8TH PETROLEUM GEOLOGY OF NORTHWEST EUROPE CONFERENCE 2015

RISC

decisions with confidence

Rhyl field, a new discovery by combining basic geological principles with advanced seismic imaging in the Irish Sea

Presented by: Gavin Ward, RISC UK

Data provided courtesy of Serica Energy

SERICAENERGY

Disclaimer

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- **This presentation examines what a top depth structure map should look like.**
- **The structural image is 'confused' by the seismic response and the velocities in the overburden.**

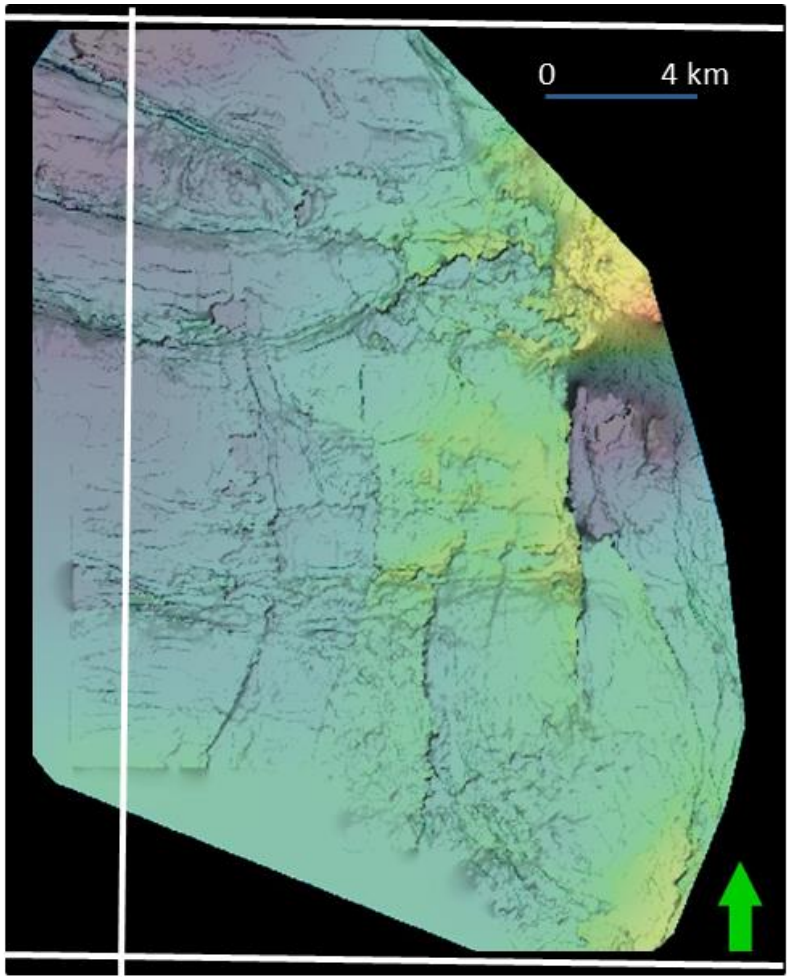
Content

1. **New Field context**
   - Location
   - Creaming curve and size
   - Time line

2. **Critical Success Factors**

3. **Evolution of mapping**
   - Volcanics
   - Overburden
   - Structural styles
   - Seismic velocity fields
   - Trust geology over algorithms

Where's the field?



Reservoir = Lower Triassic (Ormskirk Sst)

Source: Ant Track Extraction derived from PSDM reprocessed seismic - 2014

Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

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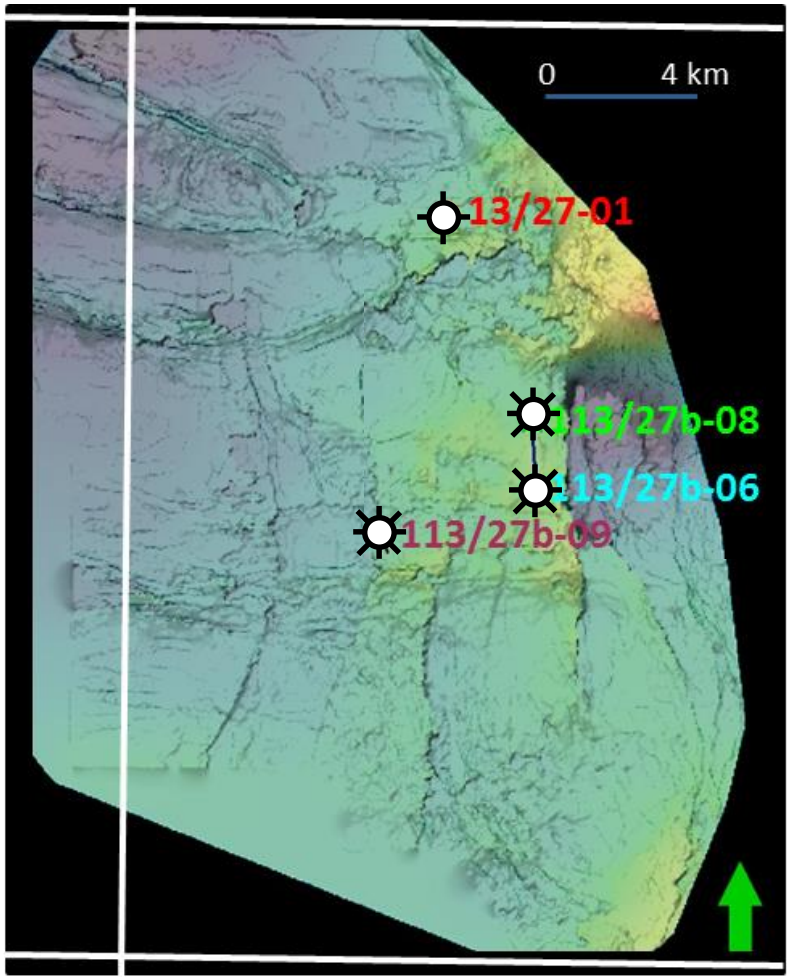

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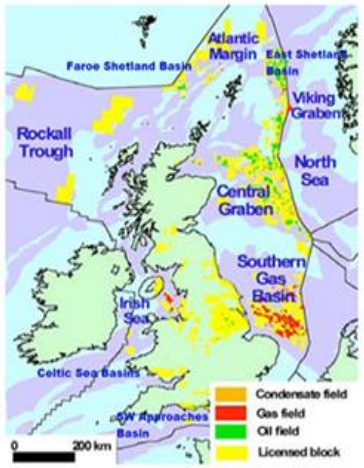
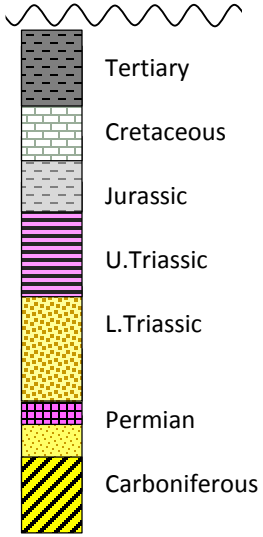
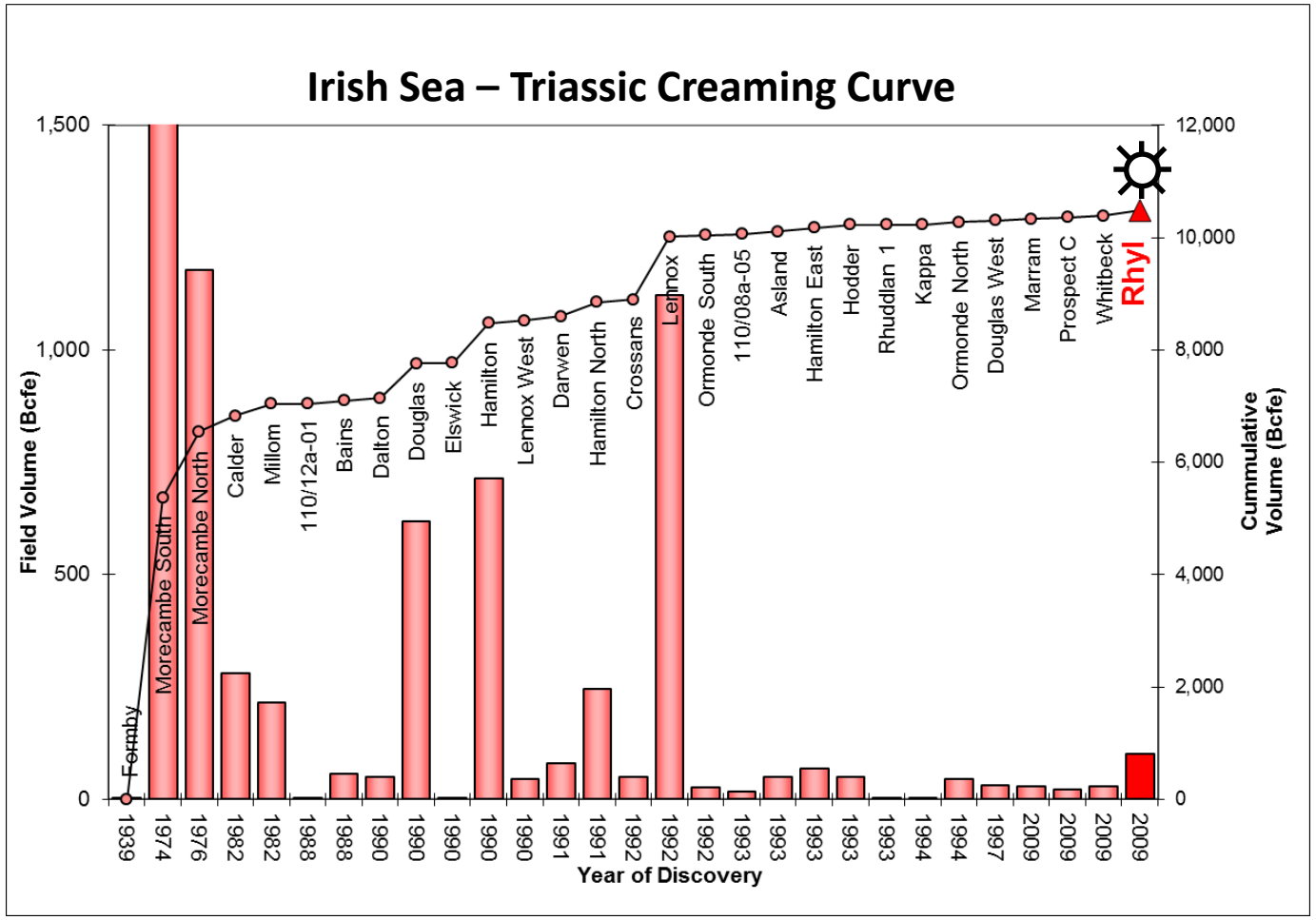
Triassic - Creaming Curve







