Norsk Regnesentral (NR)

Norwegian Computing Center

www.nr.no

Petter Abrahamsen

Joining Forces 2016

NUSSE:
- 512 9-digit numbers
- 200 additions/second

NR is an *applied* research institute

- Established by the government in 1952 to run NUSSE
- **Private** non-profit foundation since 1985
- Financed by:
  - Domestic private companies
  - Public sector
  - Norwegian Research Council
  - EU
  - International companies
- 65 research scientists and 9 staff
- Revenue 82 mill. NOK

NR has three main activities

- Statistical and mathematical analysis and modeling
- Remote sensing, image analysis and pattern recognition
- Information and communication technology (ICT)

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NR works in six main application areas

Forskningsrådet

sfi

BigInsight

BIG INSIGHT – Statistics for the knowledge economy

- **Norsk Regnesentral**
- University of Oslo
- Oslo University Hospital
- University of Bergen
- ABB
- DNB
- DNV-GL
- Gjensidige
- Hydro Energi
- NAV
- Skatteetaten
- Folkehelsa
- Cancer Registery of Norway
- Telenor

NR

BIG INSIGHT shall focus on two central innovation themes; deeply novel **personalised solutions** and sharper predictions of **transient behaviours:**

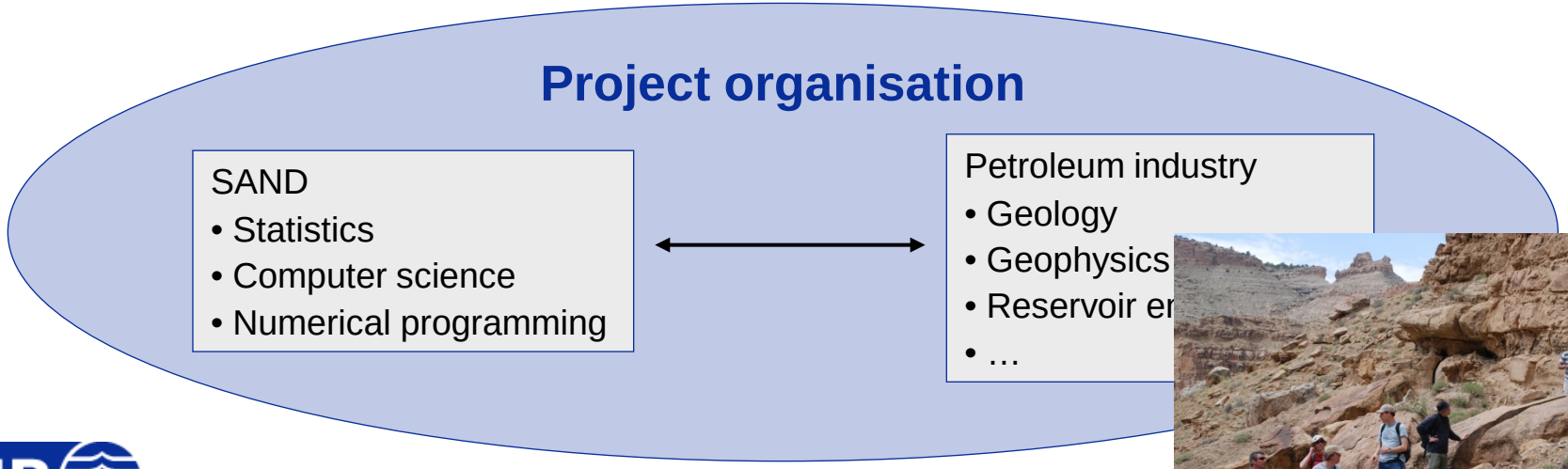
- discover radically new ways to target, towards individual needs and conditions, products, services, prices, therapies, technologies, thus providing improved quality, precisions and efficacy.
- develop new approaches to predict critical quantities which are unstable and in transition, as customer behaviour, patient health, electricity prices, machinery condition, etc.

The SAND (Statistical Analysis of Natural Resources) group

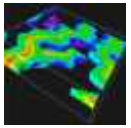
- One of 3 research groups at NR
- Currently 14 persons
  - 8 PhD's
  - 2 PhD students
  - Background from math, statistics, physics, and computational chemistry
- 350+ conference contributions and journal articles
- Main markets are
  - National oil companies
  - International oil companies
  - Roxar Software Solutions
  - National research institutes
  - Public science funding including EU

Key competence

- Math, statistics and stochastic modelling
  - Geostatistics, spatial statistics, stochastic simulation, data analysis, data integration, Bayesian methods, stochastic simulation (Monte Carlo)
- Software implementation
  - C++, Matlab, Python, Splus/R, Excel (+@Risk)

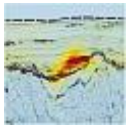


Main research areas

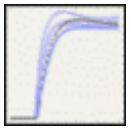


Petroleum reservoir models

Structural geology



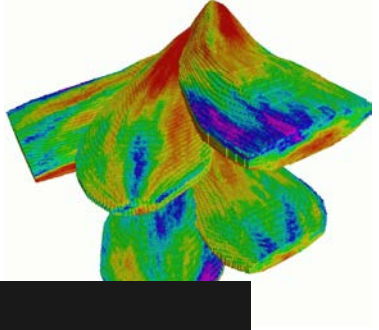
Inversion of geophysical data



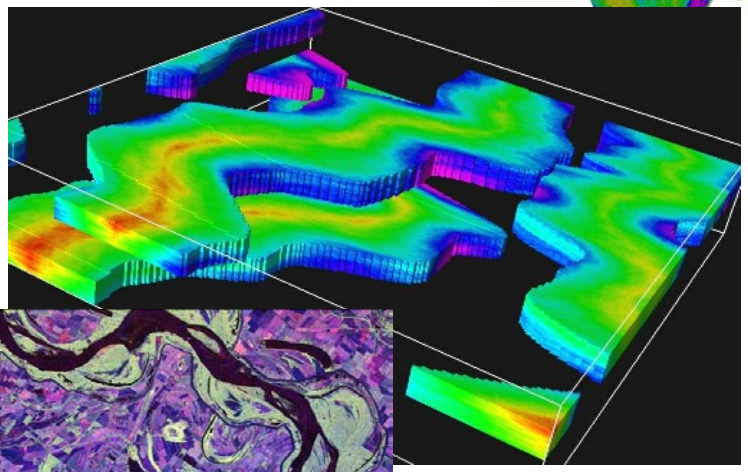
History matching and dynamic data

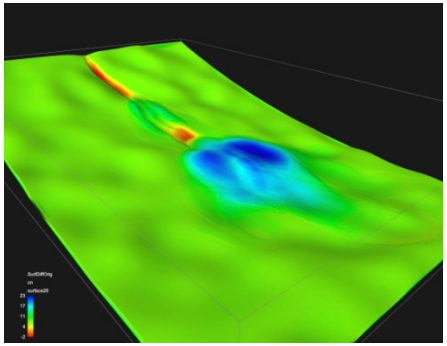
Decision support and data analysis

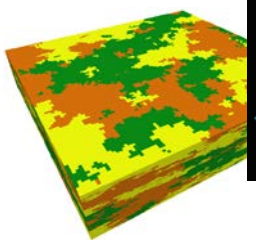
Petroleum reservoir models

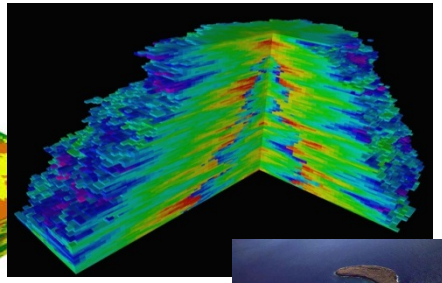


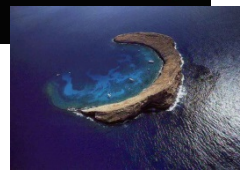
- 3D heterogeneity models for
  - Fluvial deposits
  - Shallow marine
  - Turbidites
  - …
- Consistent with data
  - Wells
  - Seismic data
- Challenges:
  - Process models
  - Speed
  - Ease of use

