GEOTHERMICA

SEISMIC REPROCESSING FOR SHALLOW STRUCTURE OF AQUIFERS

BORIS BOULLENGER, STEFAN CARPENTIER, SJEF MEEKES

heatstore

High Temperature Underground Thermal Energy Storage

CITATION AND DISCLAIMER

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GEOTHERMICA

HEATSTORE (170153-4401) is one of nine projects under the GEOTHERMICA – ERA NET Cofund aimed at accelerating the uptake of geothermal energy by 1) advancing and integrating different types of underground thermal energy storage (UTES) in the energy system, 2) providing a means to maximise geothermal heat production and optimise the business case of geothermal heat production doublets, 3) addressing technical, economic, environmental, regulatory and policy aspects that are necessary to support efficient and cost-effective deployment of UTES technologies in Europe. The three-year project will stimulate a fast-track market uptake in Europe, promoting development from demonstration phase to commercial deployment within two to five years, and provide an outlook for utilisation potential towards 2030 and 2050.

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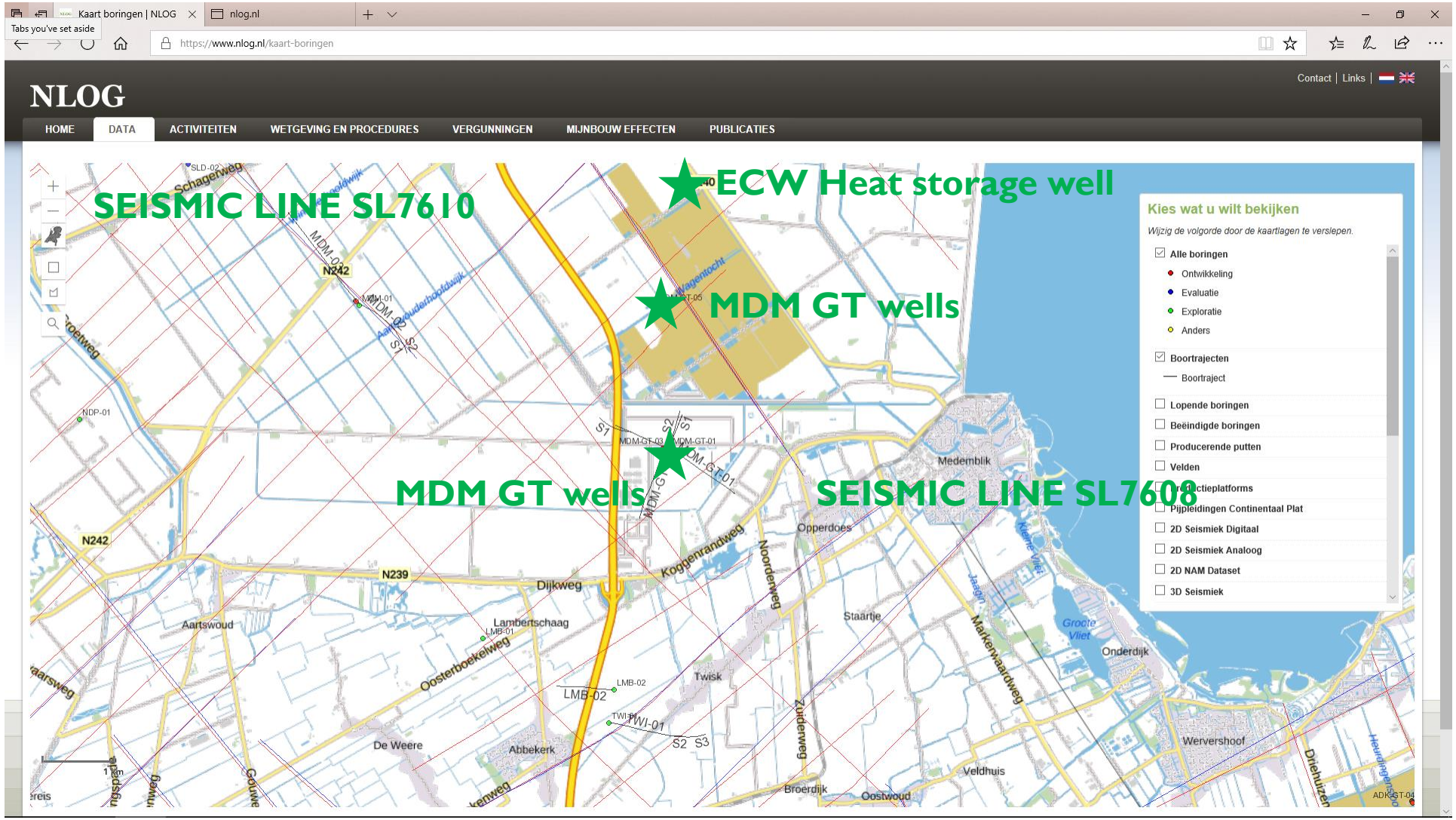
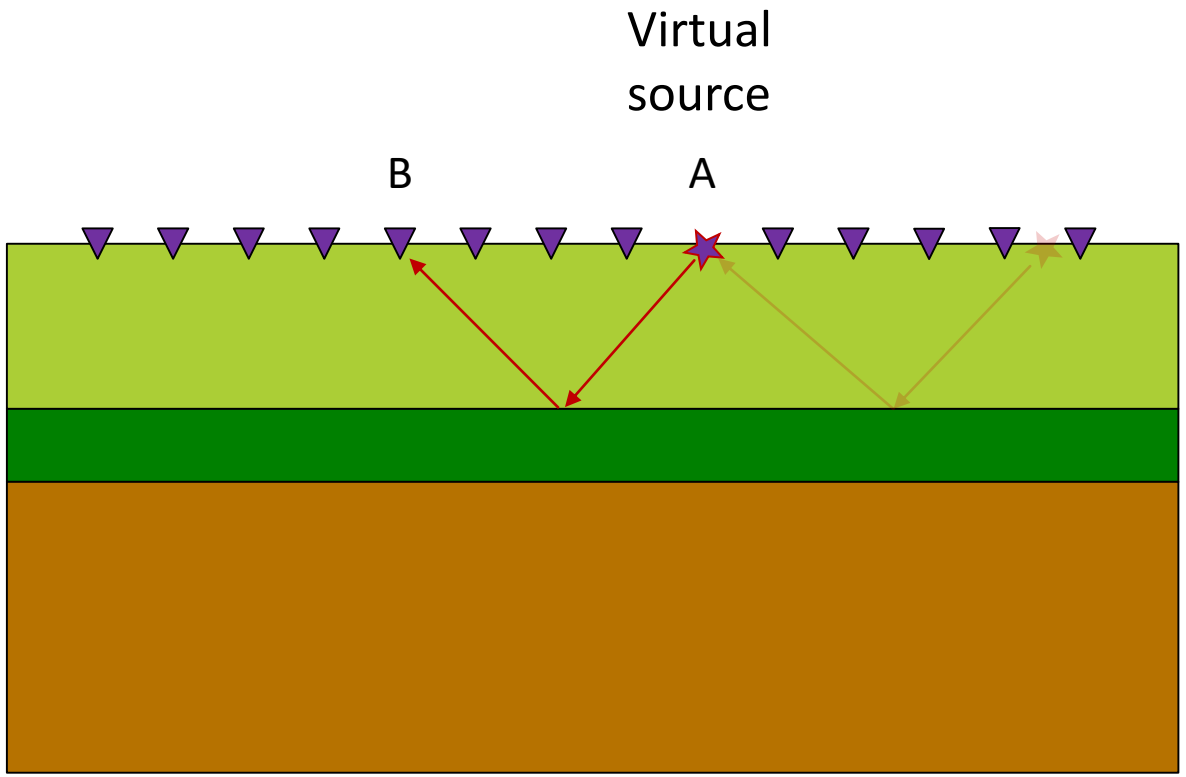
WORKFLOW FOR FAST-TRACK REPROCESSING OF SEISMIC DATA