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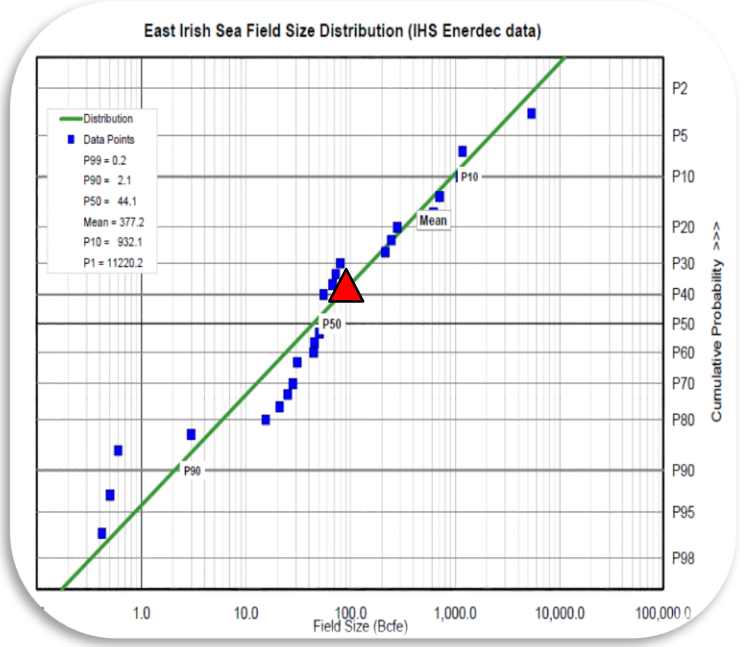
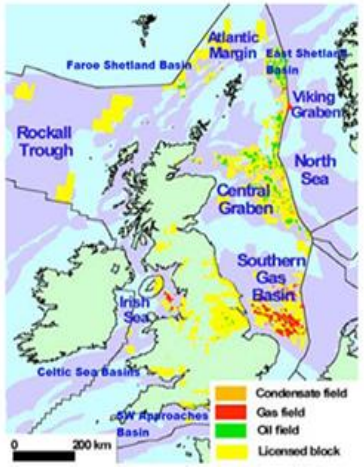
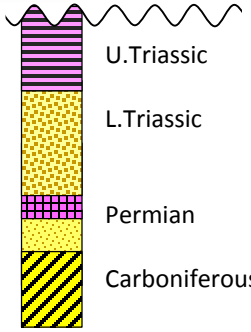
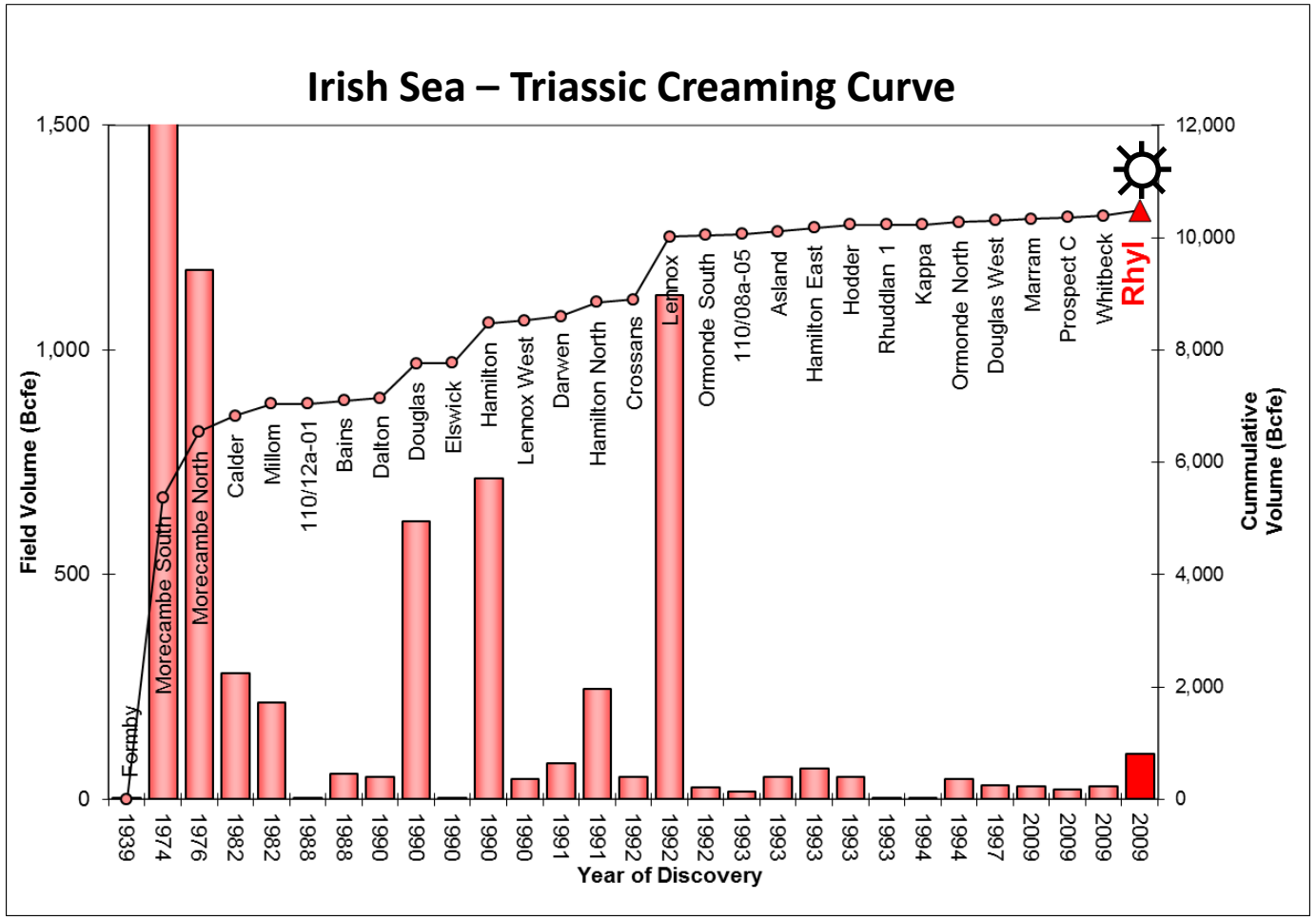