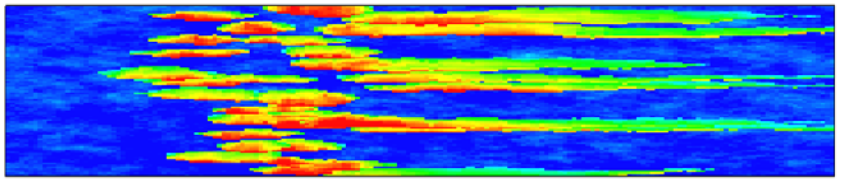






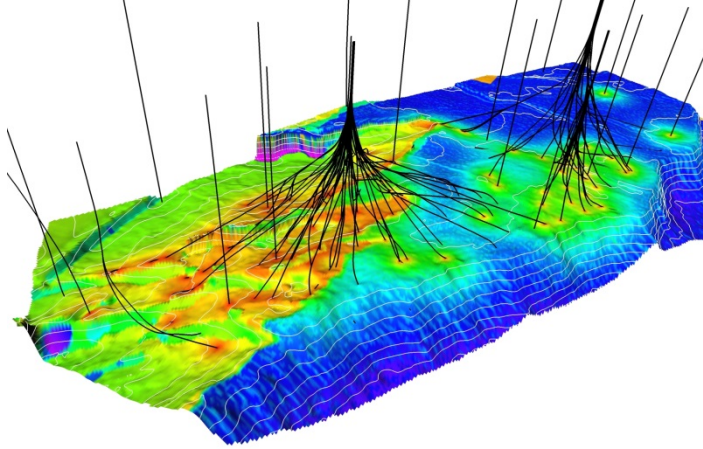


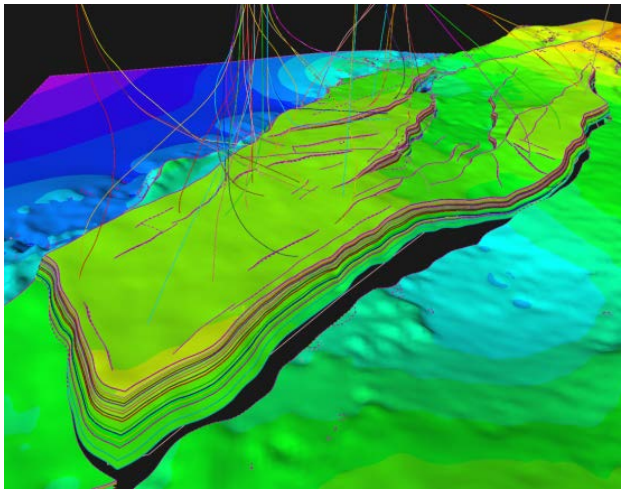


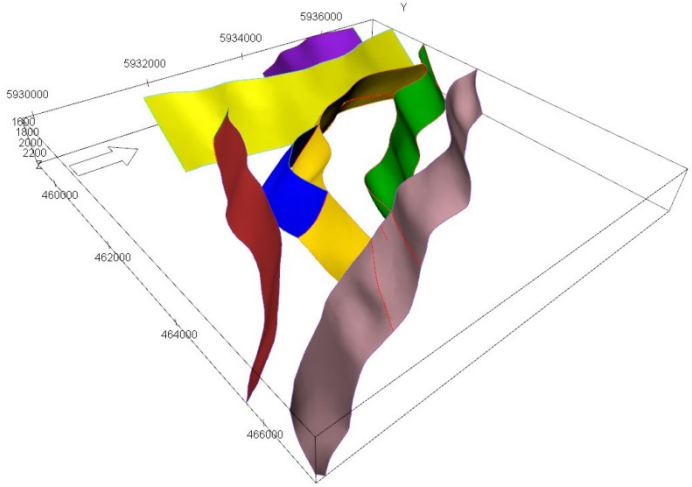


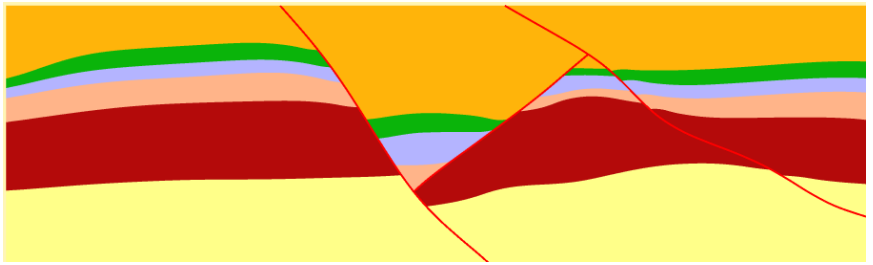
Structural geology

- Surface modelling
  - Depth conversion
  - Horizontal wells
  - QC
- Fault modelling
  - Uncertainty
  - Perturbations
  - Automatic



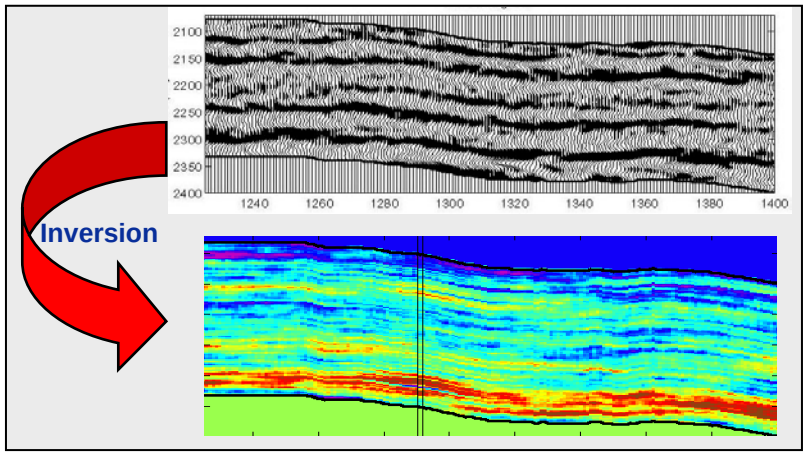


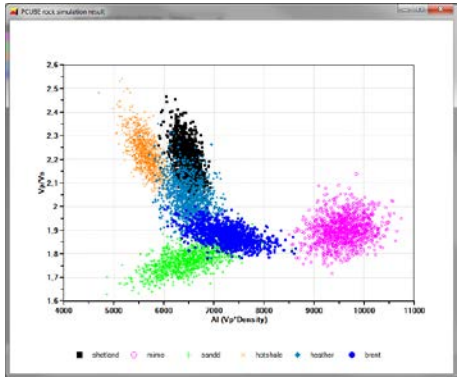


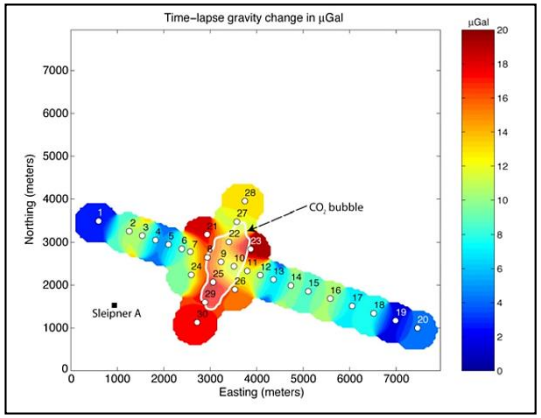


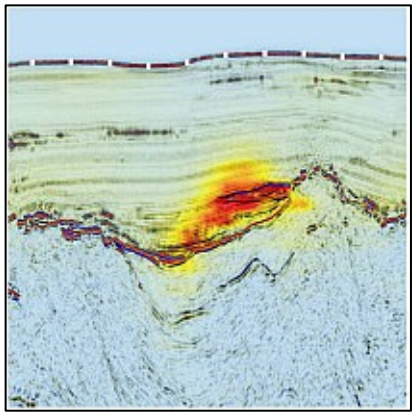
Inversion of geophysical data

- Inversion
- Rock physics
- Time lapse
- Challenges:
  - Resolution
  - Ambiguity
  - Consistency
  - Uncertainty





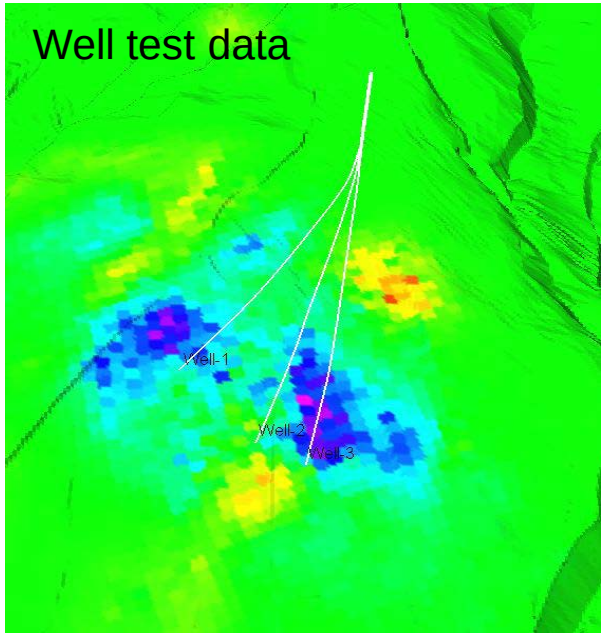


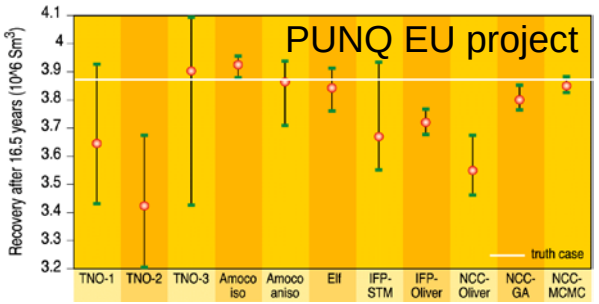


History matching and dynamic data

- Major challenge:
  - Condition 3D geomodels to dynamic data (history matching)
  - Well tests
  - Reproduce connectivity

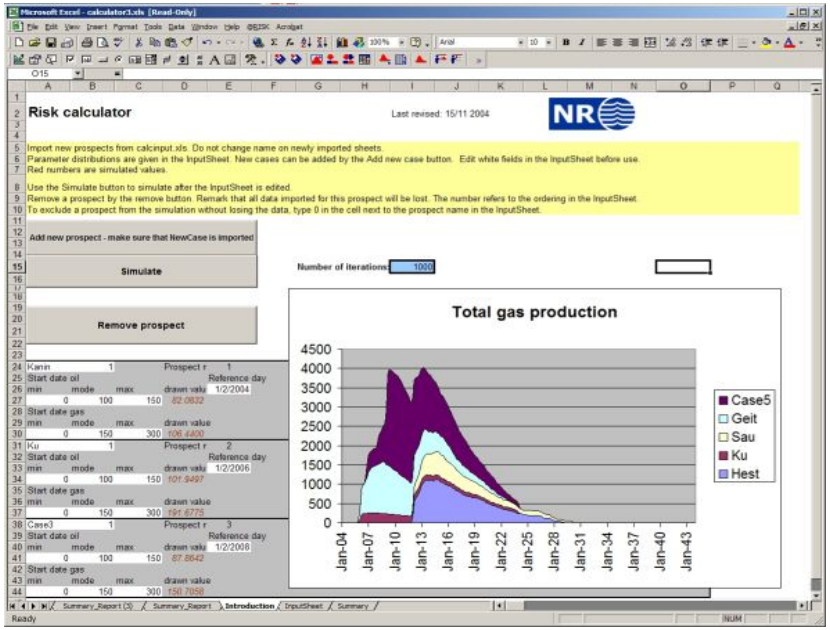
- Some approaches:
  - Ensemble Kalman filter (and other smoothers)
  - Modify geomodel in near-well area



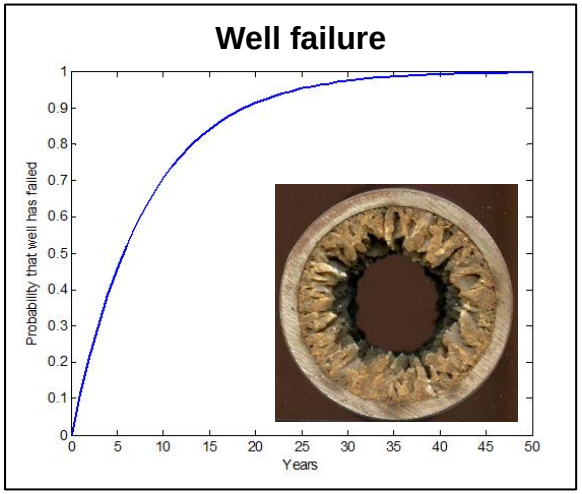


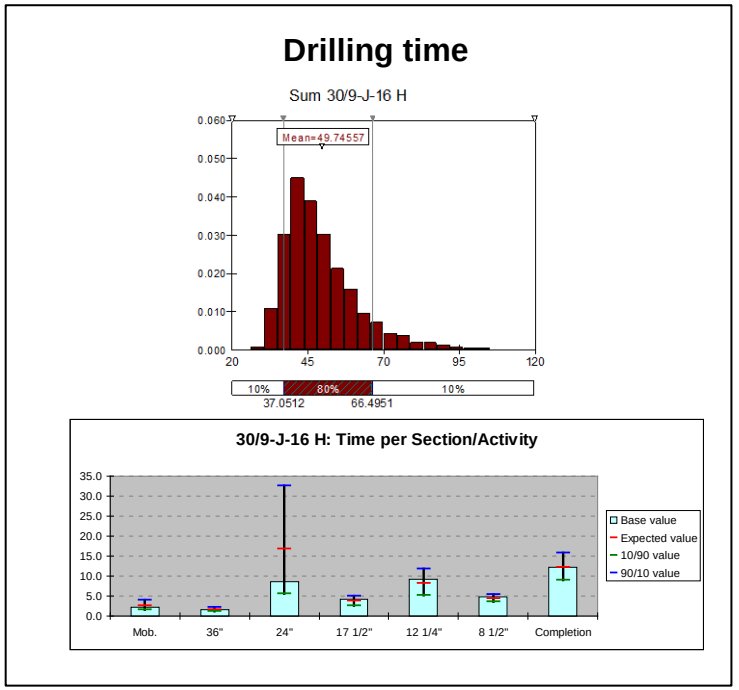
Decision support and data analysis

- Uncertainty modelling
  - Combine scenario and Monte Carlo analysis
  - Correlations in portfolios
  - Time dependency

