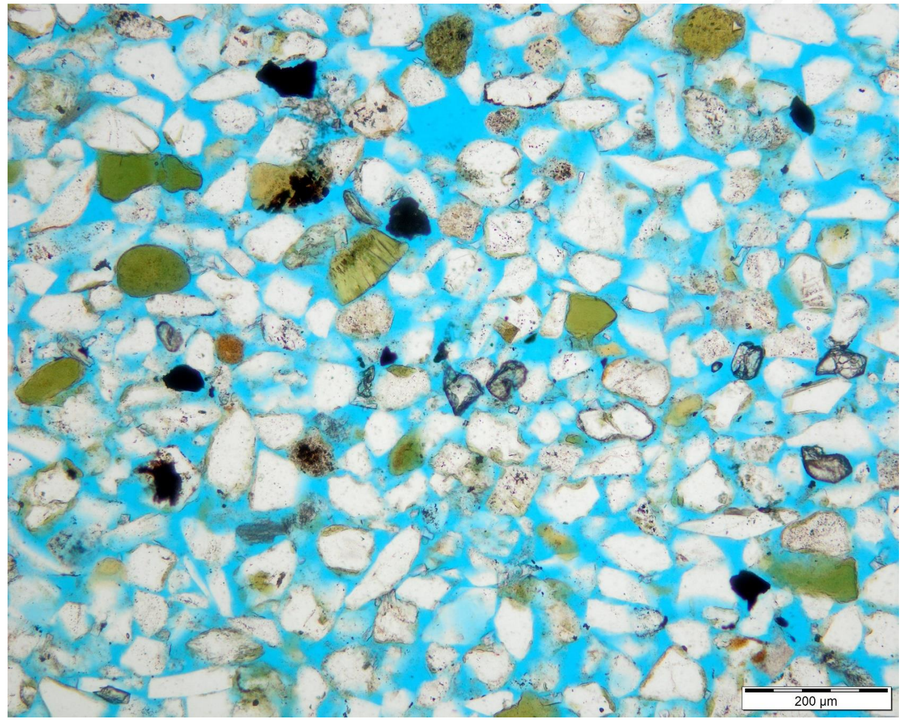
- Calcite-cemented, very fine (upper) sandstone
- Dm-thick, spaced at 5-10 m intervals
- Partly floating grains -> early, in-situ cementation