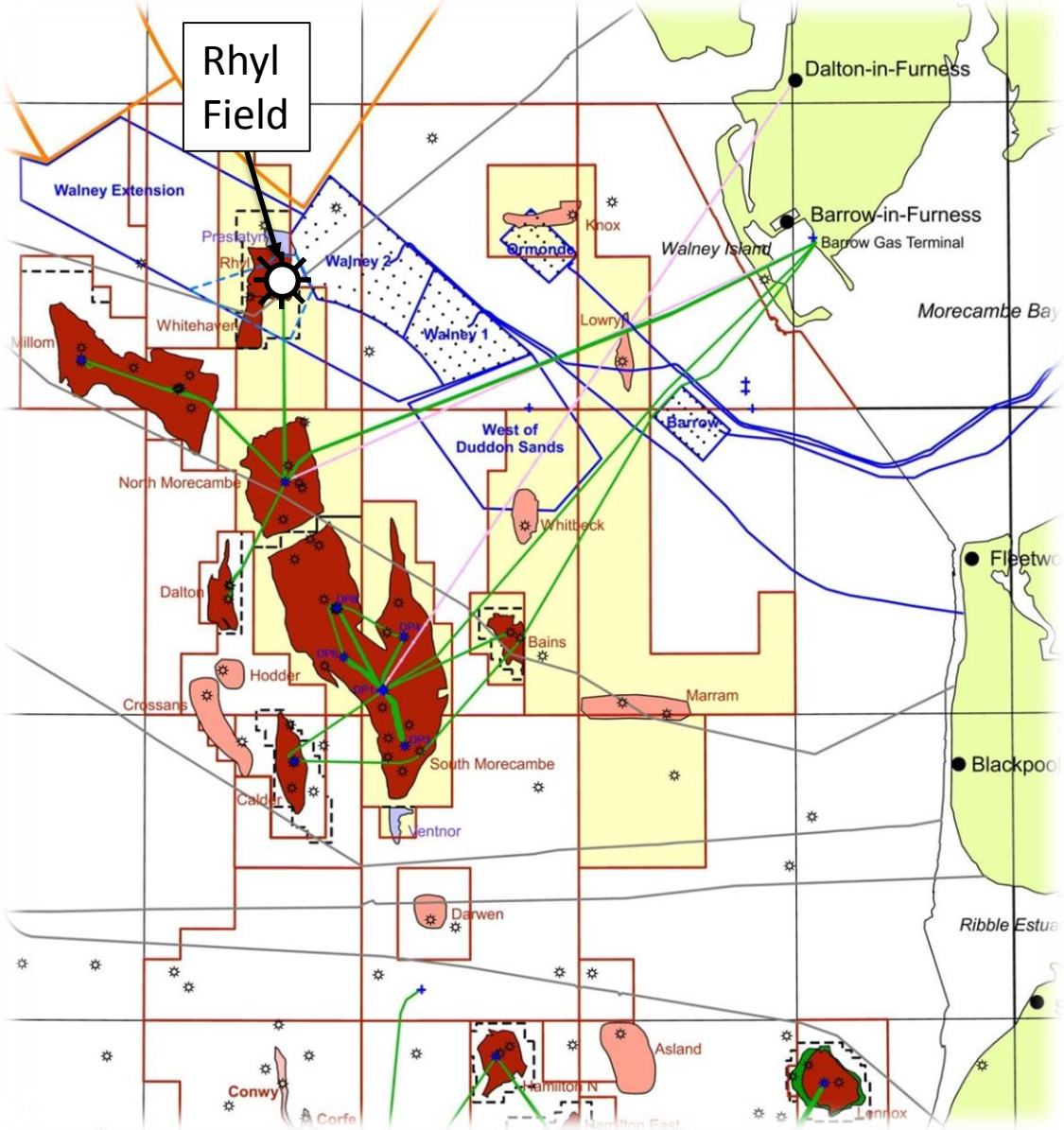


Basin has undergone inversion and removed Tertiary & Cretaceous

- Rhyl is a P40 discovery
- Over 100 Bcfe of Reserves



Mature and Busy Offshore Area



Time Line

2006 – 24th Round application

2007 – Licence start 1st April

2008 – First Seismic reprocessing

2009 – Discovery 113/27b-6

2010 – Geo model and Wind licence

2011 – Shallow seismic

2012 – Appraisal and Dev drilling

2013 – First Gas 31st March

Stakeholders:

- *DECC*
- *The Crown Estate*
- *Renewables operators : Dong, Vattenfall*
- *Ferries & Port Authorities*
- *Ministry of Defence*
- *Hoegh LNG Terminal*
- *Gateway Gas Storage*
- *Power Stations*
- *Refineries*
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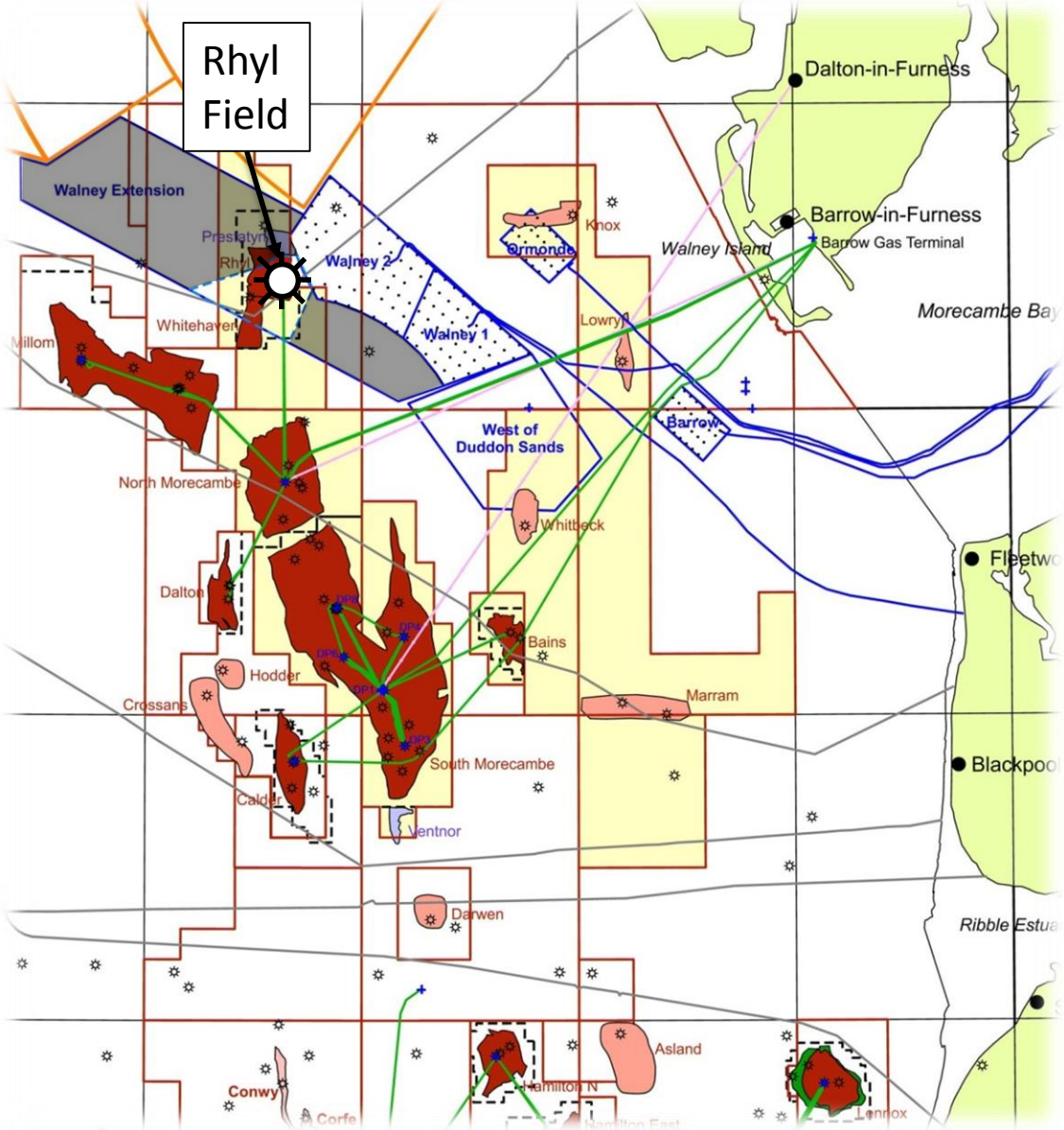

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201X – Wind Farm and Drilling?