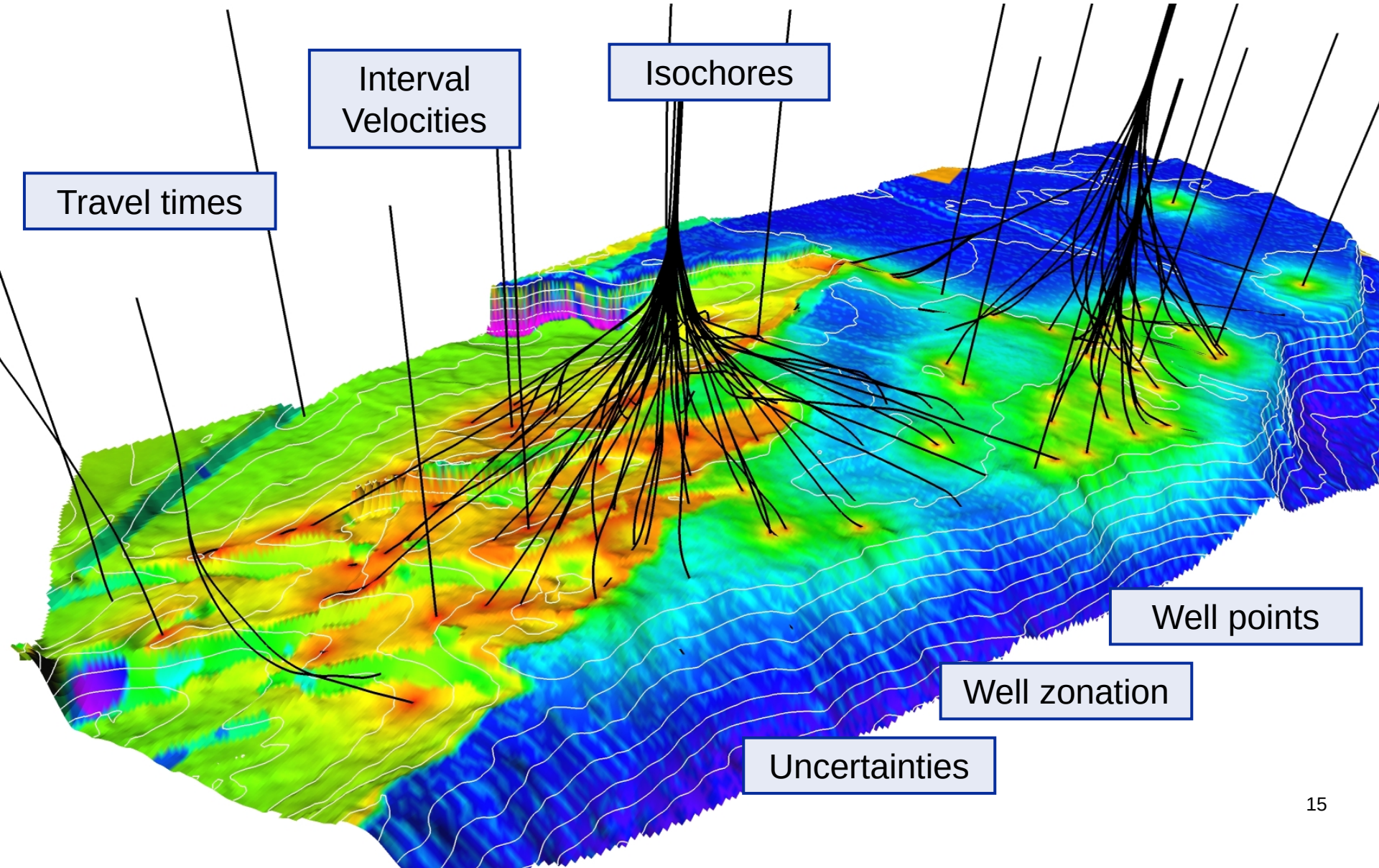


- Data analysis

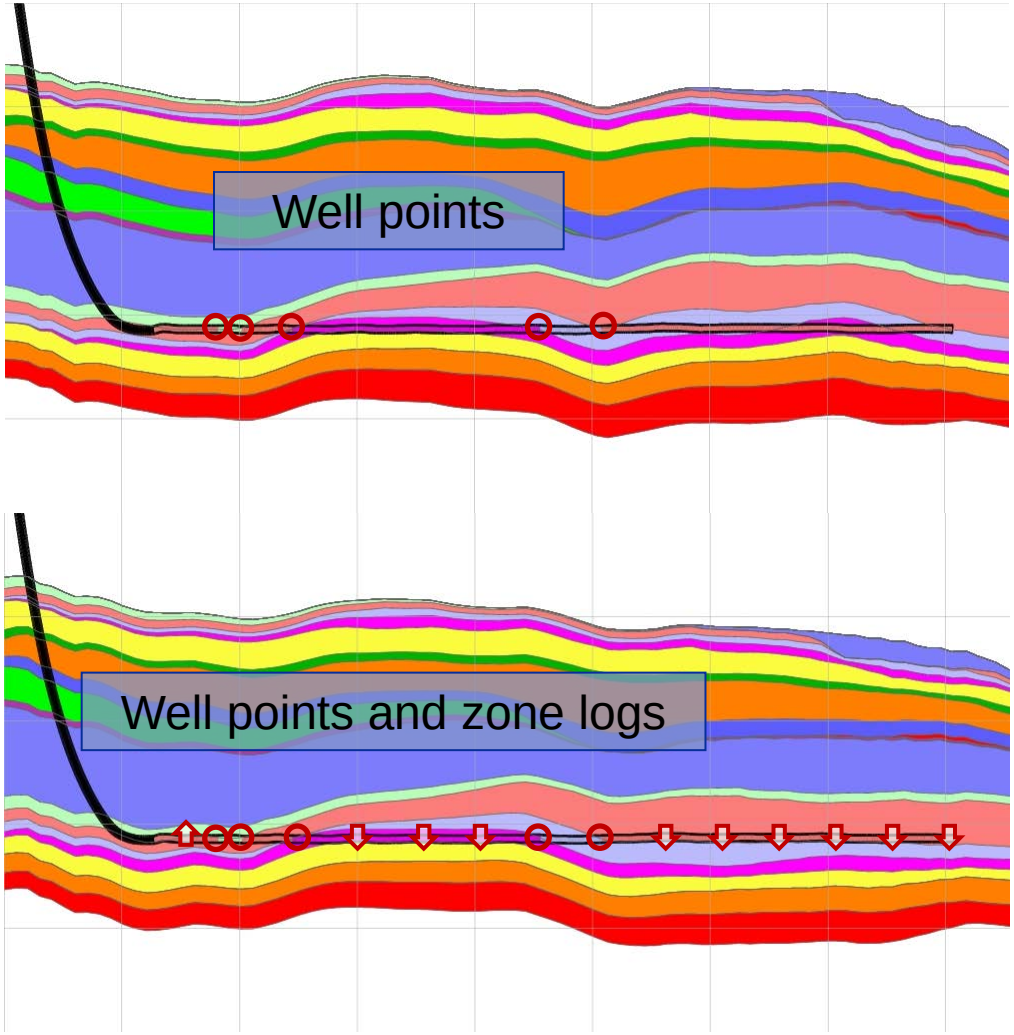


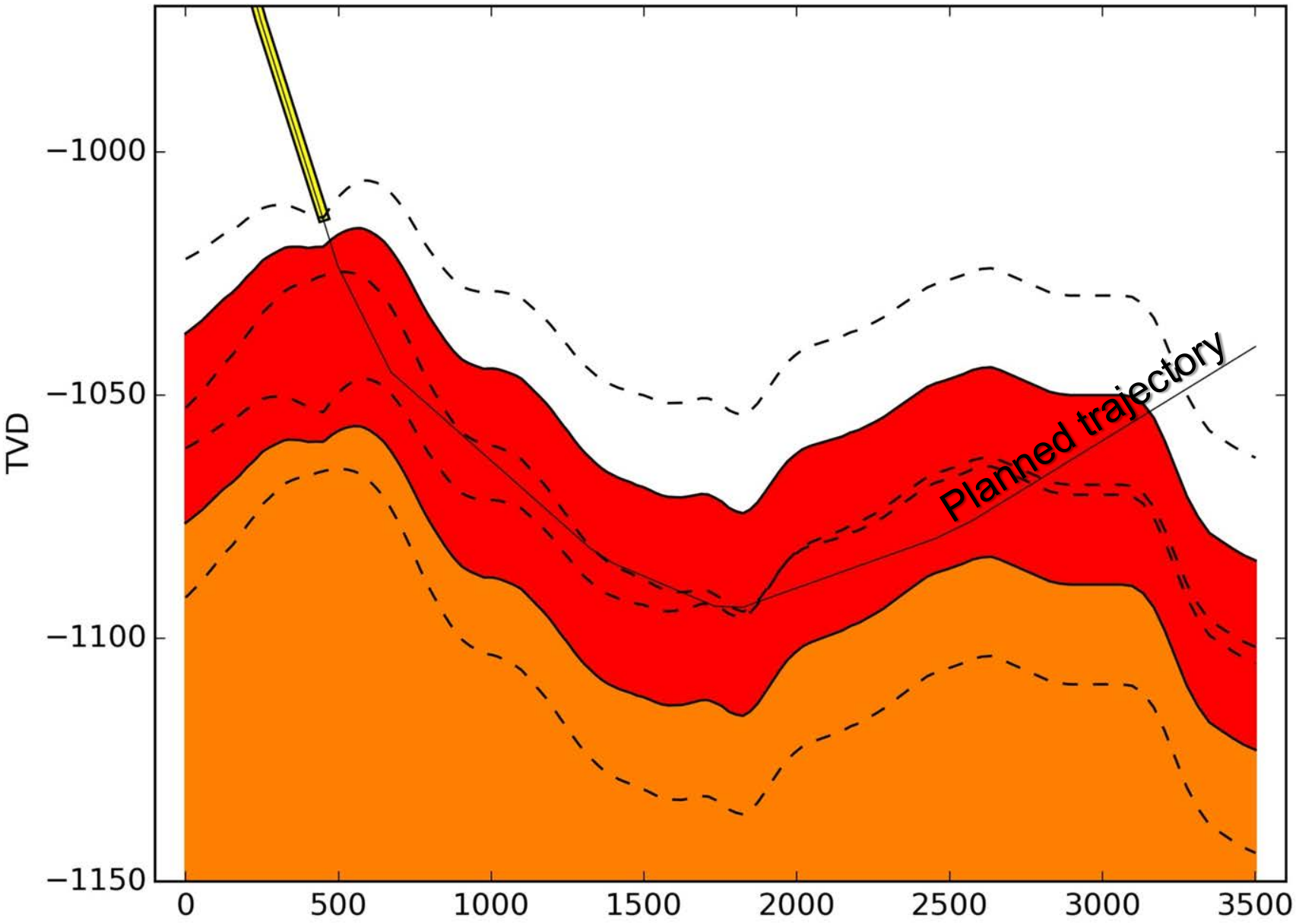


Modeling while drilling using advanced surface prediction



We have software that handles horizontal wells

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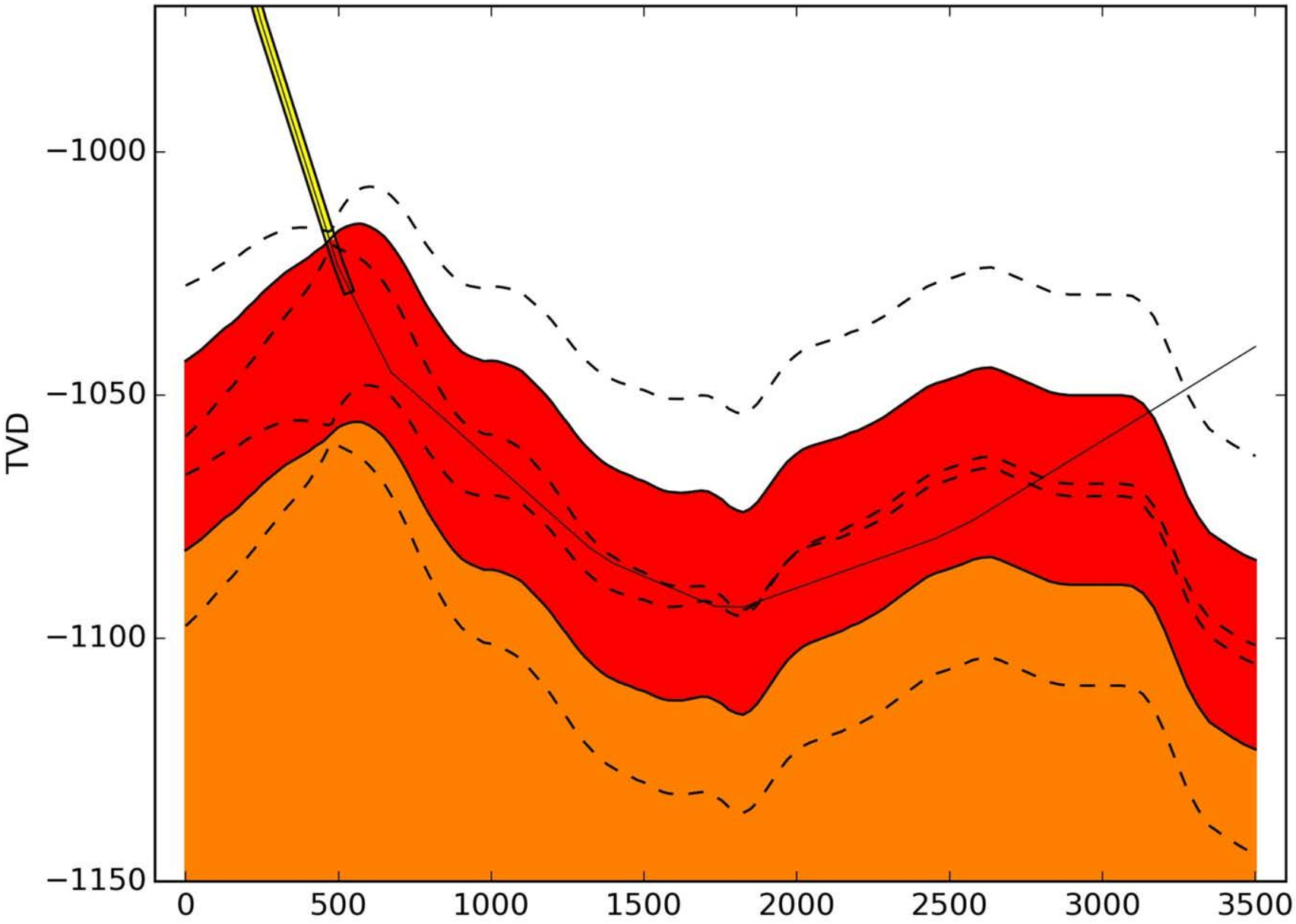