SEDIMENTOLOGICAL CHARACTERISTICS

Brussels Sand S1



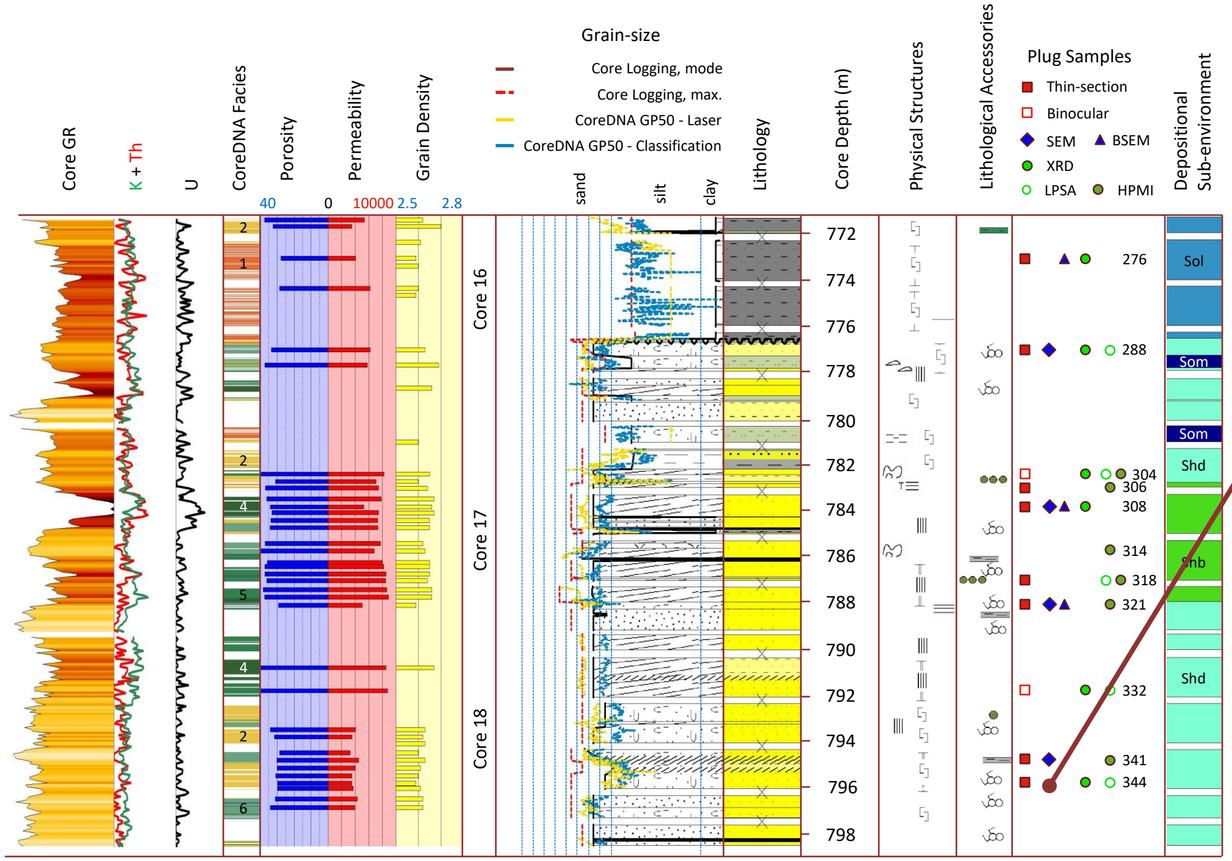


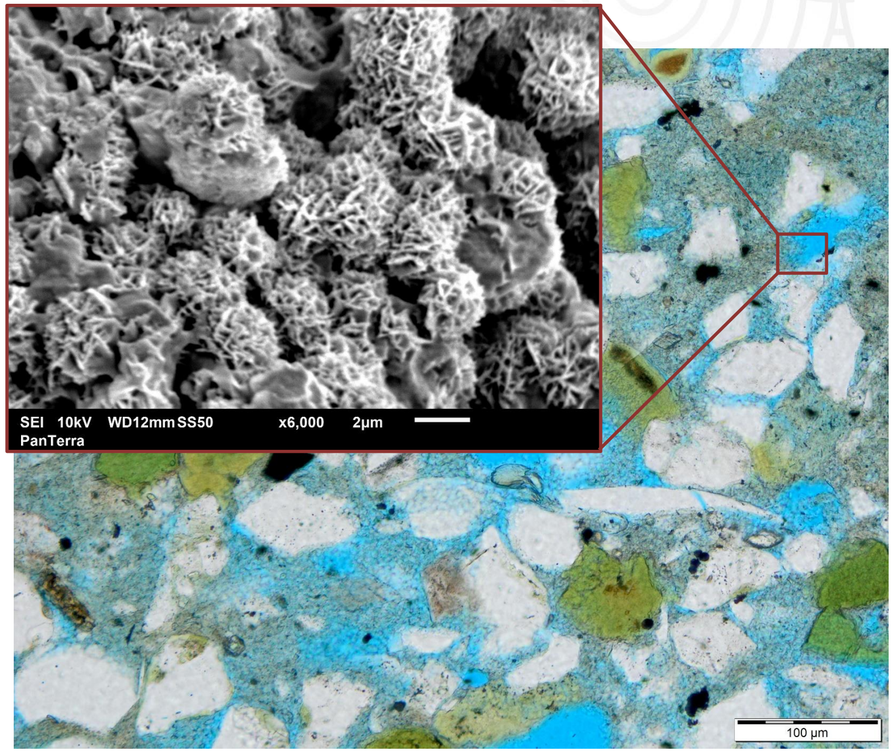


- Cross-laminated, very fine (upper) sand, sparse to common detrital clay
- Partly glauconitic