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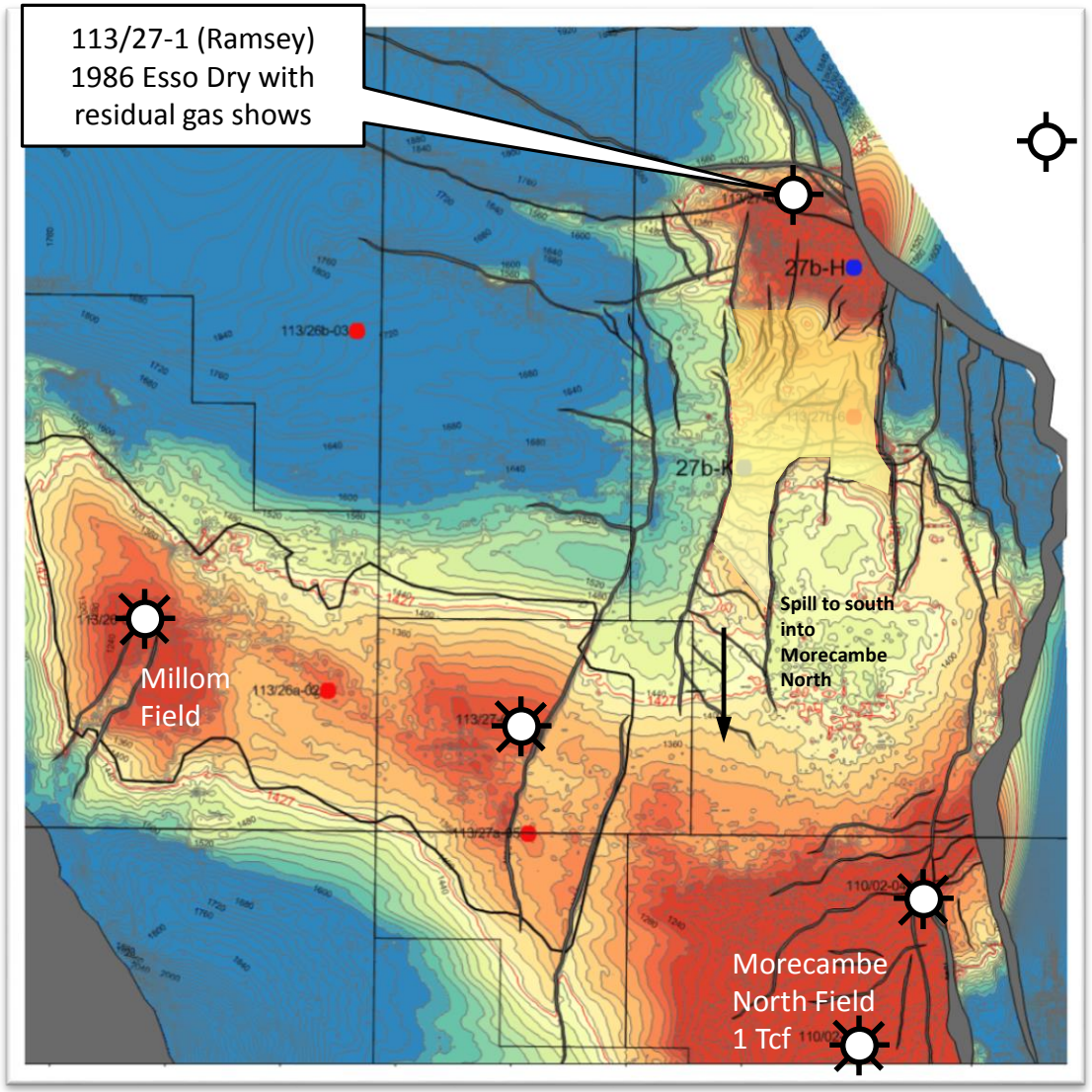
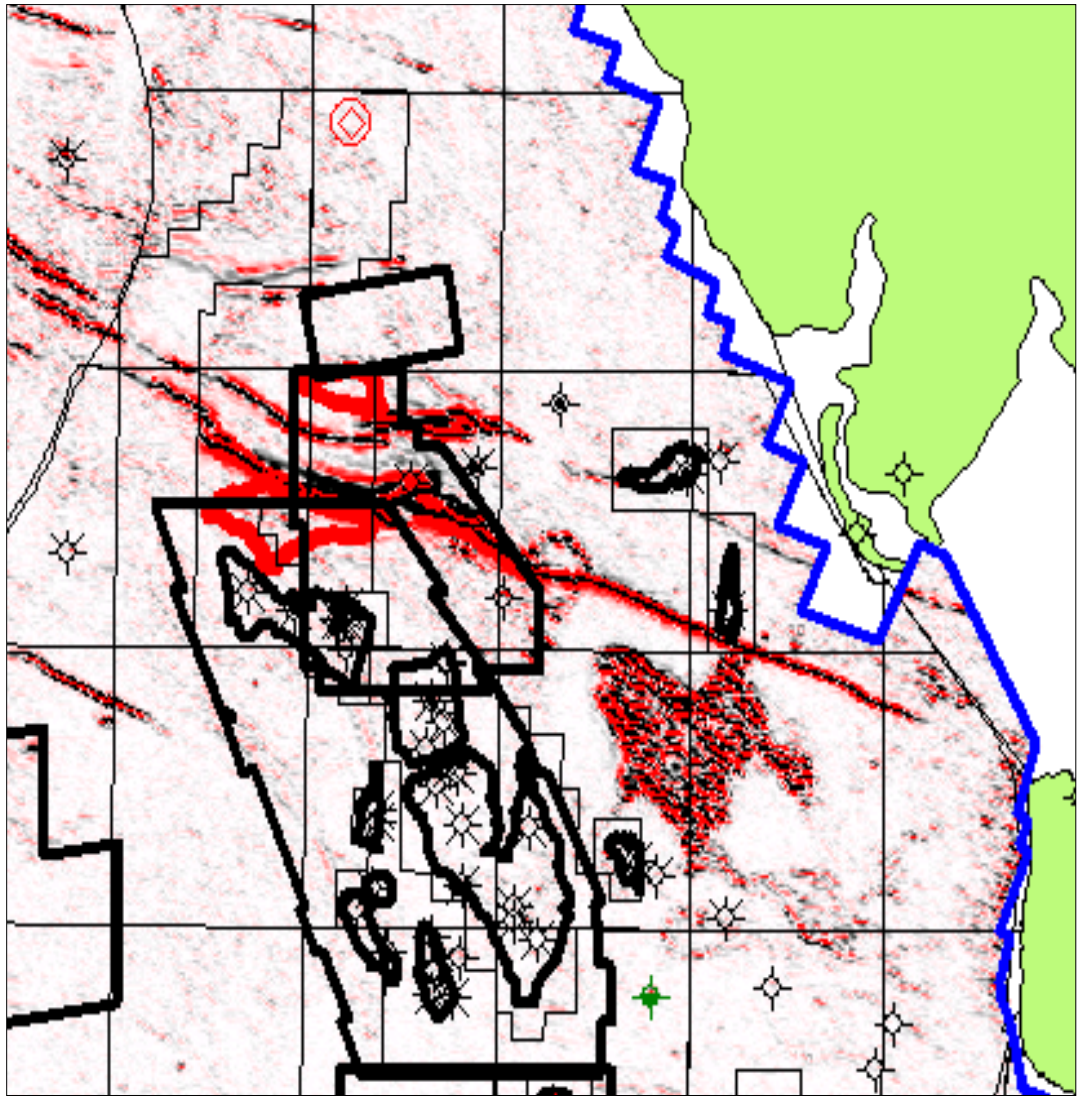
Pre Rhyl Field Drilling



Magnetic Anomalies



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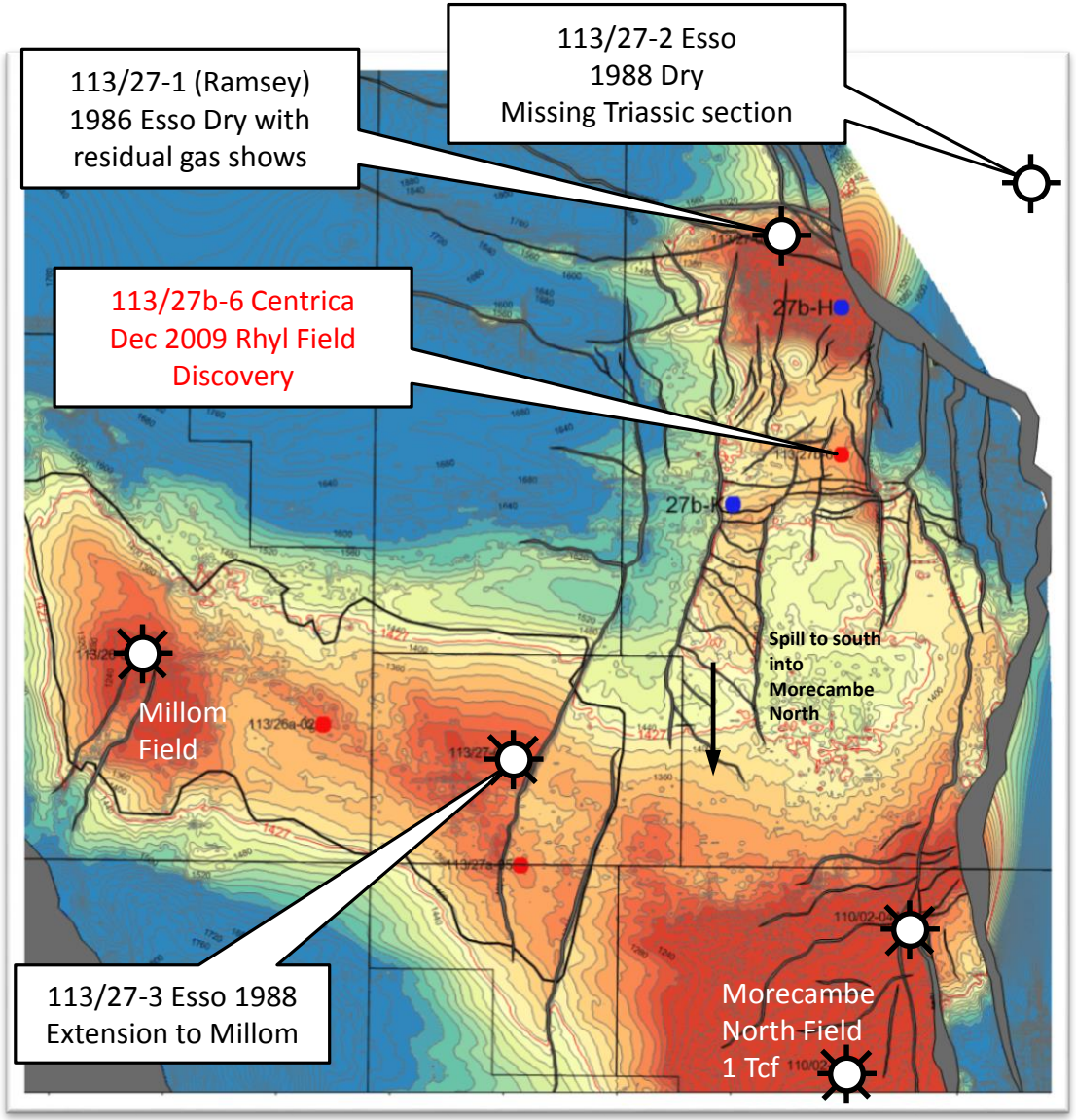