- **Problem**: Many ATES/UTES/HT-ATES sites encounter deviating hydrogeological parameters after drilling the first well, due to inaccuracy of existing hydrogeological models
- **Action**: Make more use of seismic data in sparse data regions and develop workflow for fast-track re-processing of existing seismic data. Especially use new seismic methods like broadband and ACSI
- **Result**: The MS1.3 Reprocessing work was a geophysical/technical success, but not a complete geological/heatstorage success. Some interpreted horizons in the reprocessed data are more accurately predicting the revised/right well markers then REGIS2, but some other interpreted horizons are predicting the old, wrong markers

LOCATION ECW HEAT STORAGE



METHOD: SEISMIC REFLECTION INTERFEROMETRY ACRONYM ACSI



Cross-correlation of signals recorded at **A** and **B**

turns **multiple reflections** into (pseudo) **primary reflections**
turns **receivers** into **virtual sources**

METHOD: NEW SL7608 SEISMIC LINE INTERFEROMETRIC REPROCESSING FLOW, CONVENTIONAL AND ACSI

- Read data, add geometry
- First break picking
- Top mute of first break and above
- Refraction statics
- Bandpass filtering 8-12-120-150
- Amplitude scaling, Sph. Div. + offset weighted
- Data/trace editing/Q.C. removing bad samples
- Spectral whitening
- Airwave attenuation