Planned trajectory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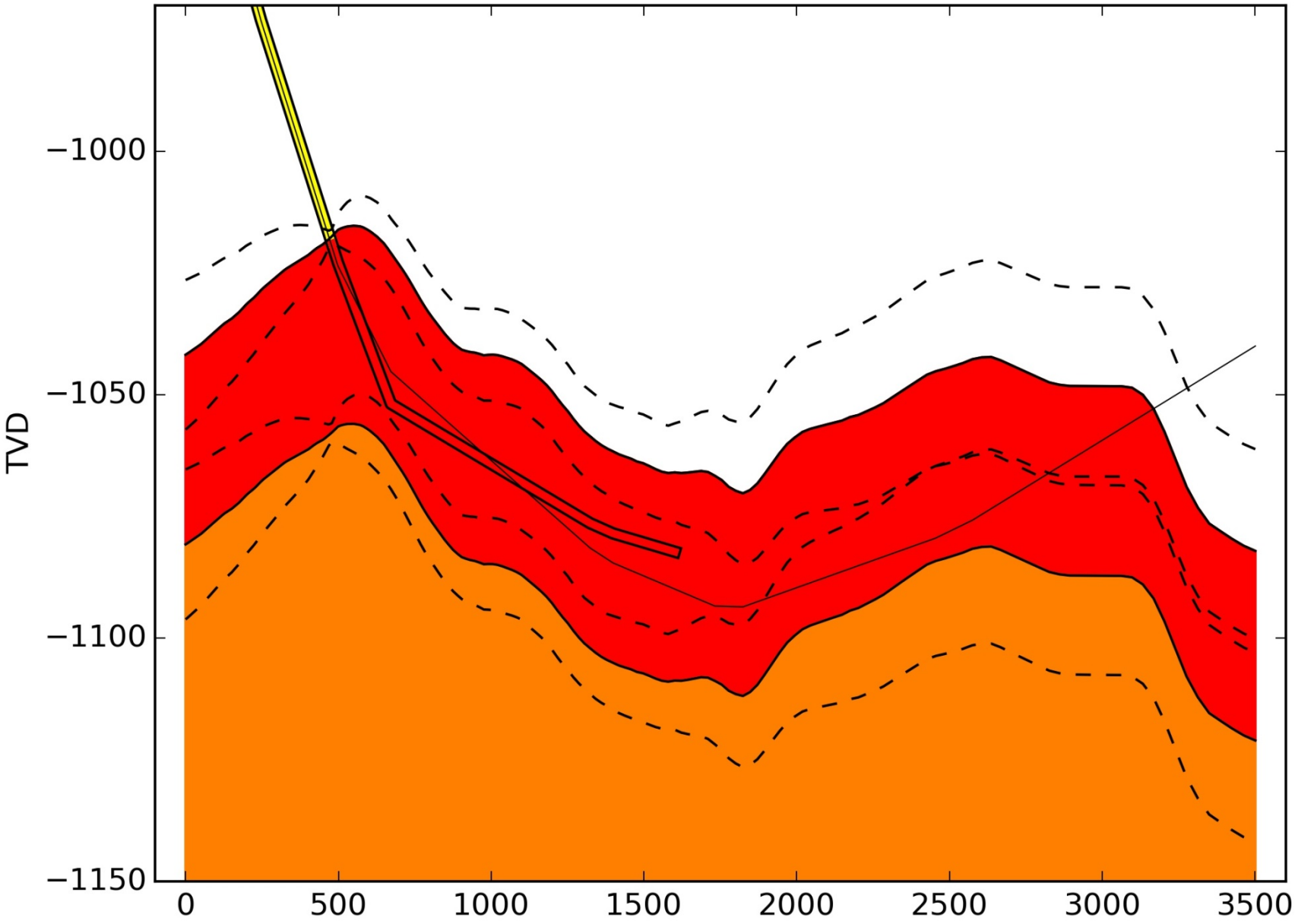
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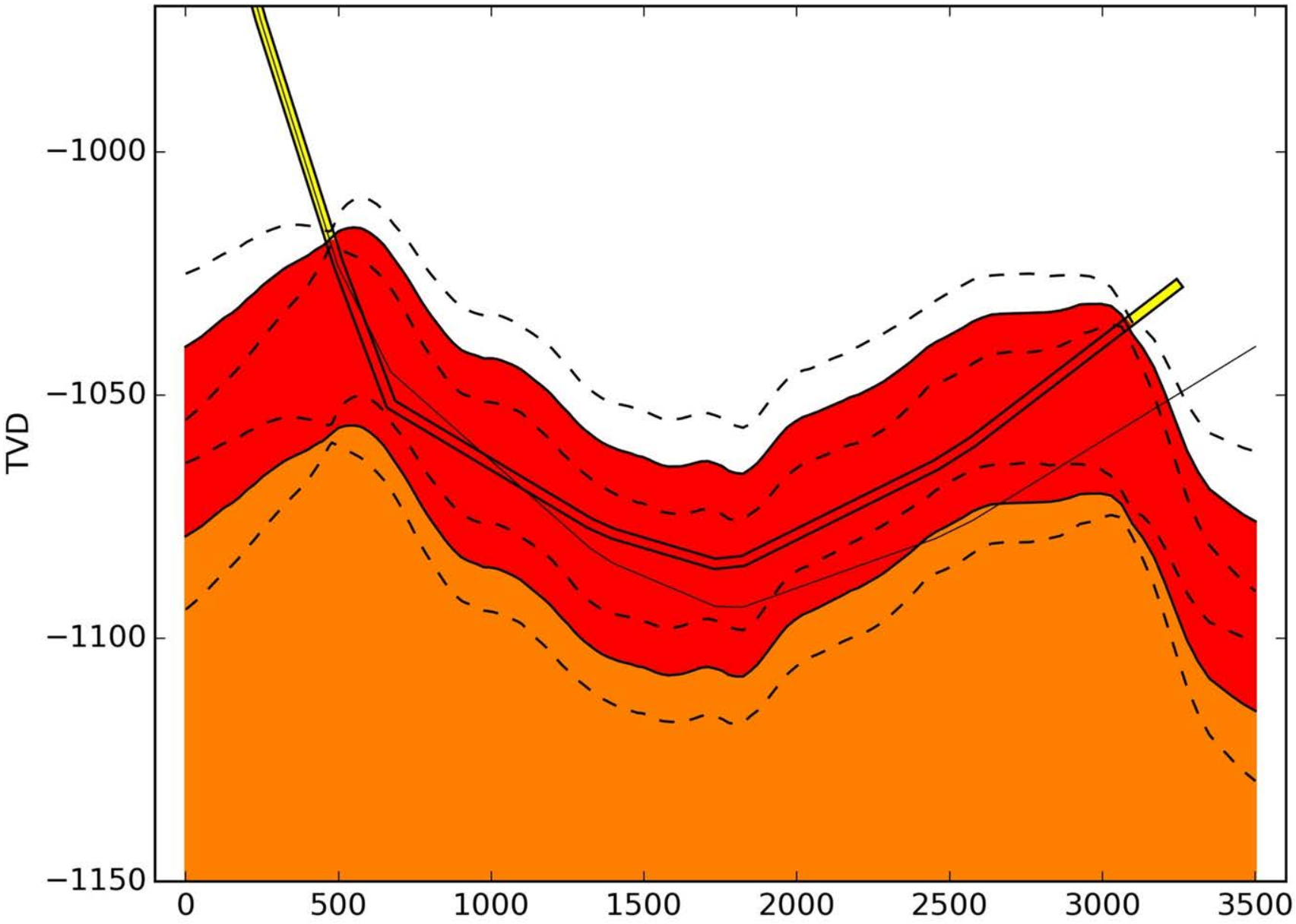
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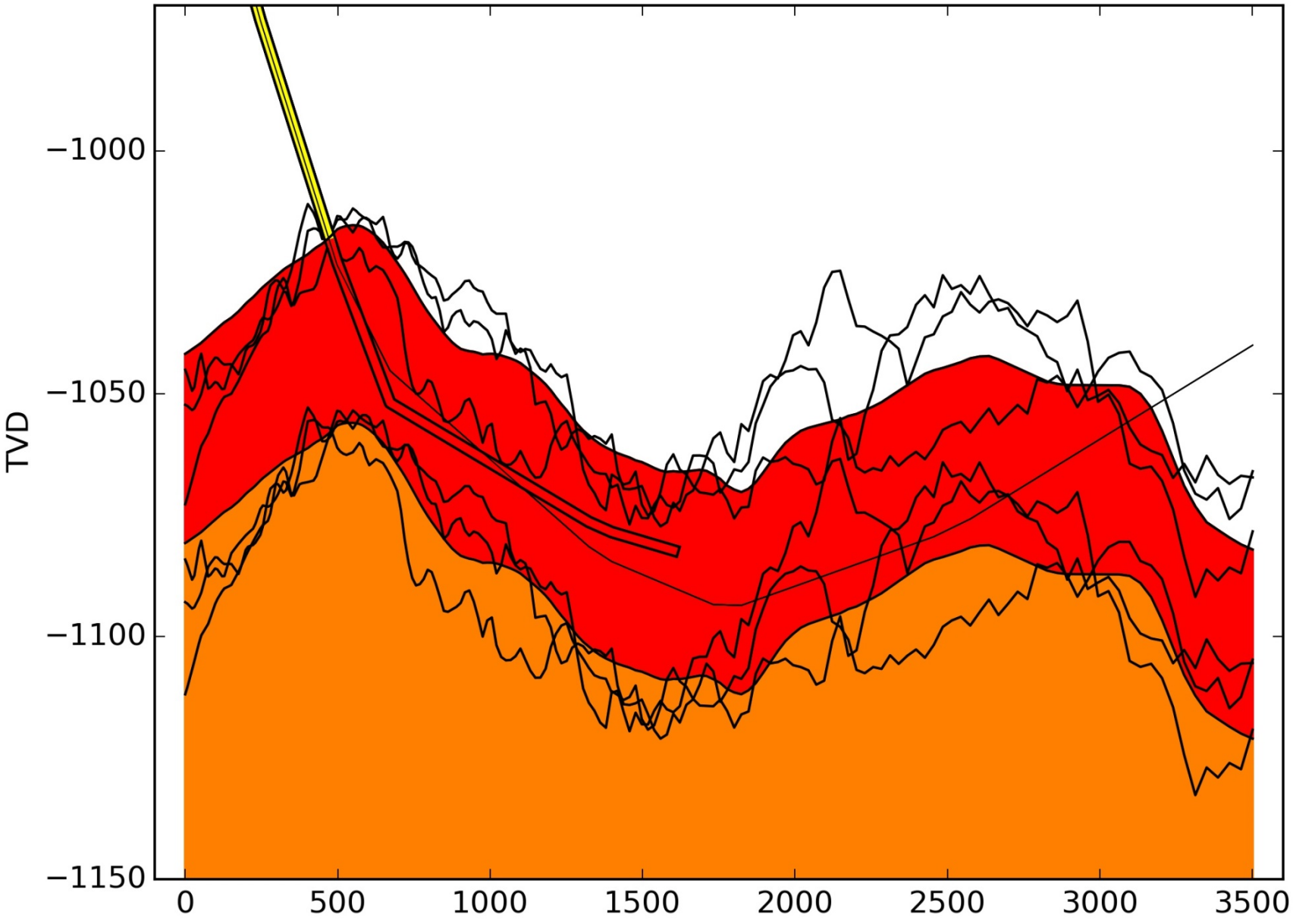