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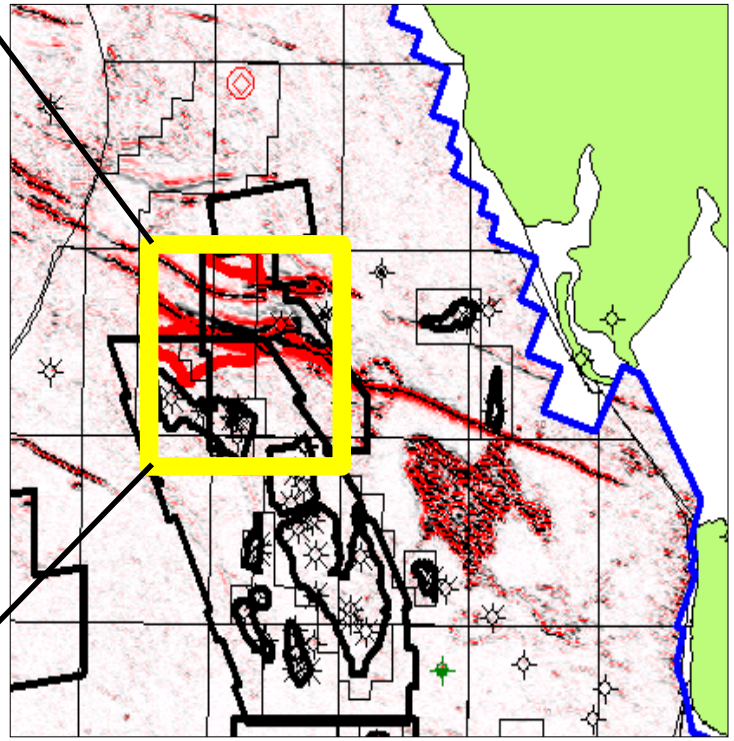

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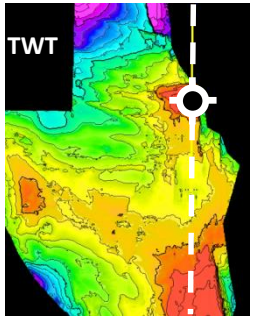
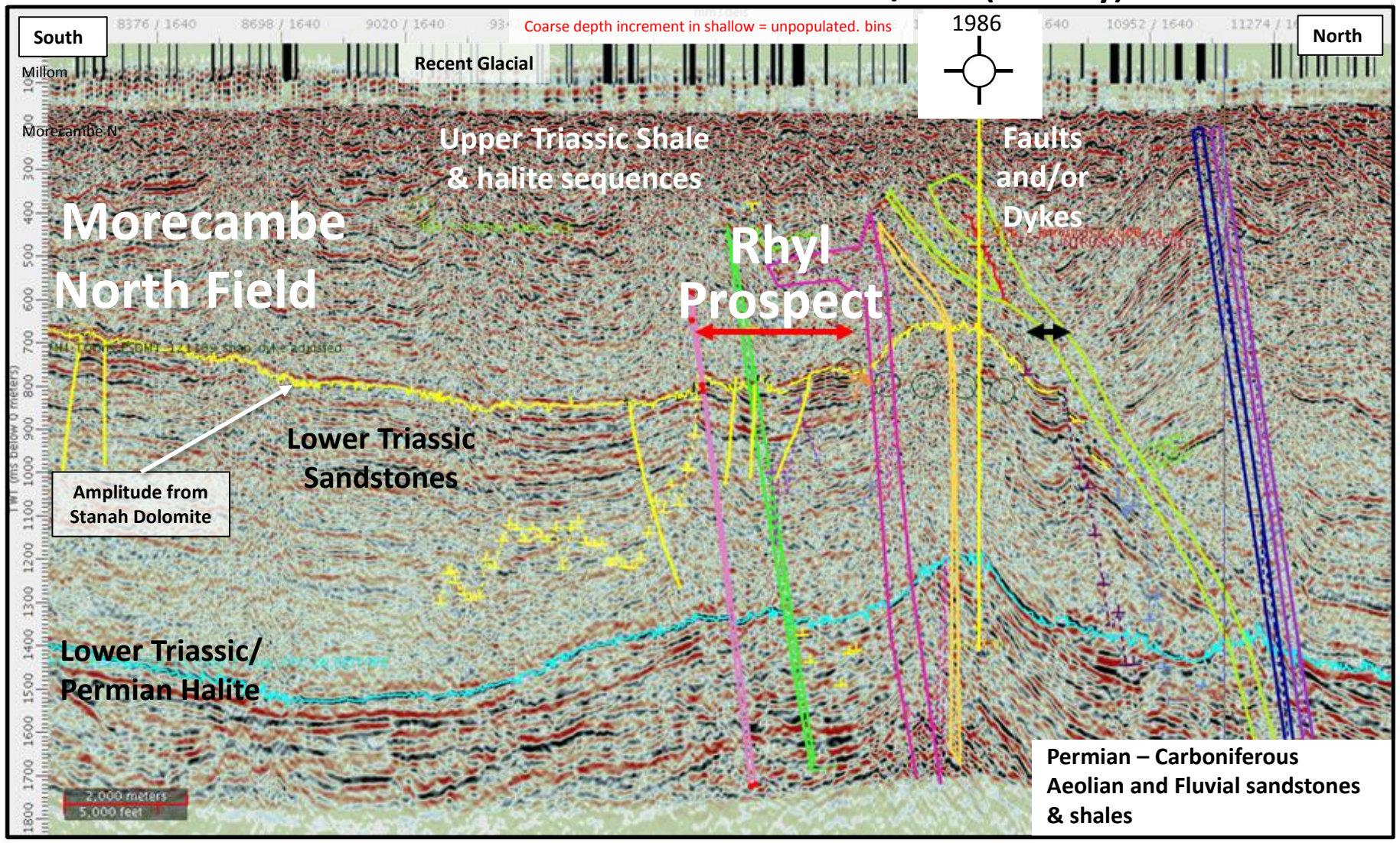
Rhyl Pre-Discovery Seismic

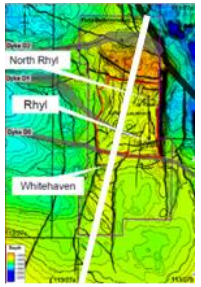
2008 PSDM stretched back to TWT



113/27-1 (Ramsey)