SEDIMENTOLOGICAL CHARACTERISTICS

Brussels Sand S1

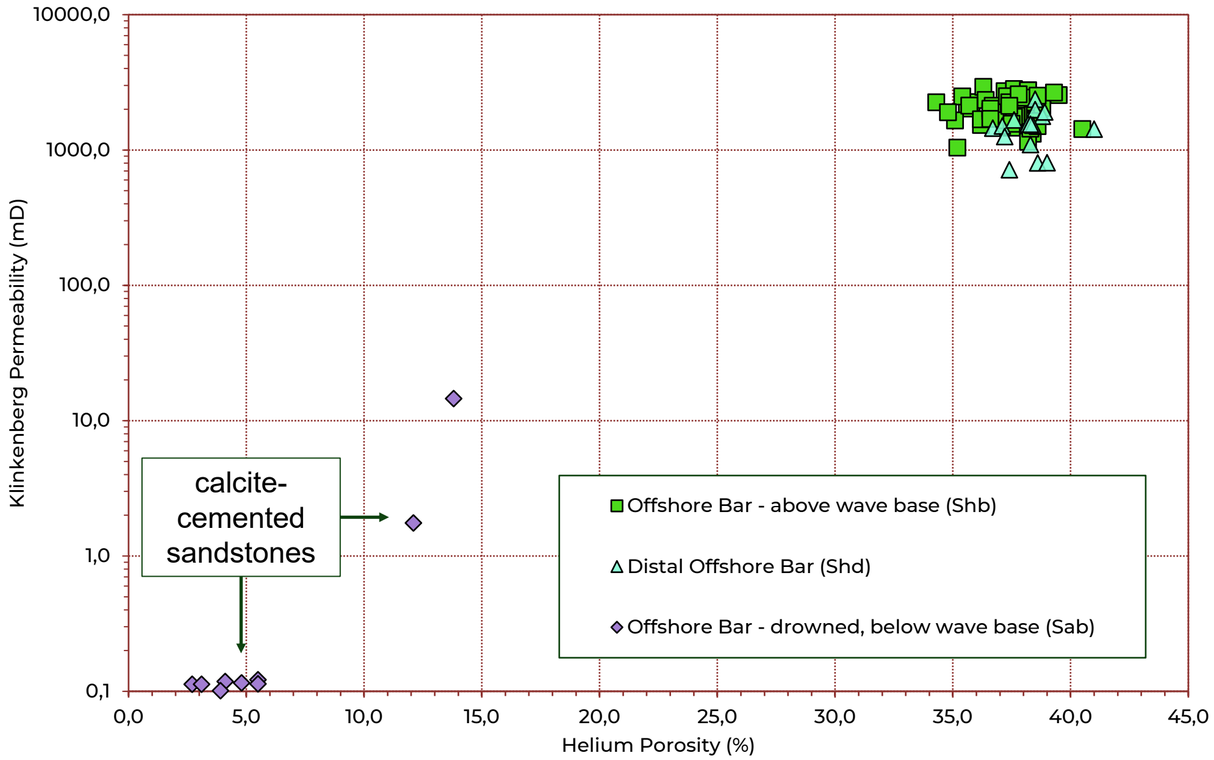




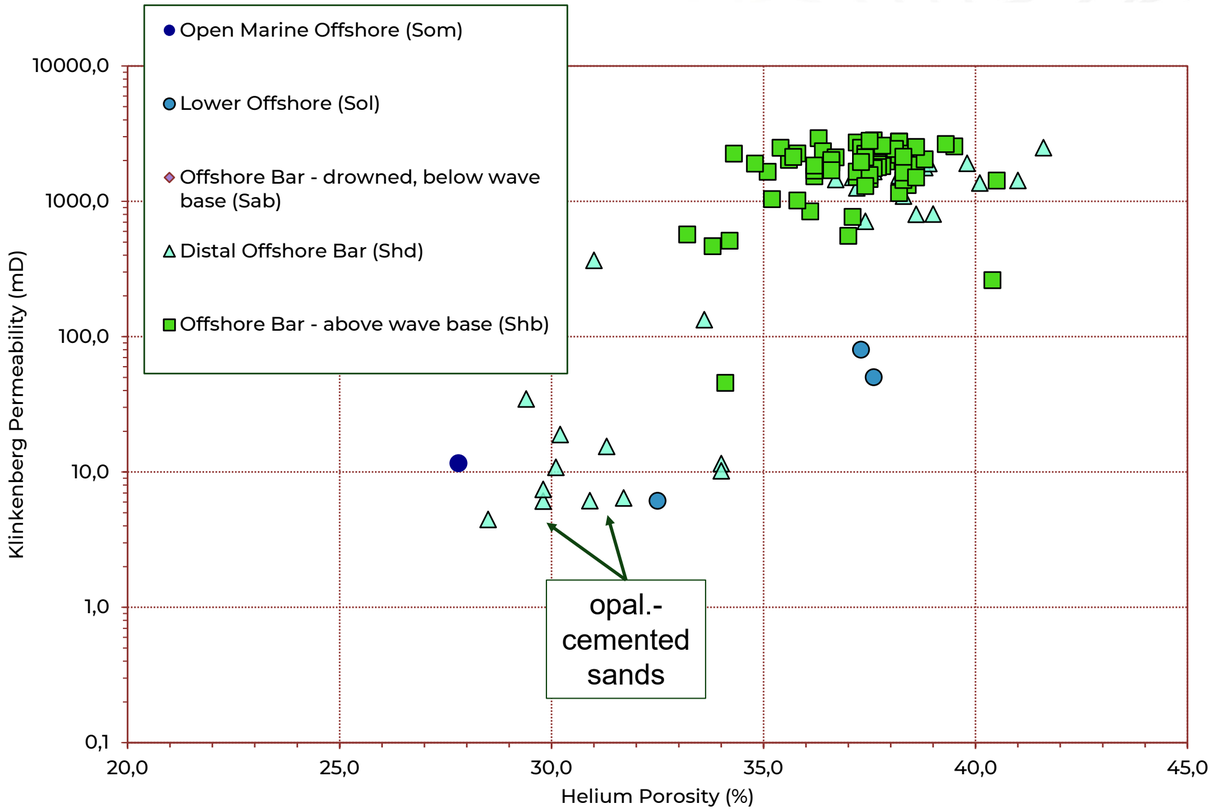
- Homogeneous, very fine (upper) sand
- Opaline silica cement