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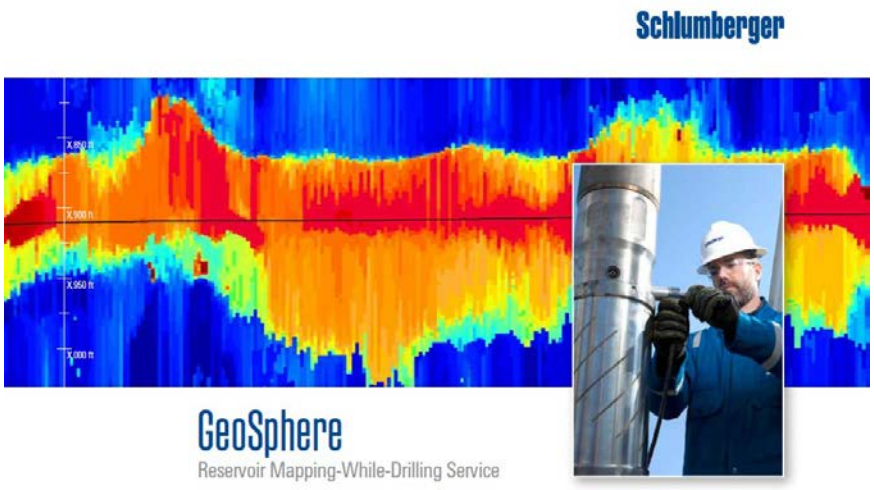
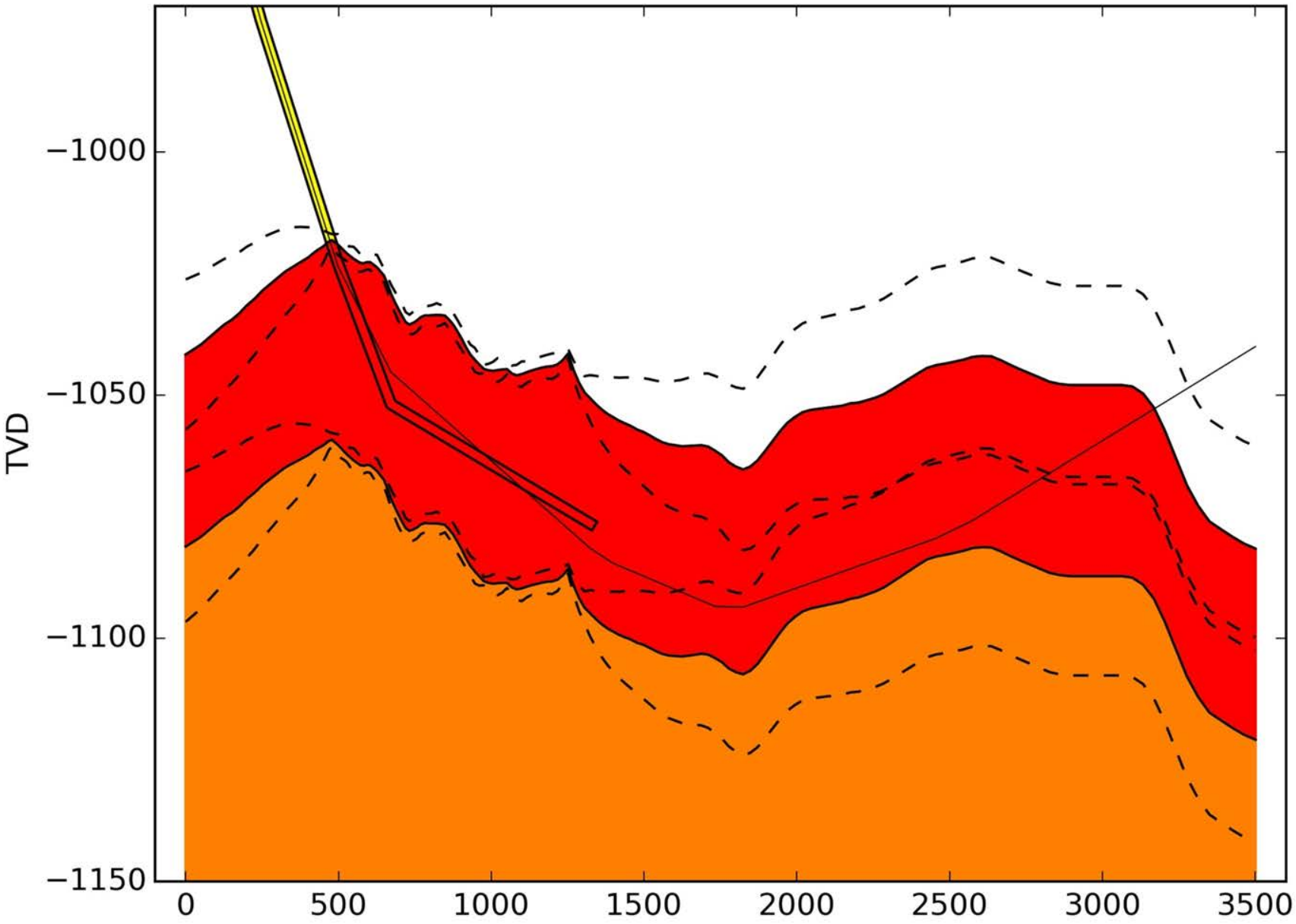
Deep resistivity logs adds very valuable information

The tools can “see” boundaries up to 30 meters away. This makes it possible to predict ahead of bit.