Pre-processing

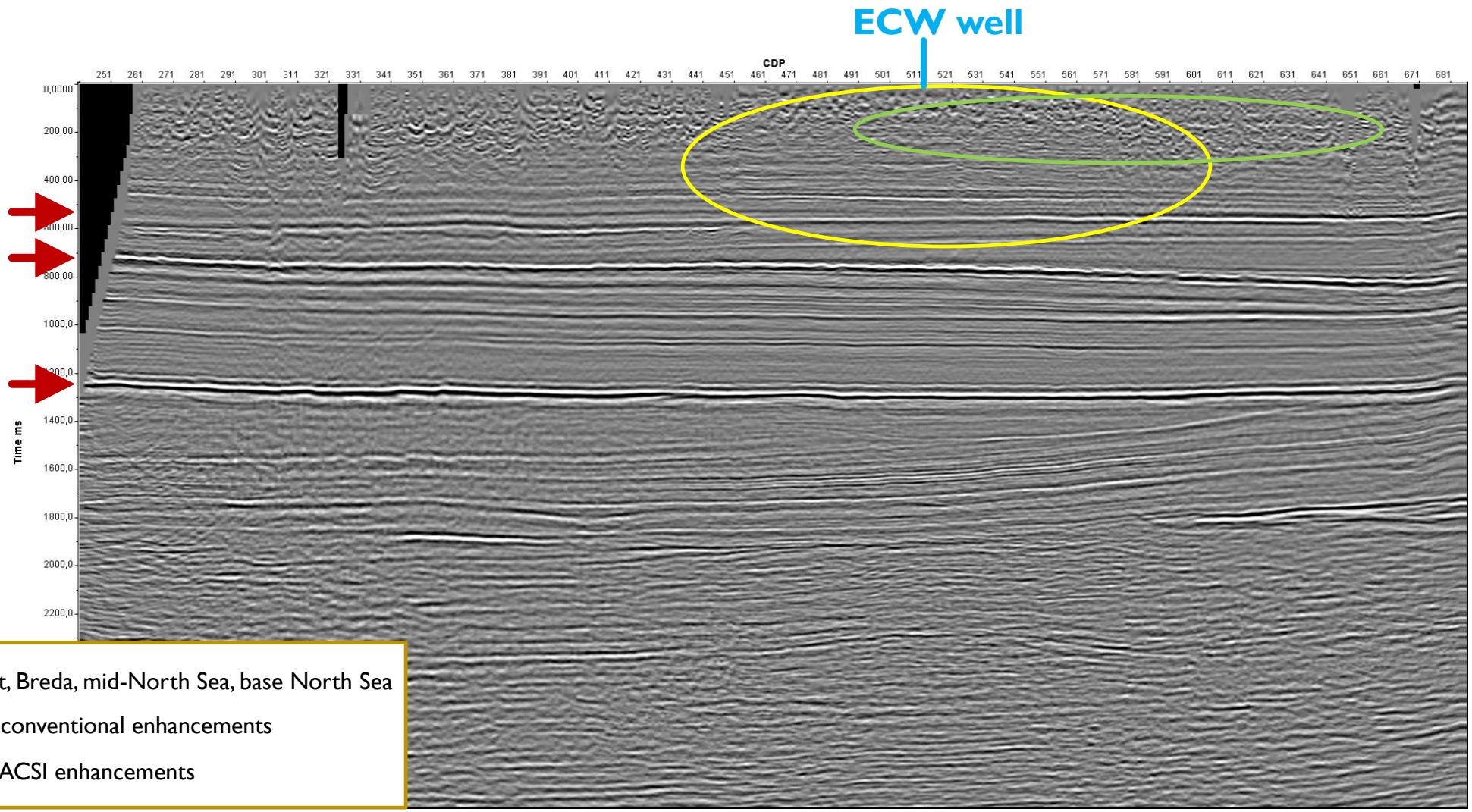
- Virtual shot cross-correlation 0-2 seconds window, kill zero-offset traces

ACSI

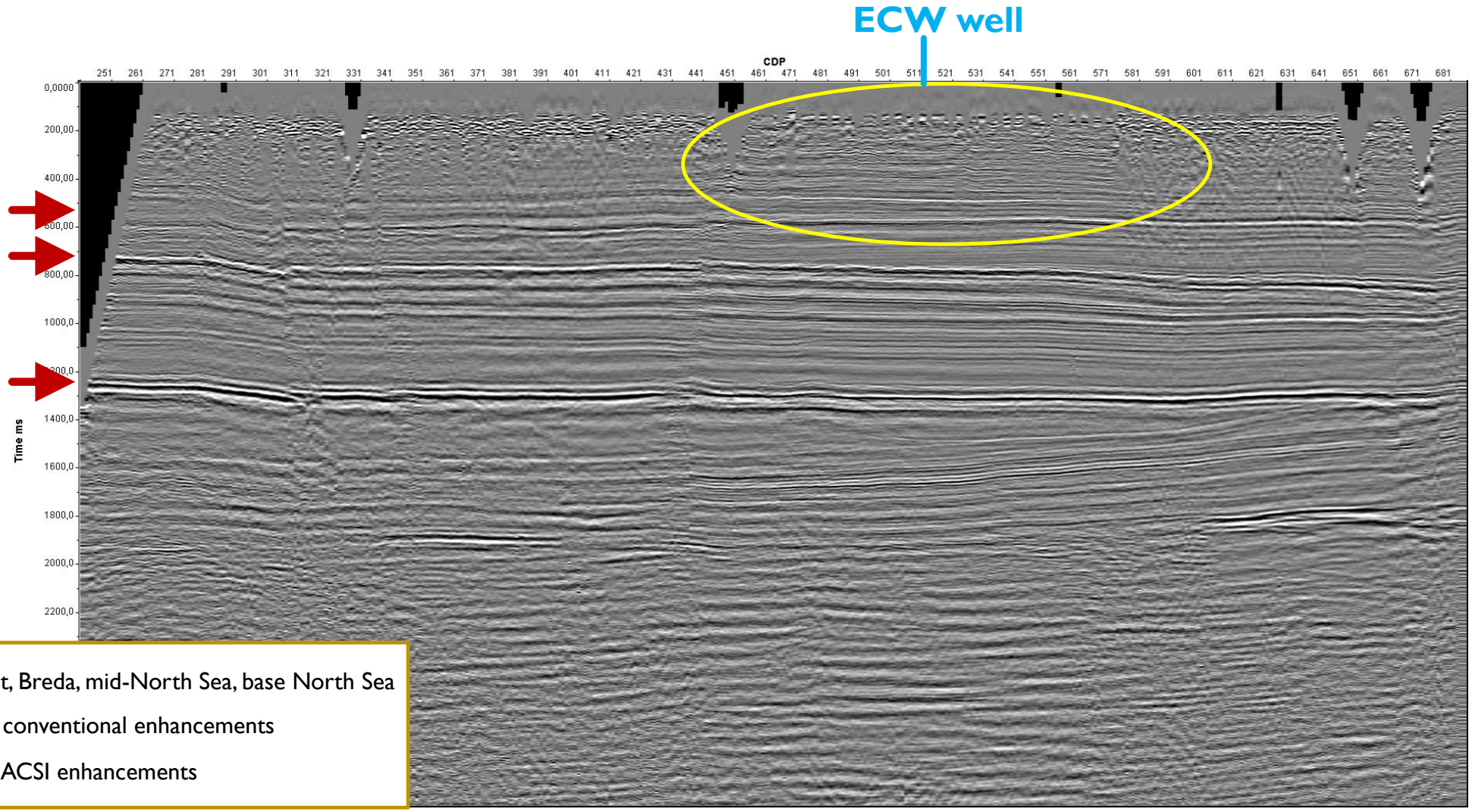
- Bandpass filtering 20-30-100-120
- Trace balancing + AGC
- K-filter of 0.7 and above
- NLM/SVDfilt/Fxdecon denoising