Rhyl Geoseismic and Drilling



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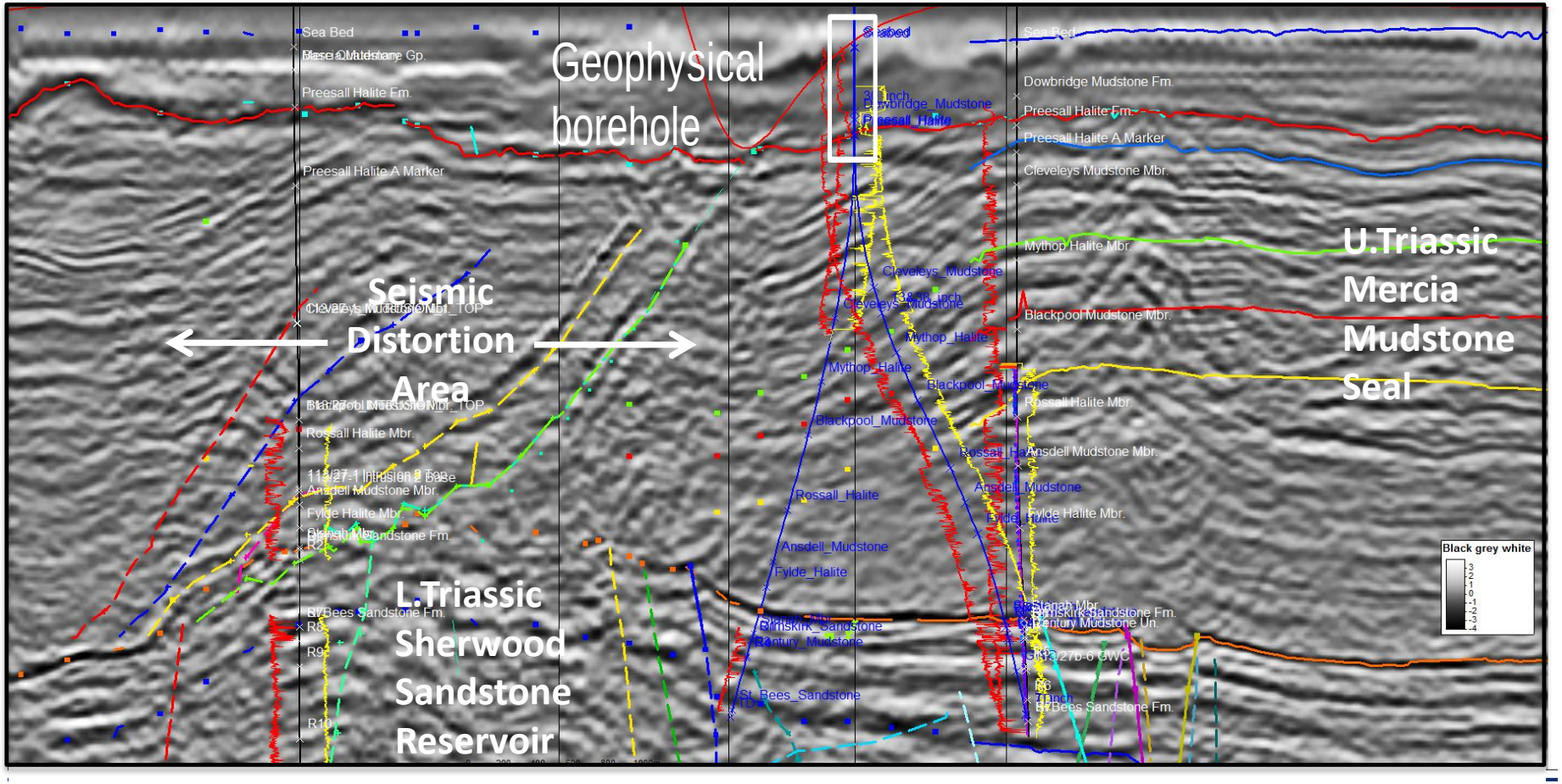
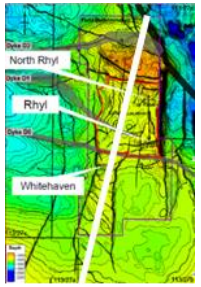
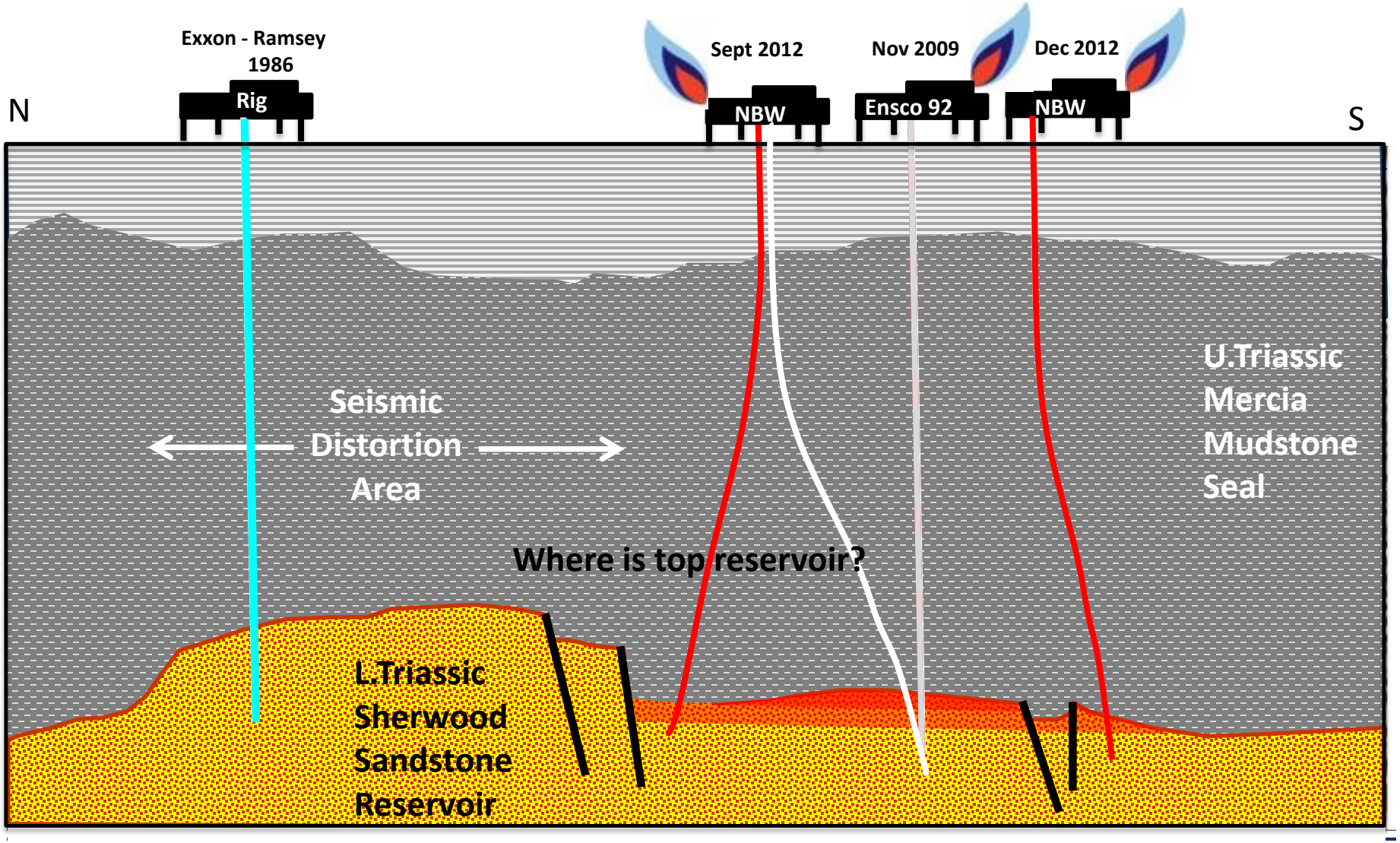


113/27b-8 113/27b-7 113/27b-6 113/27b-9

Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

Rhyl Geoseismic and Drilling





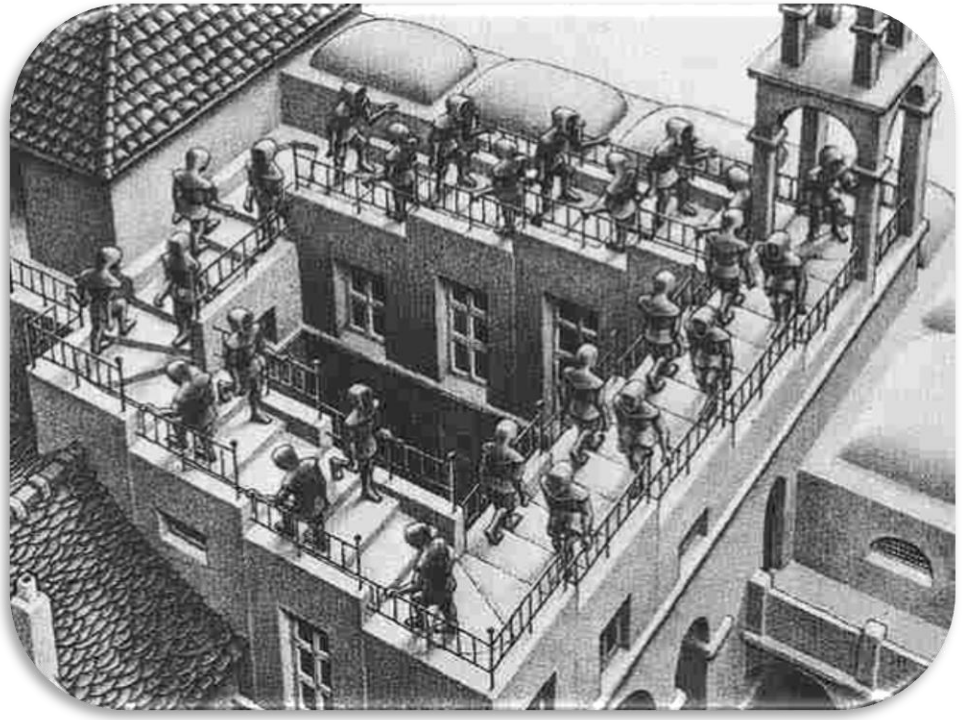
Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

Successful Oil and Gas Finders Use Geological Principles

Priority #1

Understand the structure first and before you start seismic processing

1. Seismic velocities not the same as rock velocities
2. Compression can create lineaments
3. Understand relay-ramp fault structures
4. Deep structure can/will control shallow structure
5. Igneous dykes follow paths of weakness (i.e. faults)
6. Understand formation of L.Triassic pull-apart structures



"Risk Analysis does not replace good G&G – it presupposes it..."