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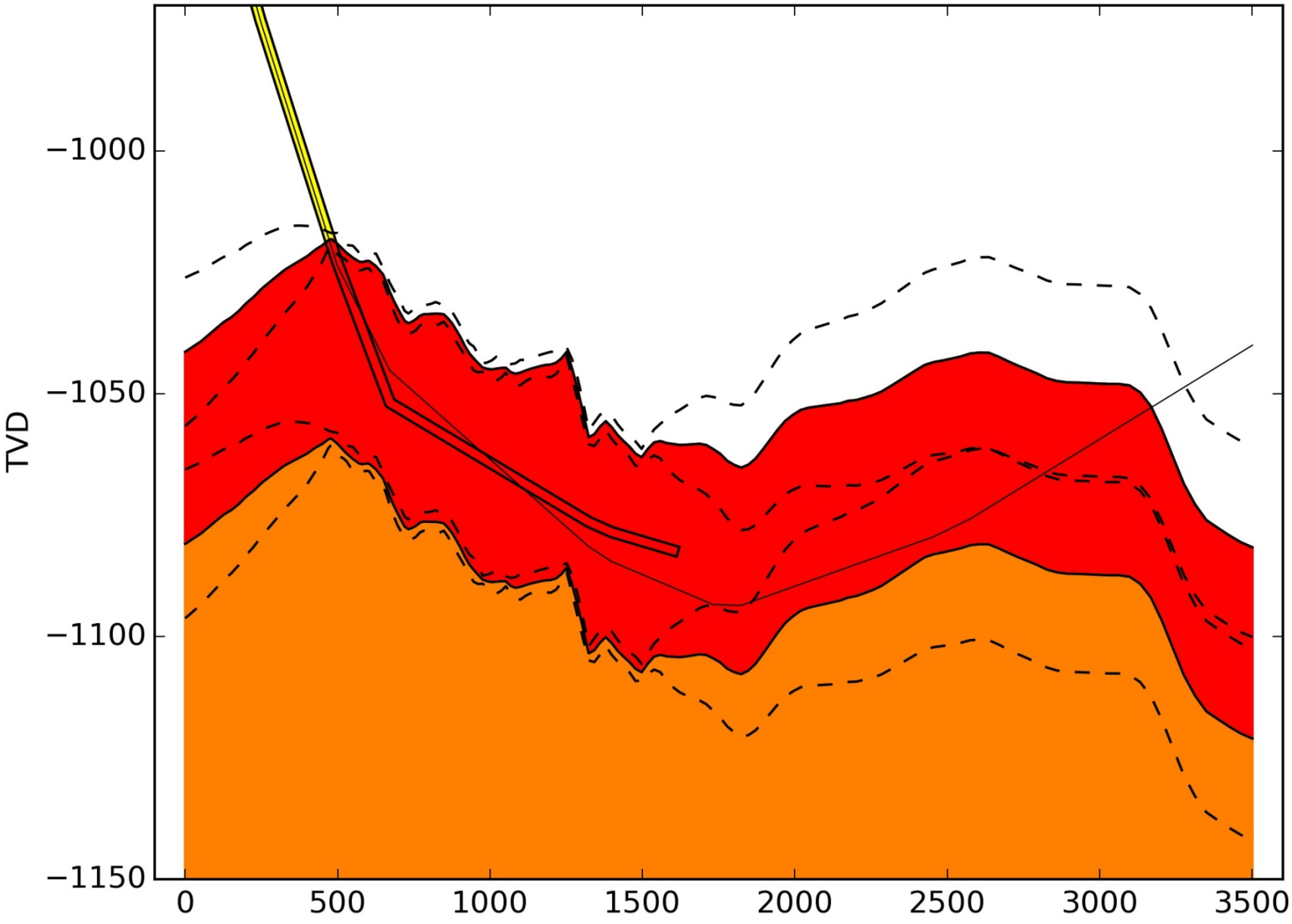
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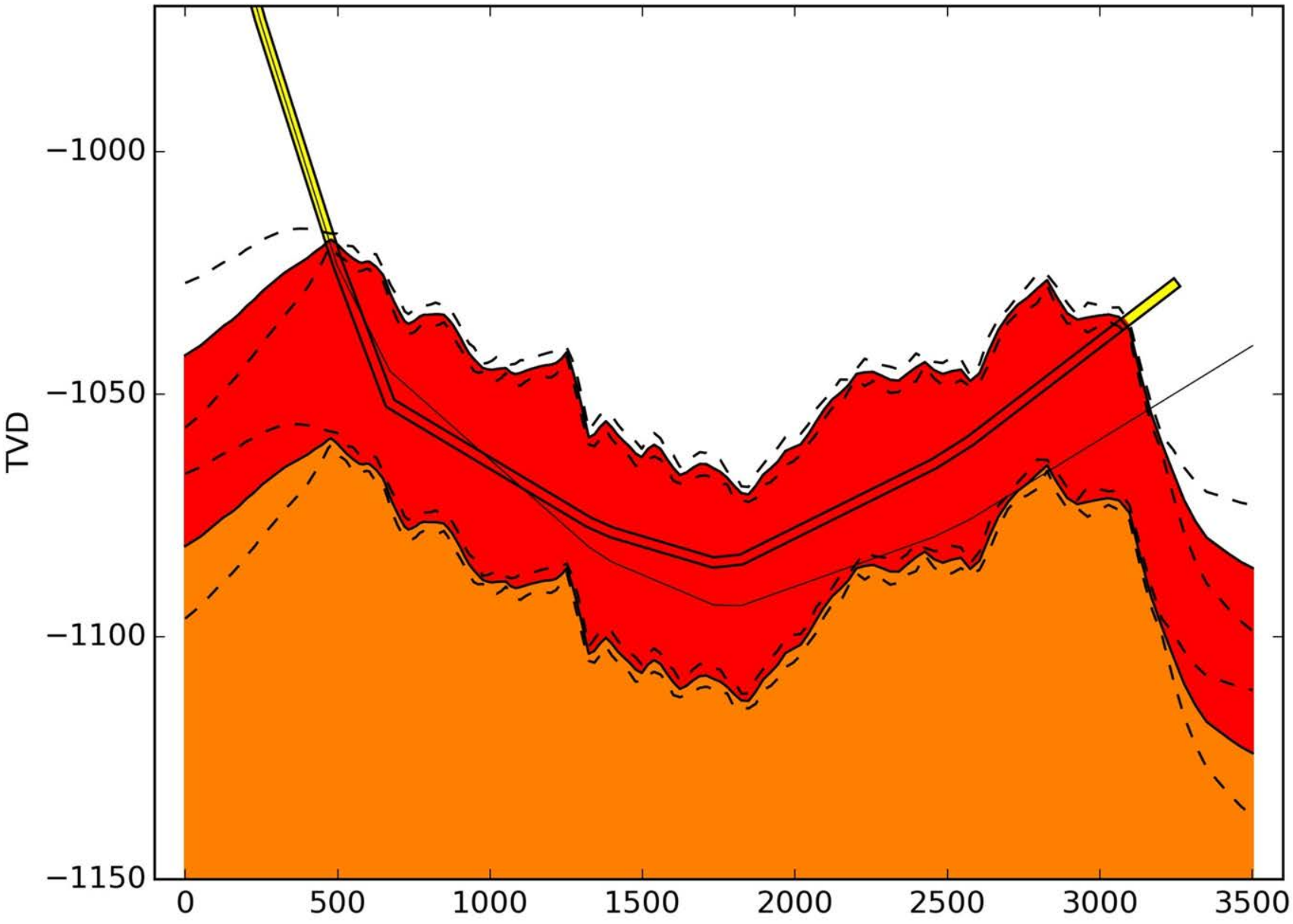
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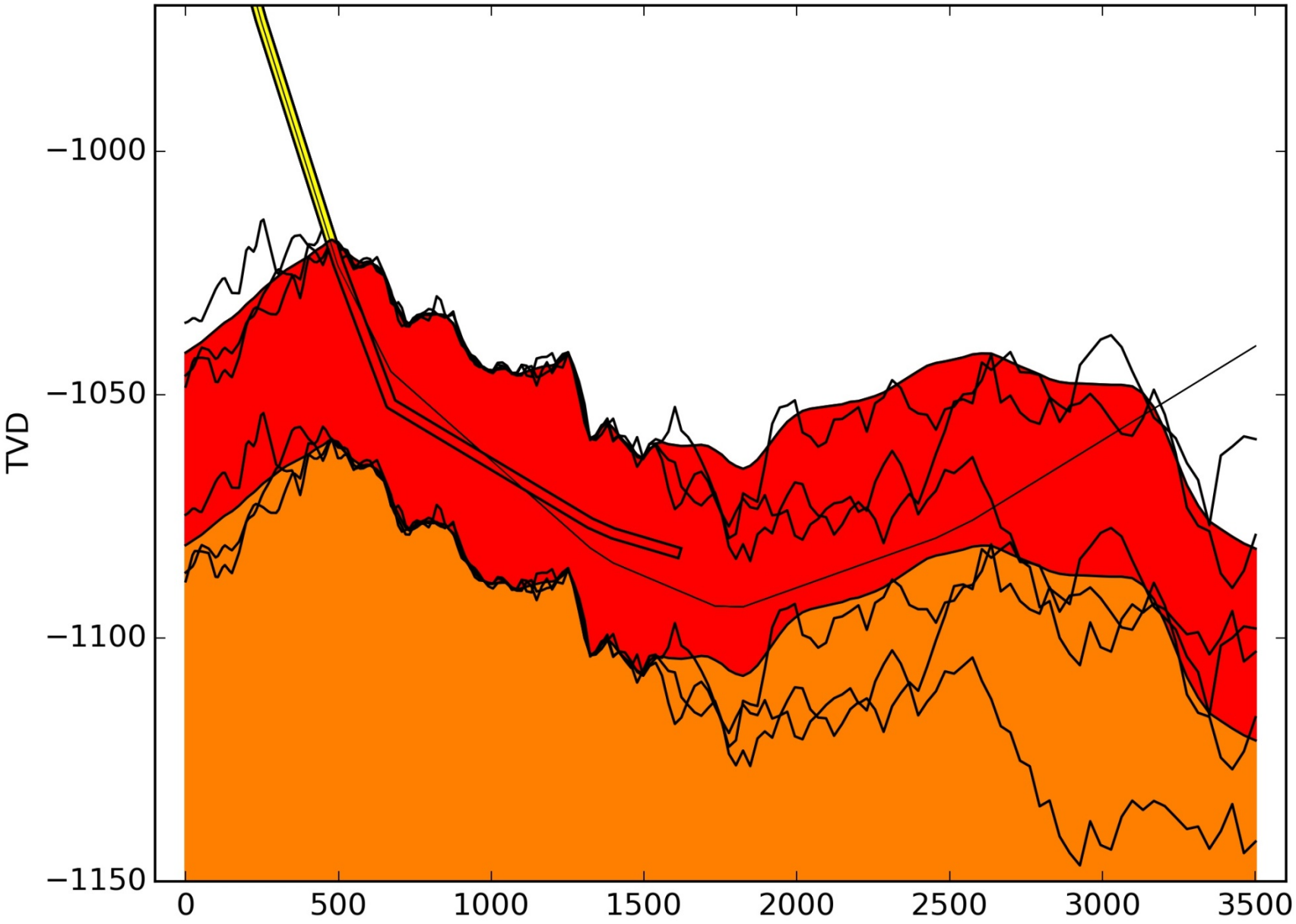
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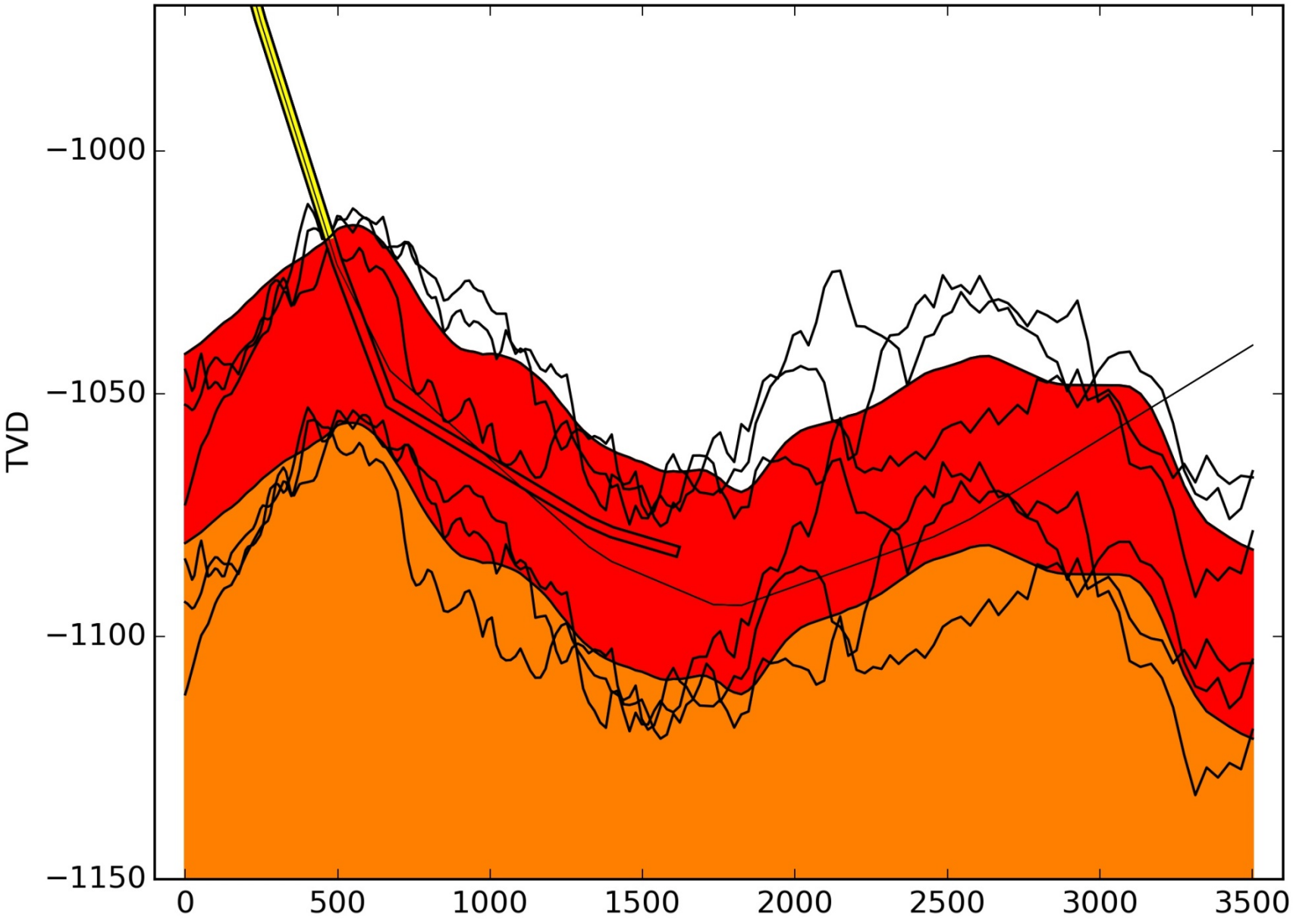
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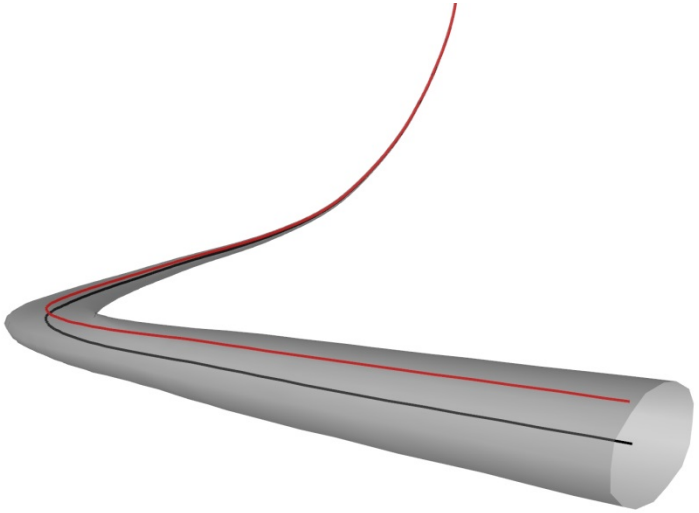
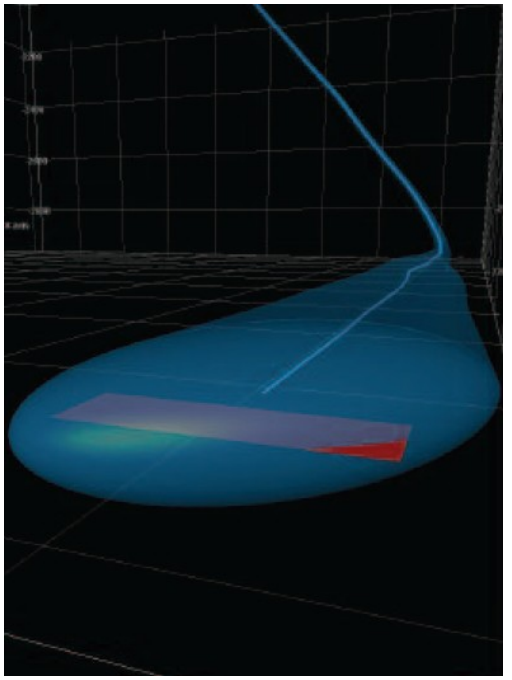
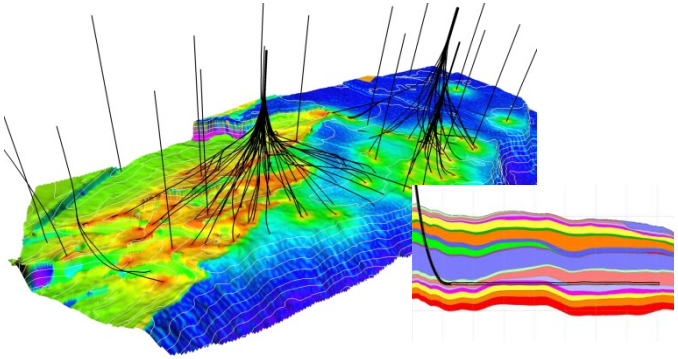
The well path uncertainty is not forgotten