Post-processing

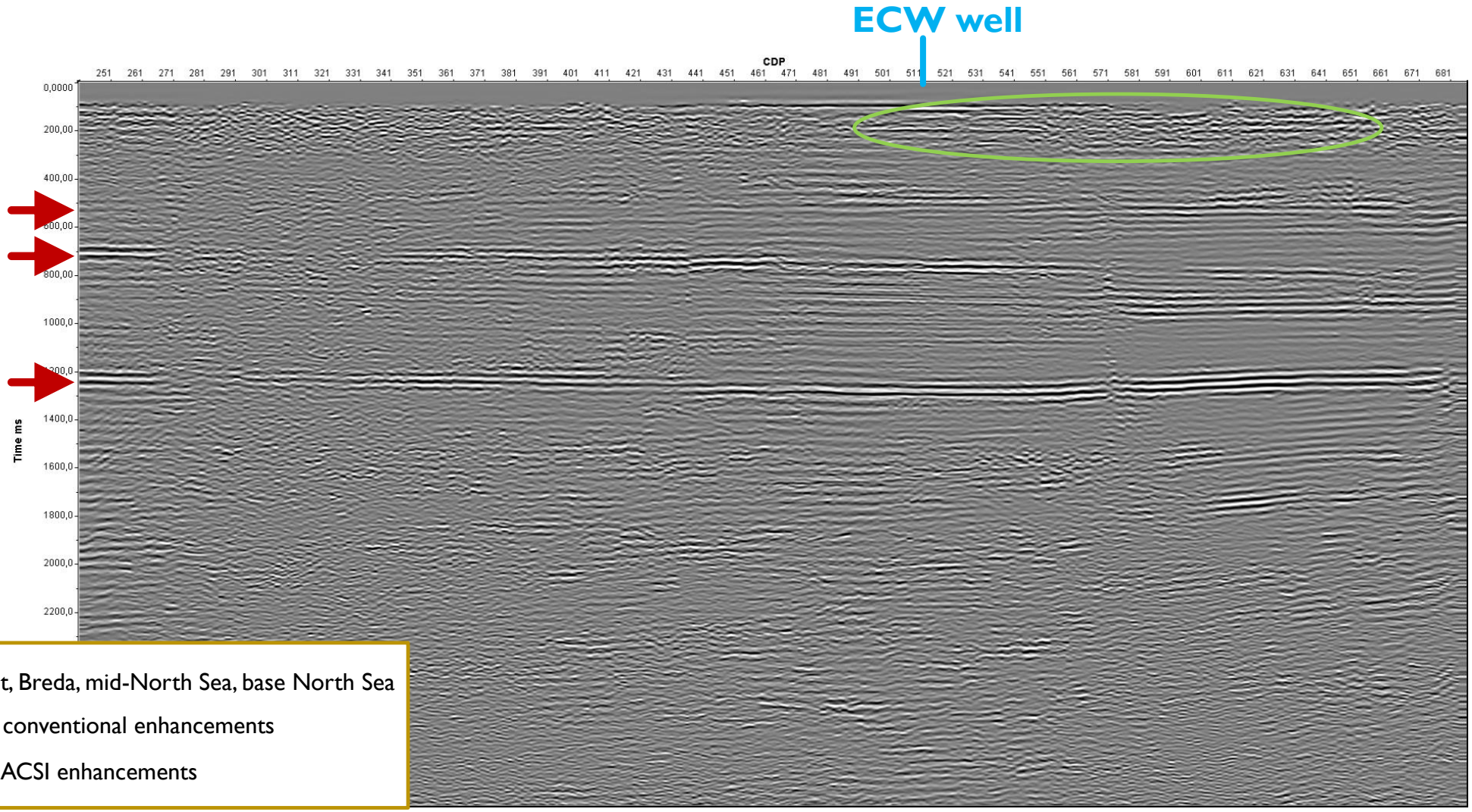
RESULTS: SL7608 ORIGINAL MIGRATED STACK



RESULTS: 7608 CONVENTIONAL REPROCESSED STACK



RESULTS: 7608 ACSI REPROCESSED STACK

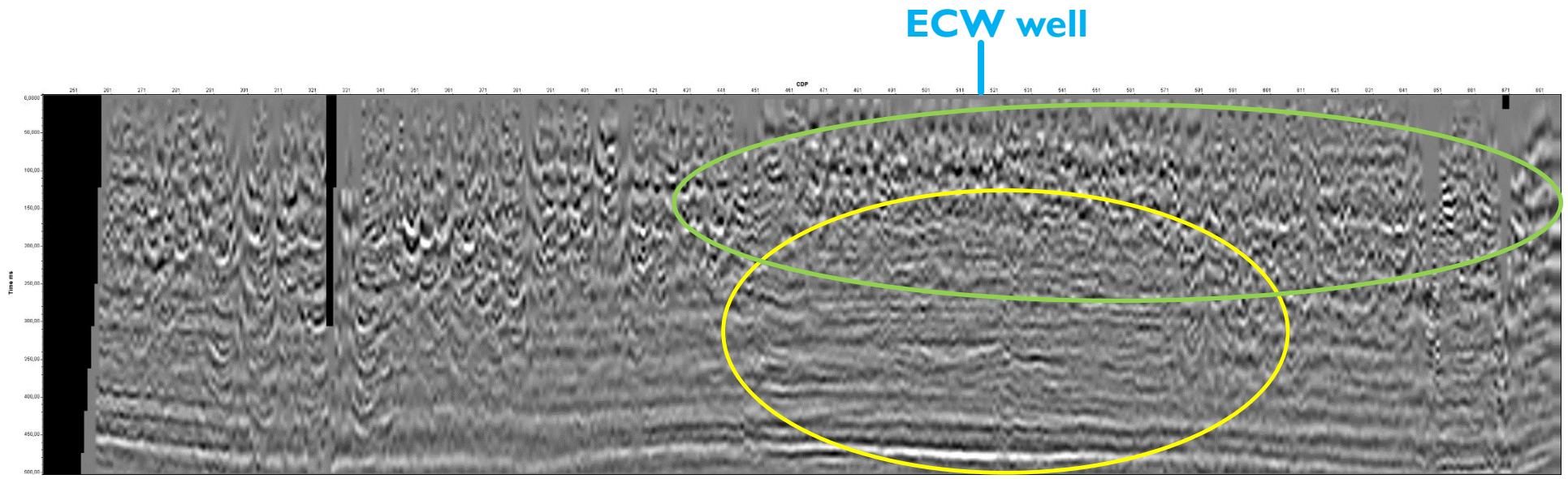


RESULTS: 7608 ACSI REPROCESSED STACK