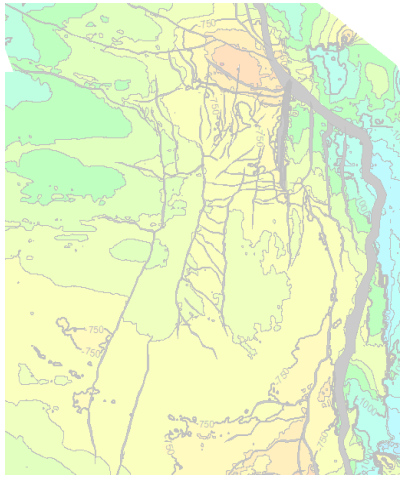
Dr. Peter R Rose, AAPG Short Course

"Successful oil and gas finders ensure that their interpretations are geologically and geometrically valid in three dimensions – e.g. M.C. Escher"

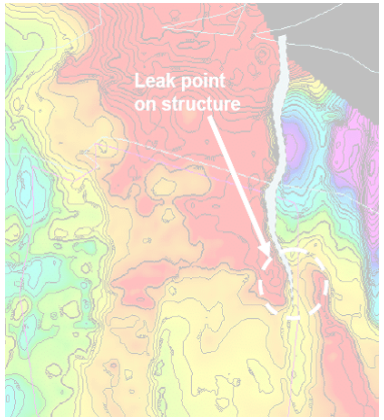
Dan Tearpock, AAPG 'Ten Habits of Successful Oil Finders'

Evolution of Rhyl Maps

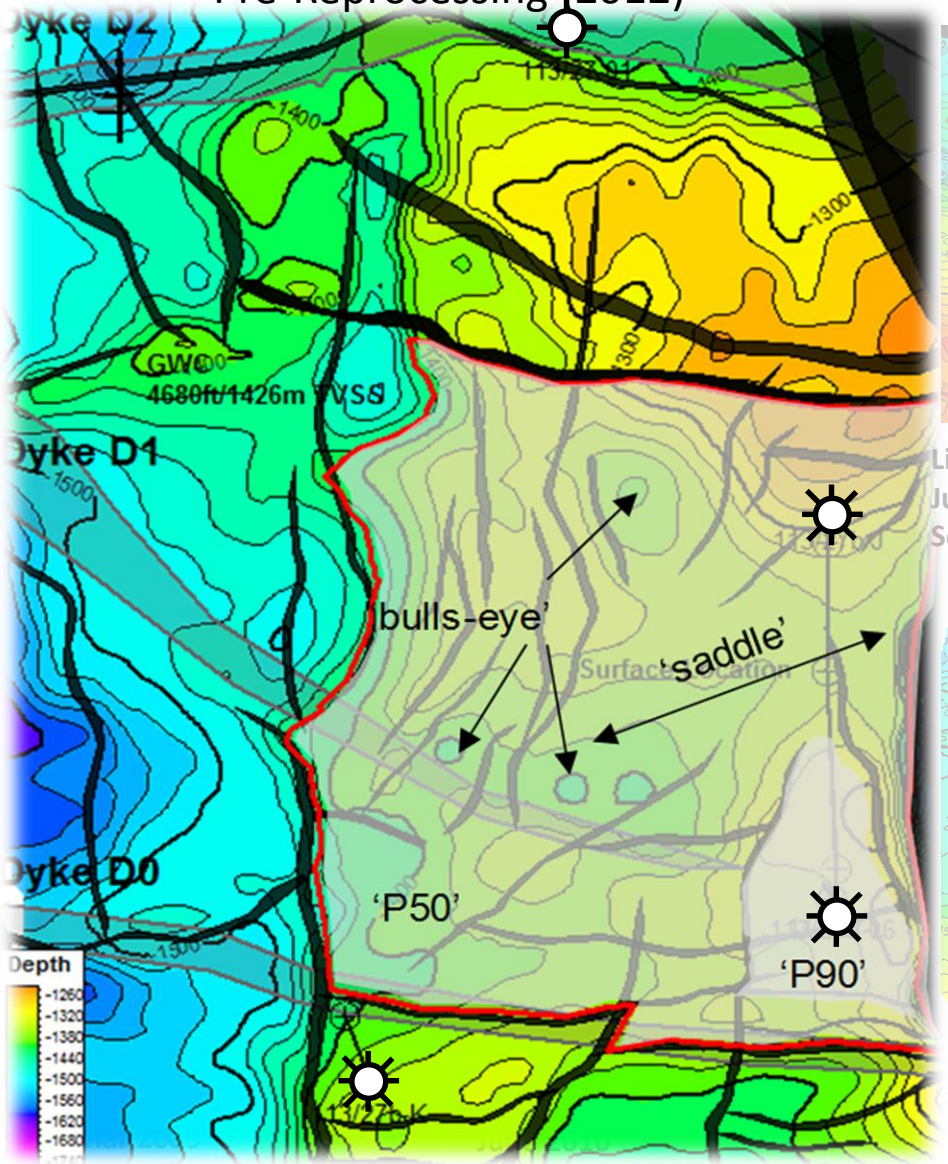
Pre-Reprocessing (2012)