- Well path uncertainty is handled properly
- Can display surfaces in TVD or relative to well path
- Can update well path

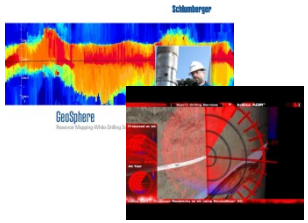




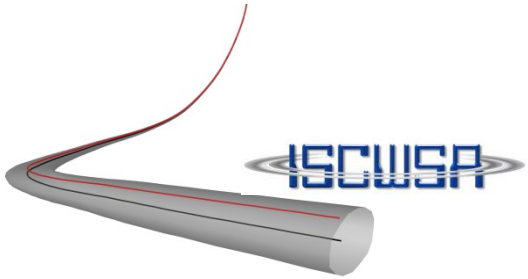
So we need some *sponsors* to develop an interactive tool that can update surfaces, and borehole trajectory, in real time while drilling



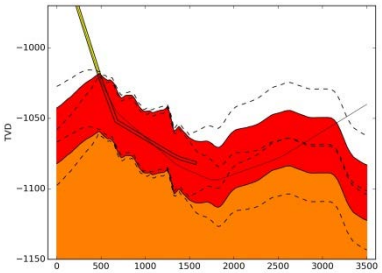
Accurate surface models



LWD (DDR)



Wellbore uncertainty



Fast and accurate prediction of drilling target risk while drilling

Contact:
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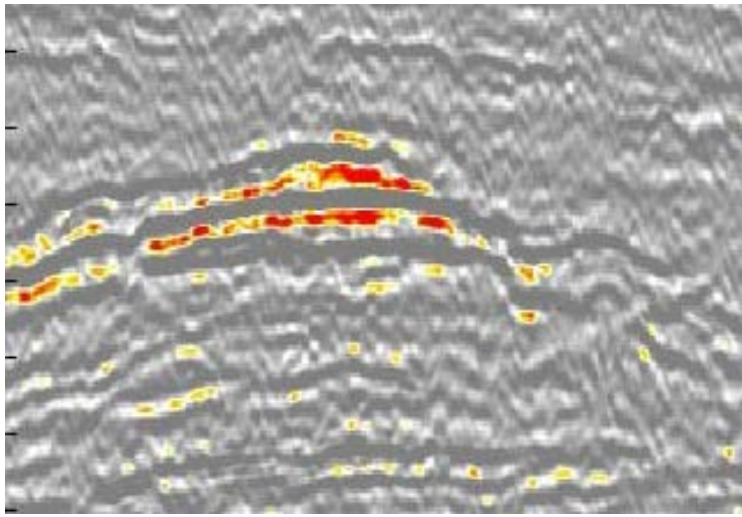
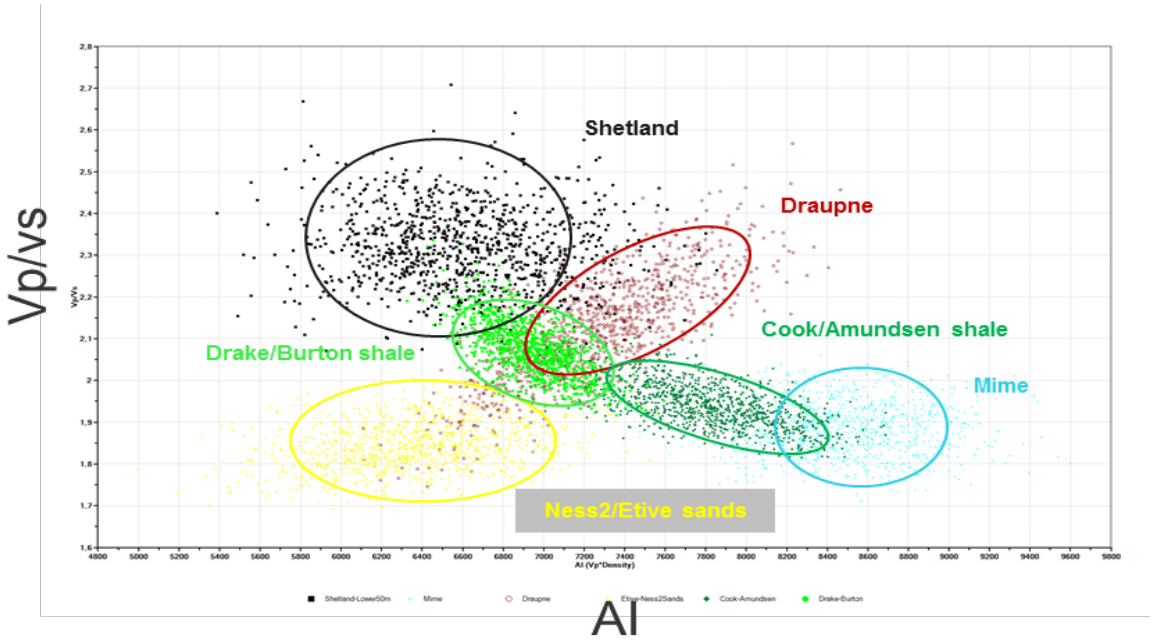
Ariel.Almendral.Vazquez@nr.no or
pal.dahle@nr.no