Major horizons Oosterhout, Breda, mid-North Sea, base North Sea

Area of interest with most conventional enhancements

Area of interest with most ACSI enhancements

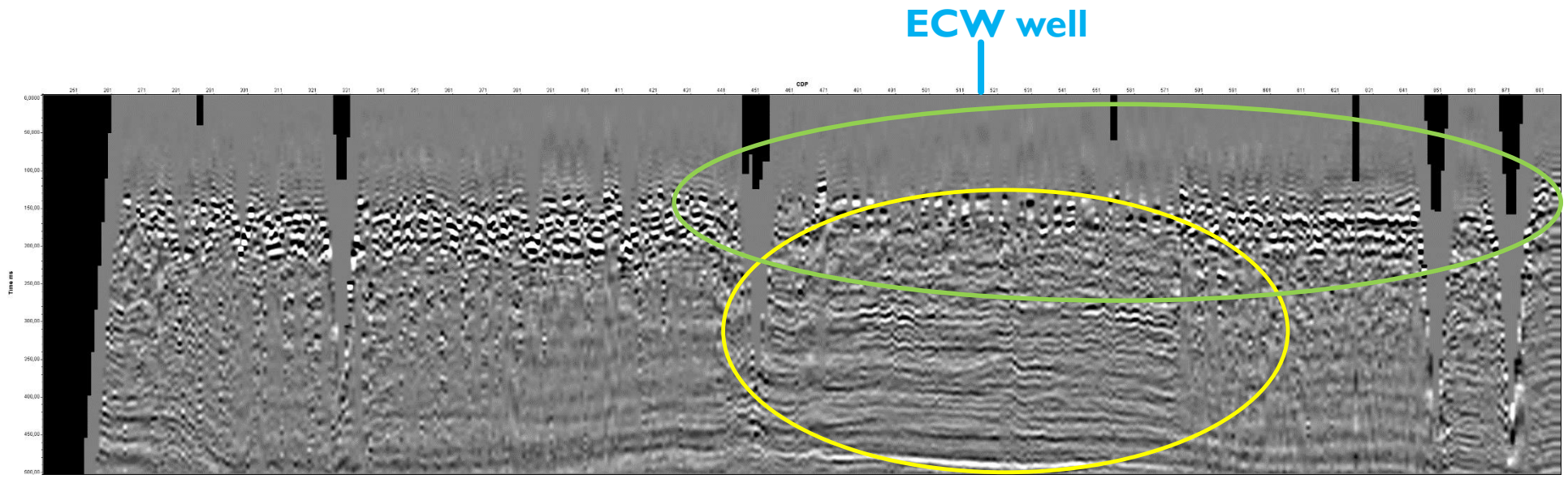


RESULTS: 7608 CONVENTIONAL REPROCESSED STACK

Major horizons Oosterhout, Breda, mid-North Sea, base North Sea