RESERVOIR QUALITY

Brussels Sand S3



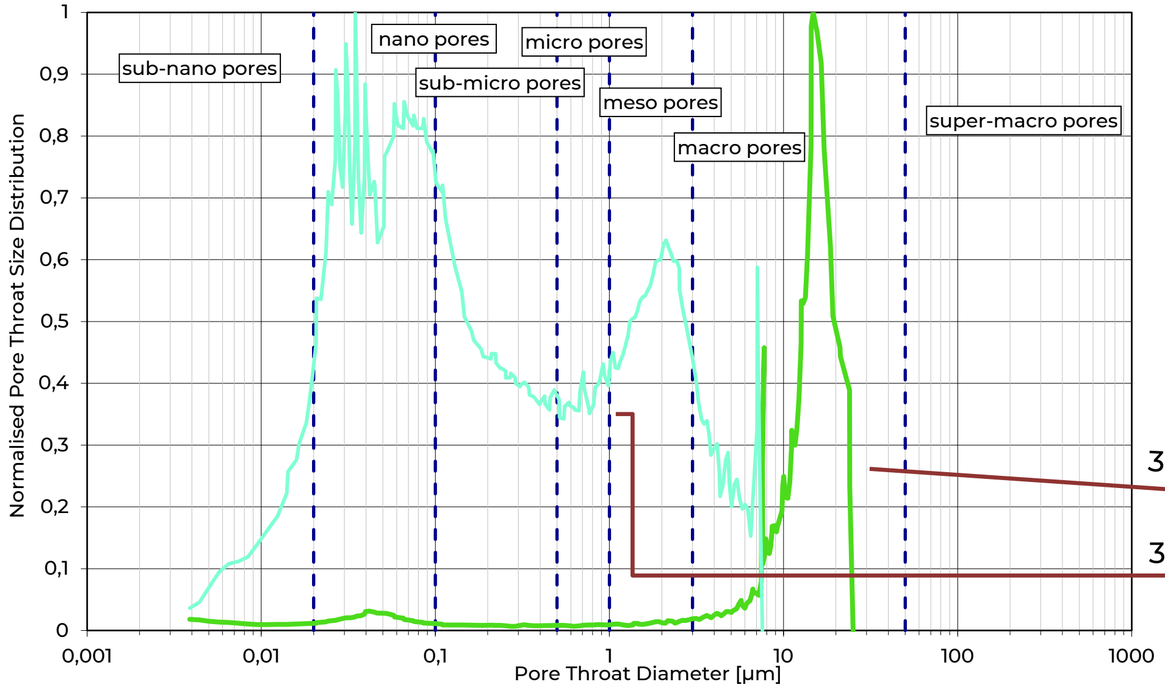
Brussels Sand S1

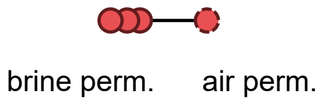


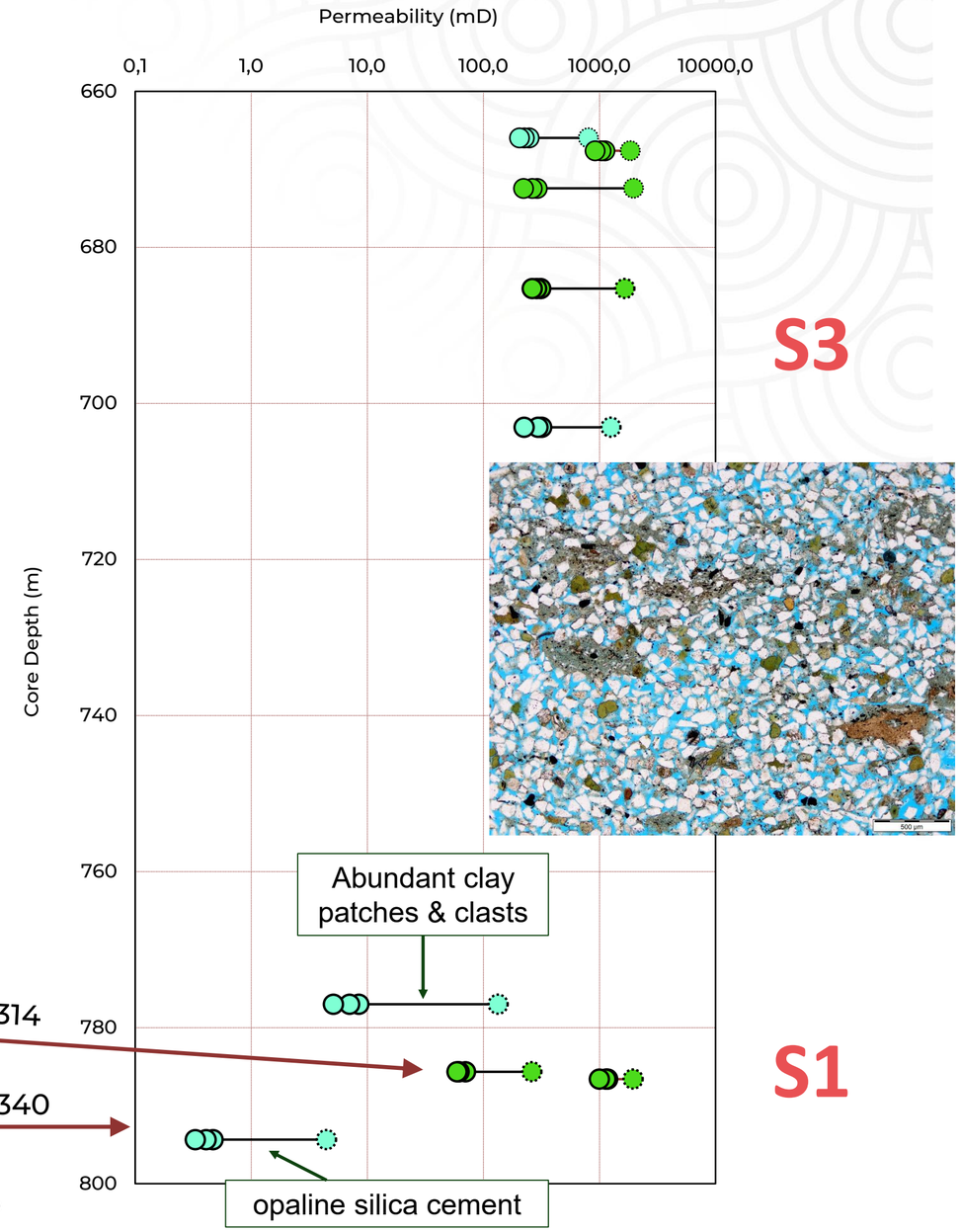
RESERVOIR QUALITY

On brine permeability

- remarkably low k_{brine}/k_{air} ratios
- Air (Klinkenberg) perm. at ambient conditions;
  brine perm. at stressed conditions
- ratio driven by pore throat size distribution – effective porosity







CONCLUSIONS

and further considerations

- **Extensive database acquired in ORO-01 Well**

- Brussels Sand S3 offers favourable and uniform properties for geothermal development
- Calcite-cemented intervals represent baffles -> to be considered for well completion

- Significantly limited geothermal energy yield possible from Brussels Sand S1
- Despite high porosity, brine permeability reduced due to detrital clay content
- Base non-reservoir, widespread opaline silica cement

THANK YOU FOR LISTENING

SCAN well data incl. ORO-01 report available shortly on NLOG.nl and scanaardwarmte.nl