NR

New established consortium: GIG – Geophysical Inversion to Geology

- **Geophysical** and **rock physics inversion**
- **New understanding, algorithms and software**
- Software development based on existing inversion software (PCube, CRAVA)
- Will obtain:
  - **zonation,**
  - **fluid and lithology classes,**
  - **petrophysical properties**
- **Uncertainty and risk will be quantified**
- Applies to **exploration** and **production**




Vp/vs
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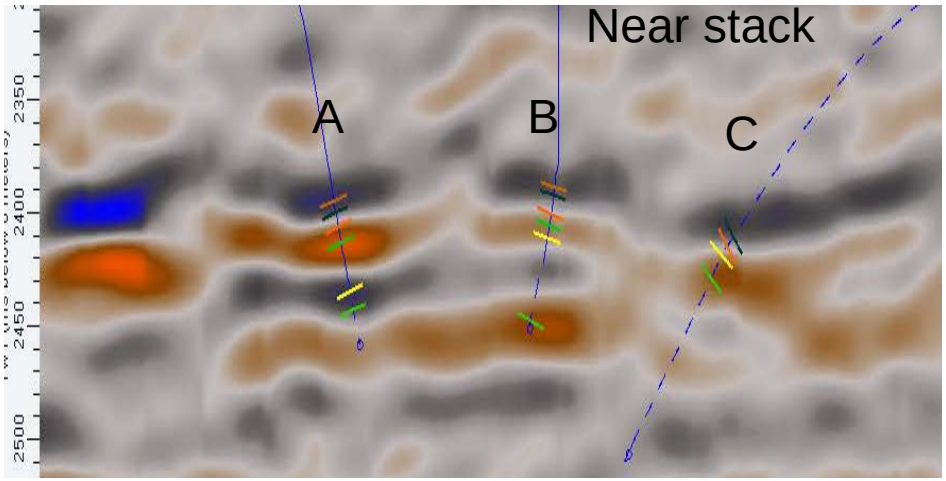
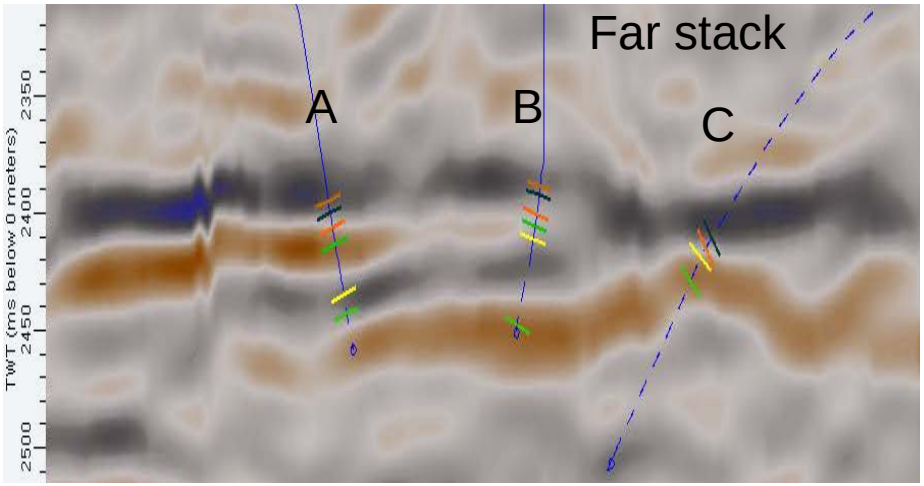
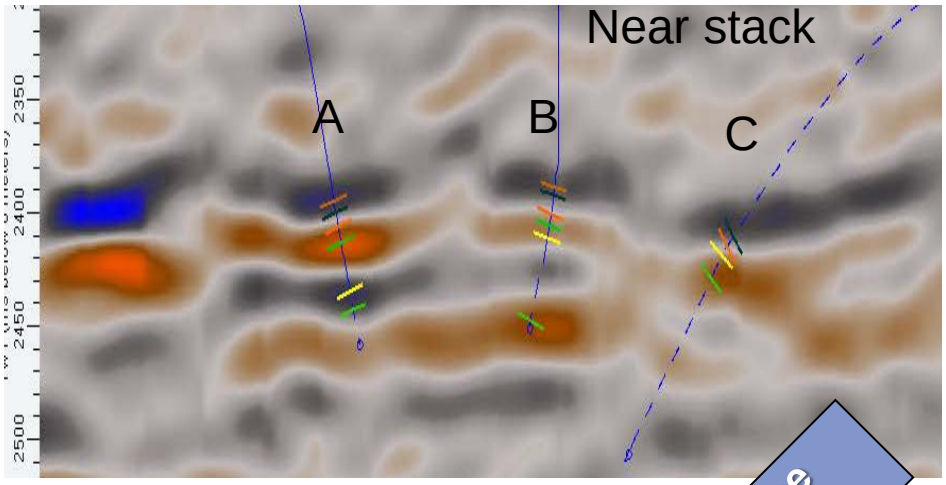
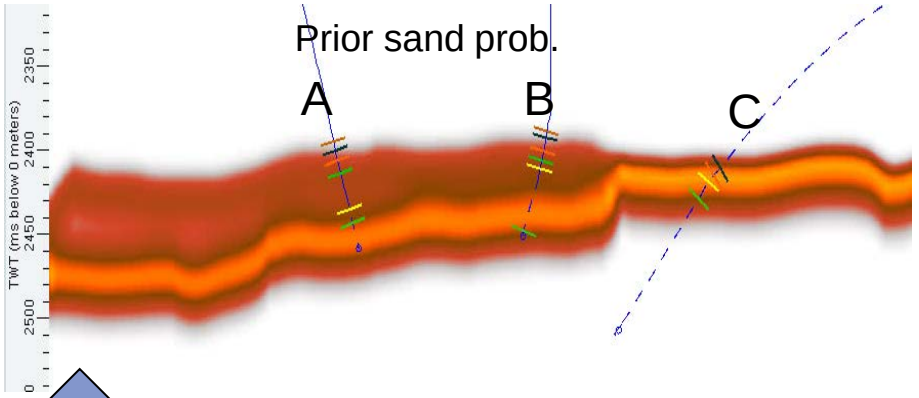
Shetland
Draupne
Cook/Amundsen shale
Drake/Burton shale
Mime
Ness2/Etive sands


Near stack
A
B
C

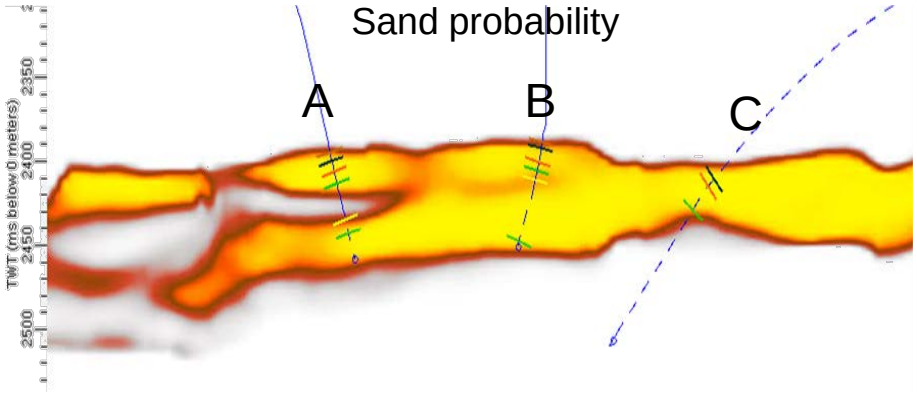

Far stack
A
B
C
TWT (ms below 0 meters)
2350
2400
2450
2500

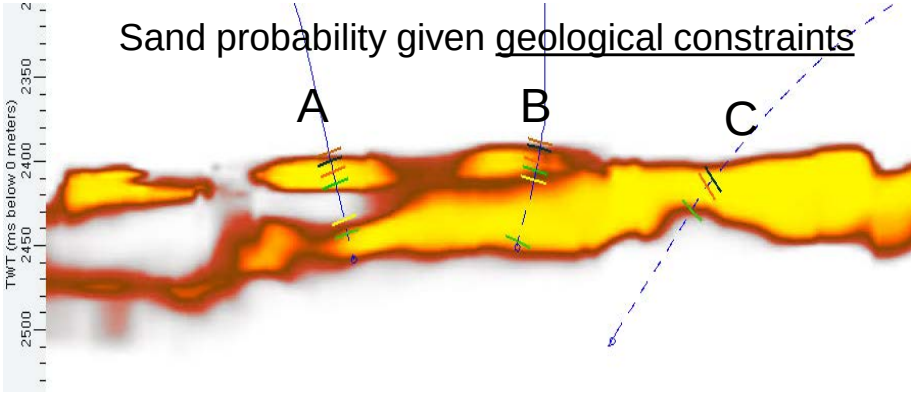




Standard pointwise inversion

Inversion with geological constraints





So why join *Geophysical Inversion to Geology ?*

- Starting now ☺
- Access to state-of-the-art inversion software
  - Prototype with GUI (available now)
  - Commercialized (end of 2016)
- Meetings with scientists and professionals that develop and actively use inversion results in exploration and production
- Influence on research and development
- Norwegian Computing Center has long experience in developing inversion methods and software

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Per.Roe@nr.no

NR Lundin Statoil DETNORSKE

At NR we know math/statistics and work in G & G applications…

Cooperate with vendors, oil companies, research institutes and universities

SINTEF

NORSAR

UNIVERSITAS BERGENSIS

uniResearch CIPR

NTNU Innovation and Creativity

STANFORD UNIVERSITY

UiO : Universitetet i Oslo

IFE Institutt for energiteknikk

NR

We have

- Unique competence
  - math/statistics/programming
  - long experience in petroleum applications
- Long history of successful projects
  - Research (publications, presentations, PhD's,…)
  - New methods
  - Case studies
  - Commercial software

Thank you for your time