Area of interest with most conventional enhancements

Area of interest with most ACSI enhancements

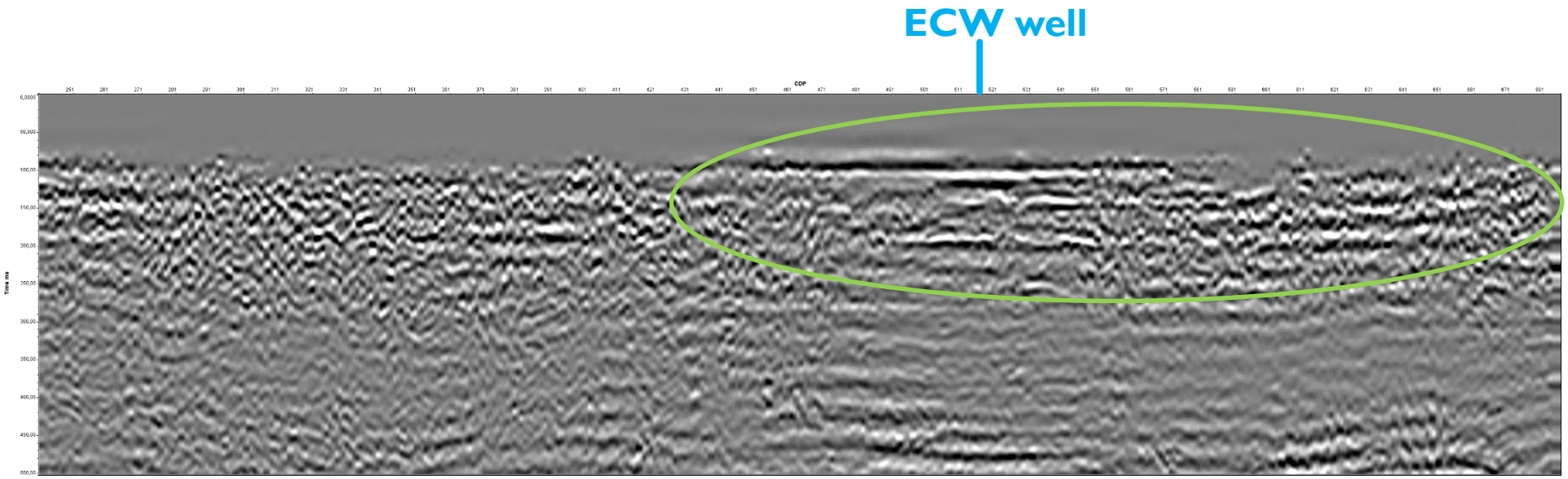


RESULTS: 7608 ACSI REPROCESSED STACK

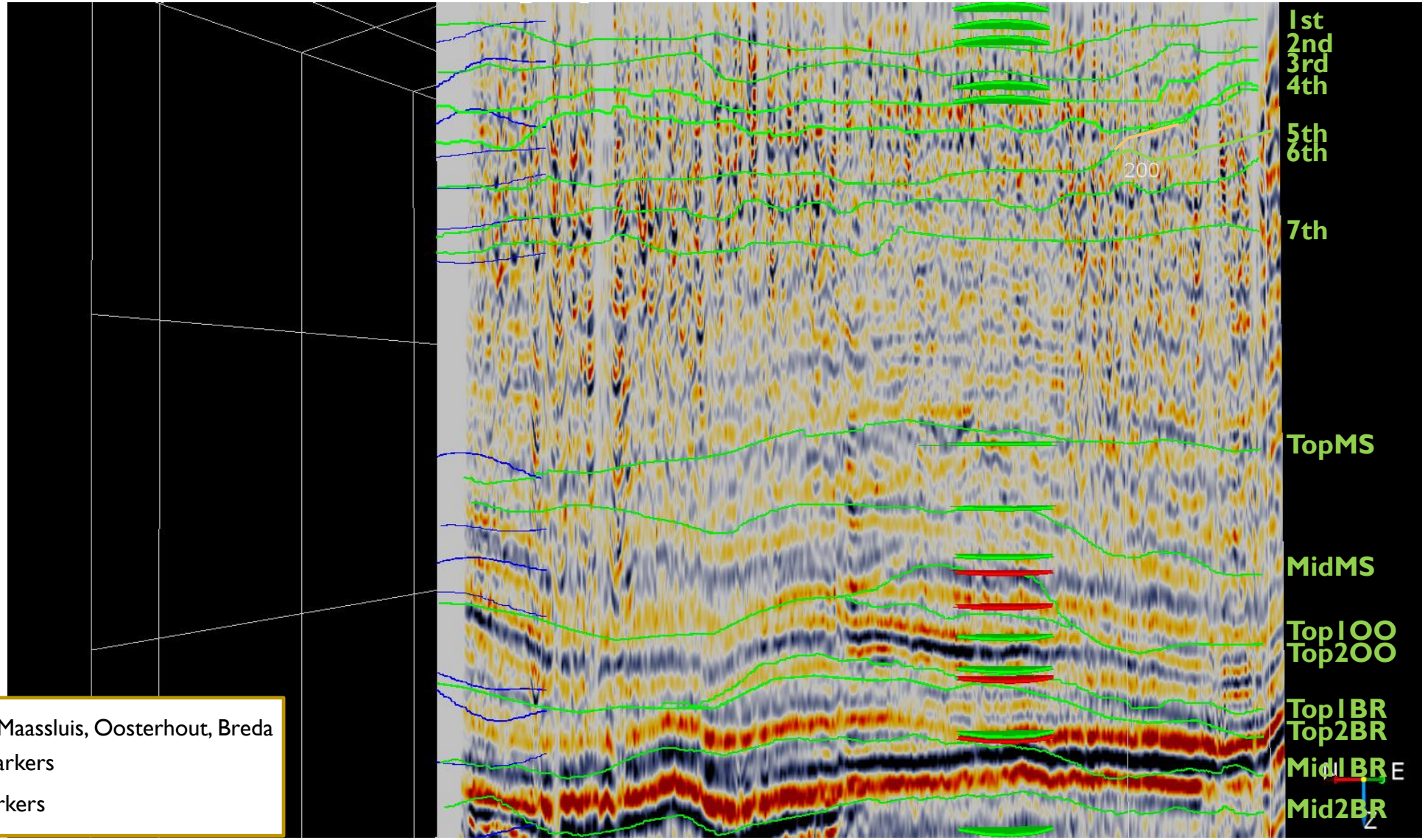
Major horizons Oosterhout, Breda, mid-North Sea, base North Sea

Area of interest with most conventional enhancements

Area of interest with most ACSI enhancements

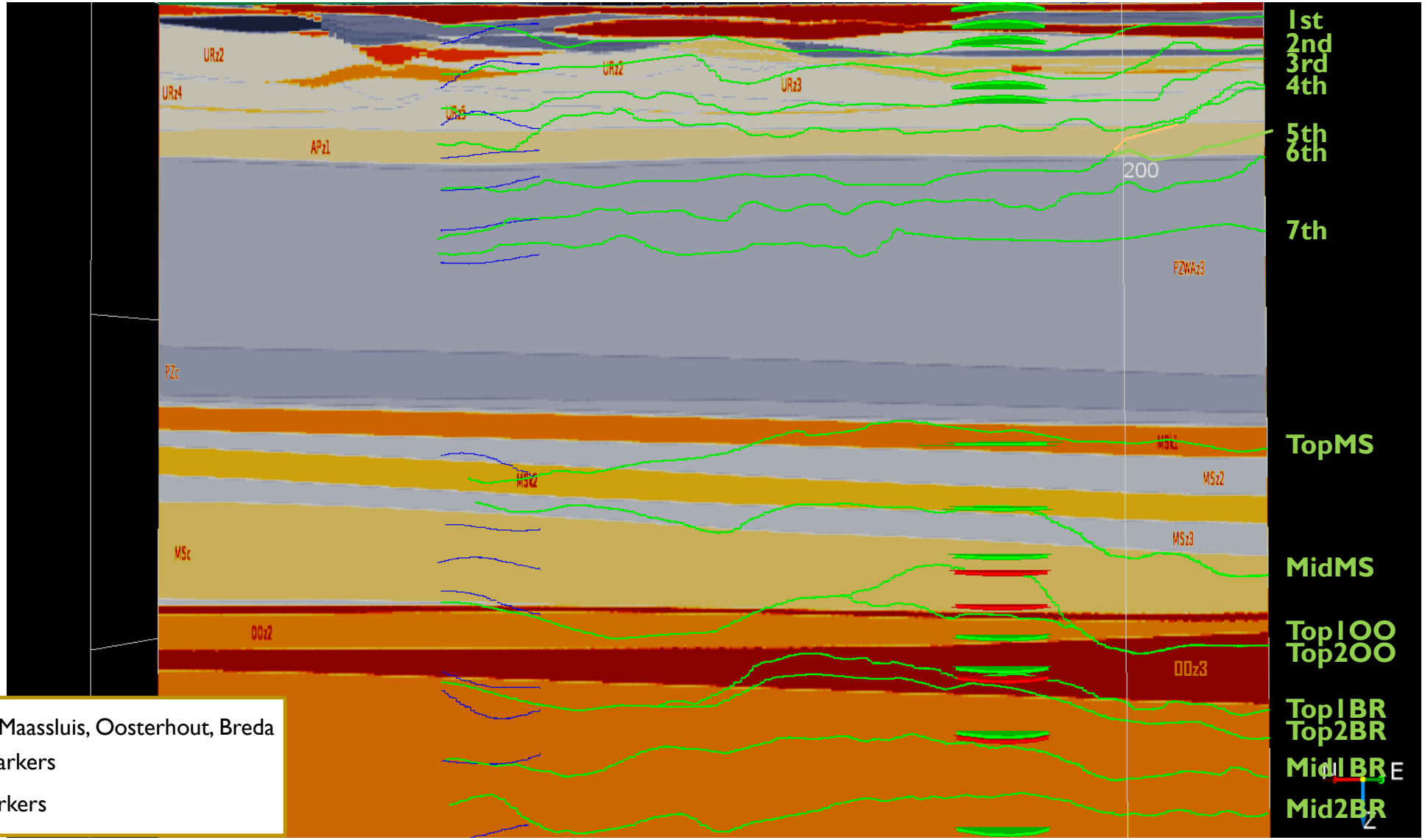


RESULTS: INTERPRETED 7608 ACSI REPROCESSED



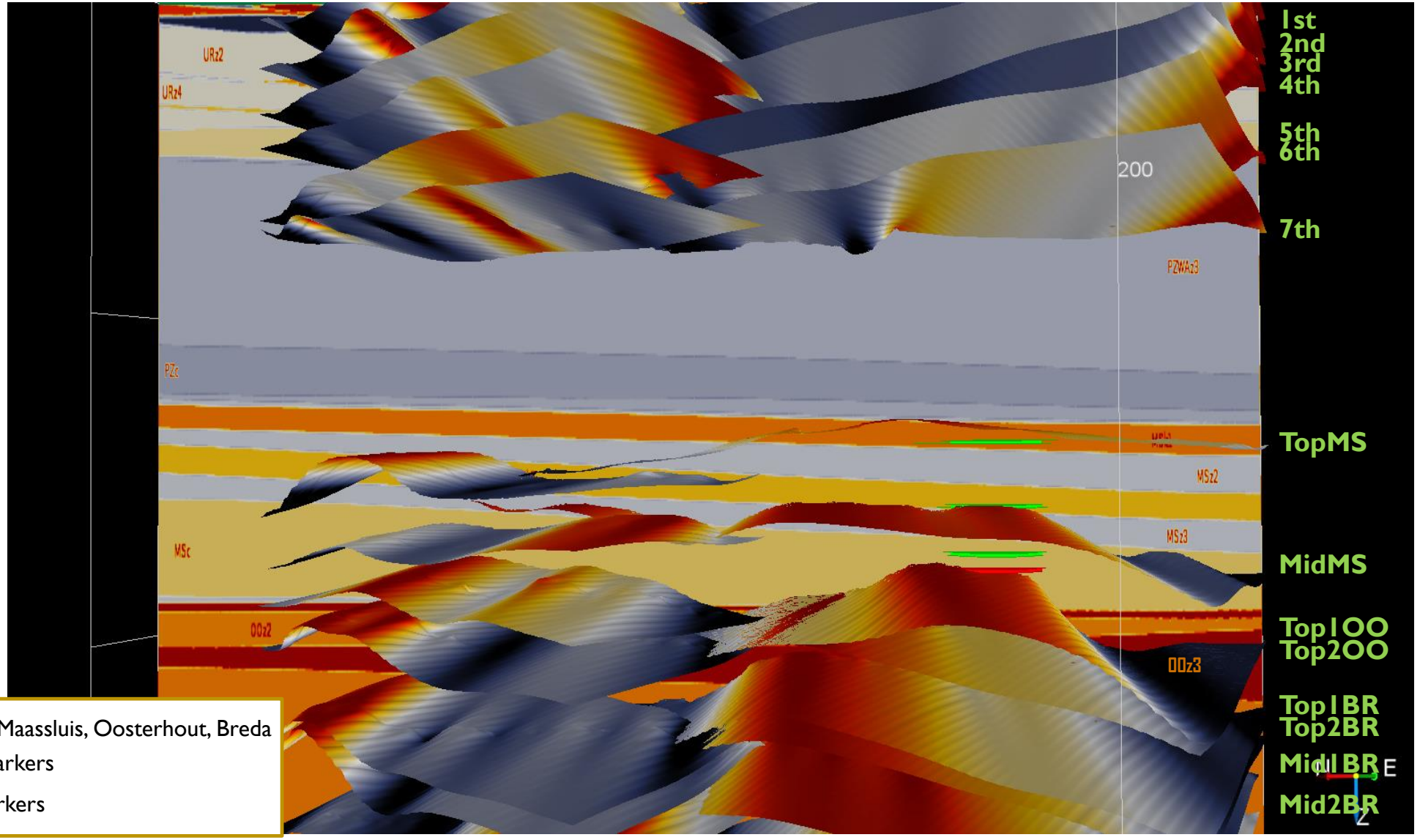
Major horizons Peize, Waalre, Maassluis, Oosterhout, Breda
ECW test well post-drilling markers
ECW test well pre-drilling markers

RESULTS: INTERPRETED 7608 ACSI ON REGIS II



Major horizons Peize, Waalre, Maassluis, Oosterhout, Breda
ECW test well post-drilling markers
ECW test well pre-drilling markers

RESULTS: INTERPRETED PSEUDO-3D ON REGIS II



CONCLUSIONS

- **The MS1.3 Reprocessing work was a geophysical/technical success, but not a complete geological/heat storage success**
- **Shallow reflections were retrieved in the reprocessed data were none were in the original data, and some new ones regarding REGIS2**
- **Time/depth conversion proved challenging as the seismic velocities used have large uncertainties, still the well-tie is relatively good**
- **Most interpreted horizons in the reprocessed data match the revised well lithography but were already present in the REGIS2 model**
- **Some interpreted horizons in the reprocessed data are more accurately predicting the revised/right well markers then REGIS2**
- **However some interpreted horizons in the reprocessed data are more accurately predicting the old/wrong well markers then REGIS2**

CONCLUSIONS

- **Having the reprocessed data available during prediction of before-drill anticipated heat storage aquifers and aquitards is advantageous**
- **If it pays off in an individual business case to go through the developed reprocessing workflow given the uncertainties is not clear**
- **The retrieved shallow reflections can be of added value for the REGIS2 model in areas of sparse well-coverage**
- **The retrieved shallow reflections merely confirm or mismatch the REGIS2 model in areas of dense well-coverage and are less valuable**
- **The workflow requires more development regarding especially velocities/time-depth conversion and interpretation methodology**
- **Economic heat storage benefits especially from seismic reprocessing in areas of very sparse data coverage where REGIS2 is inaccurate**

THANK YOU FOR YOUR ATTENTION

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