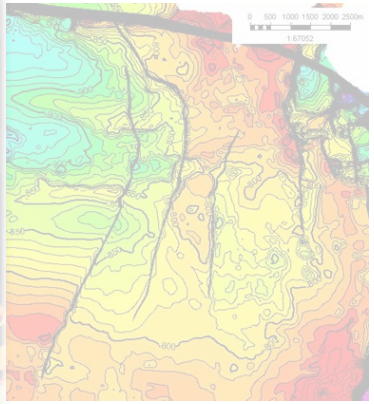


TWT : 2009 - 2013

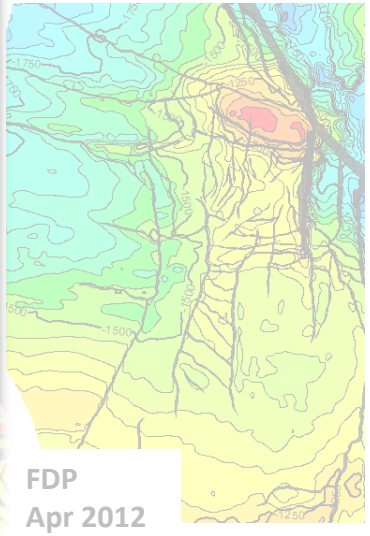


Peer review
Jul 2009





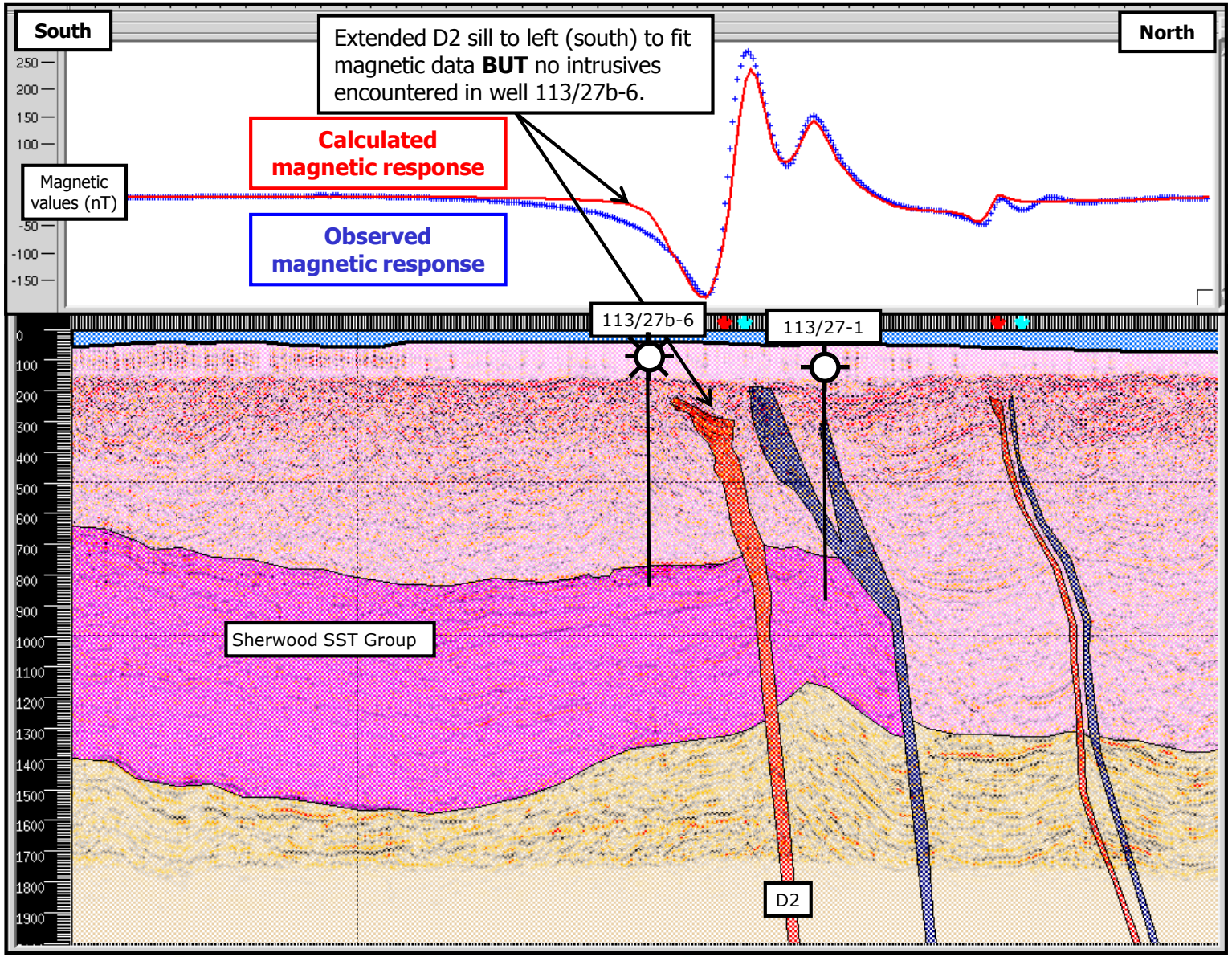
Licence Application
Jun 2006
Seis Vels



FDP
Apr 2012

Reference = Devex 2014
(http://www.devex-conference.org/programme_archives/presentation-archives.php)

Igneous Magnetic Response

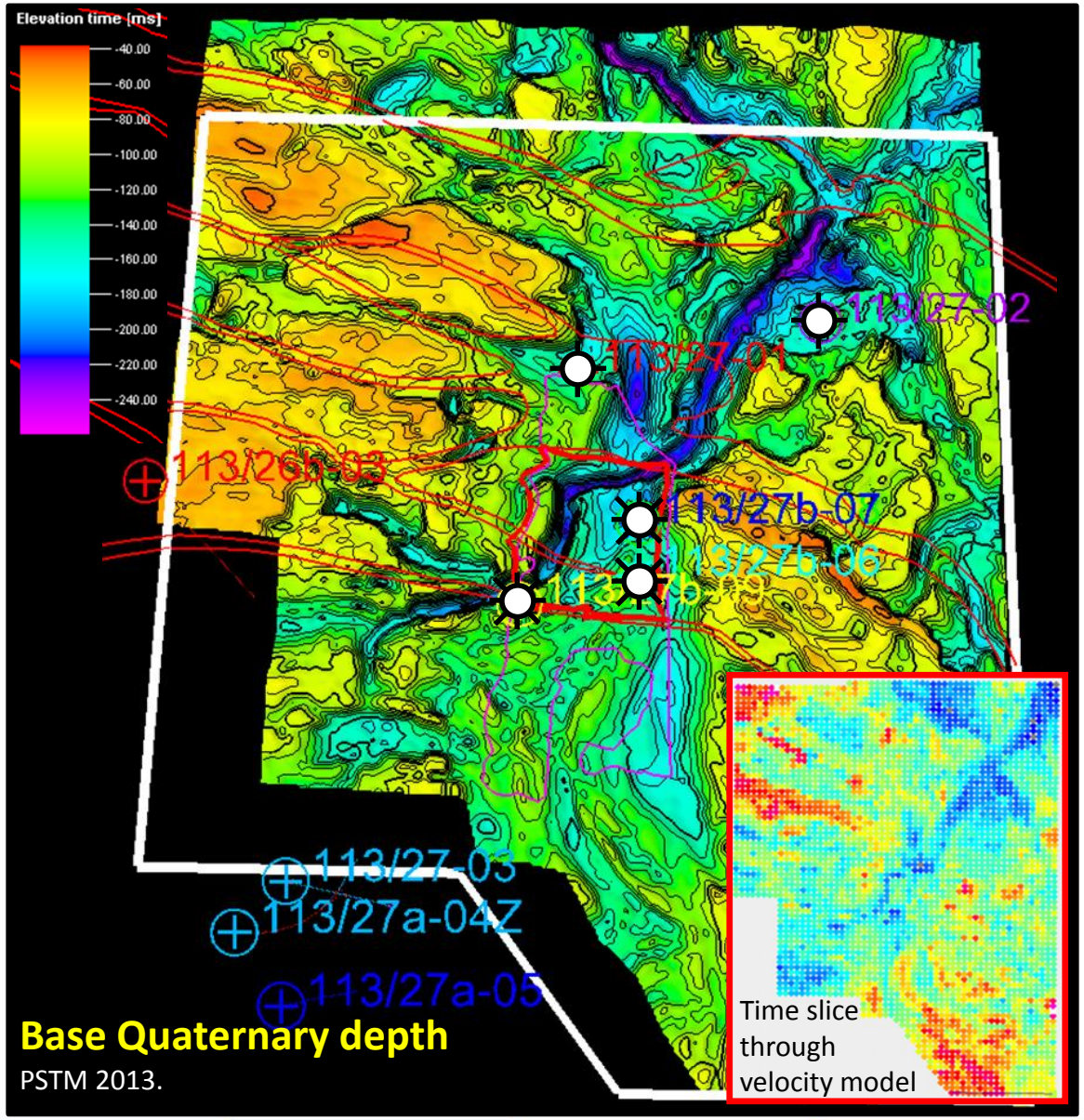


Basic Geology

= Lineaments are Stress Fields

Reference = Devex 2014
(http://www.devex-conference.org/programme_archives/presentation-archives.php)

Shallow Velocity Field



Base Quaternary depth

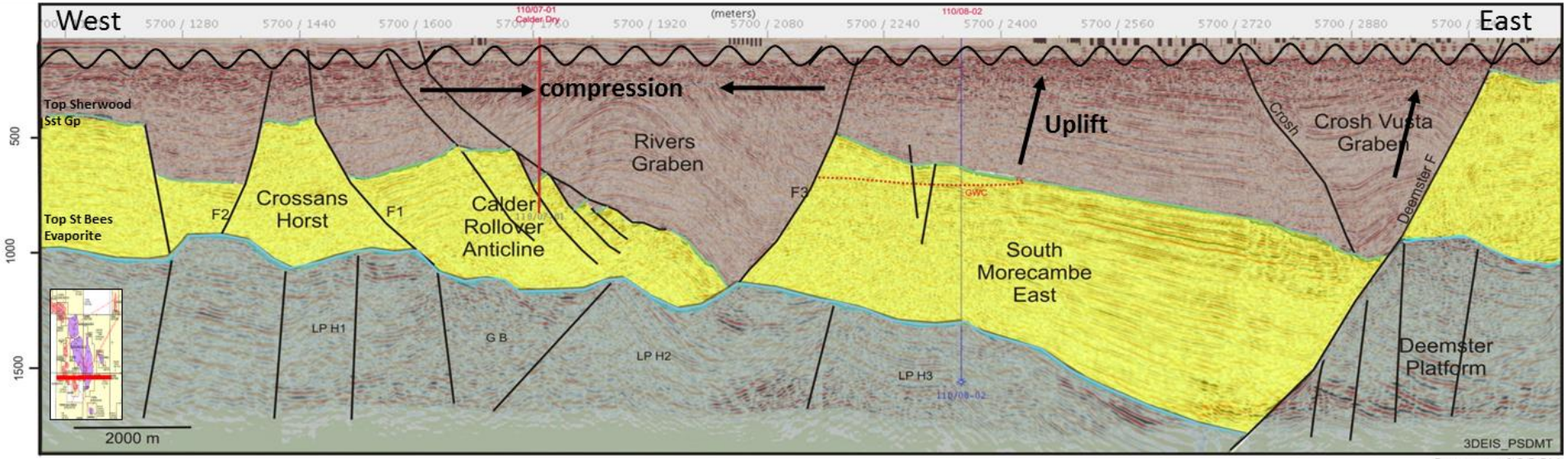
PSTM 2013.

Basic Geology = Shallow Channels

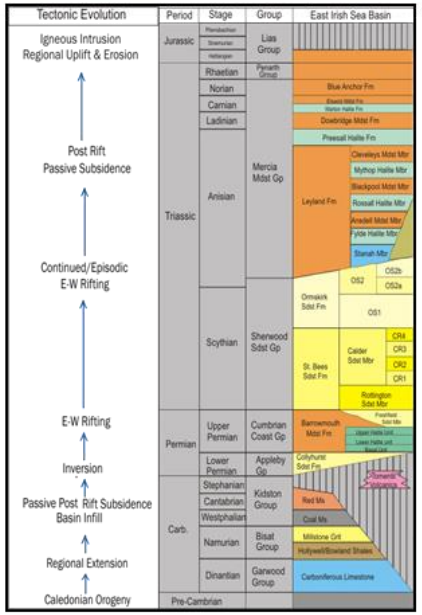
- Excellent imaging of the base quaternary channel systems in Rhyl area
- Good correlation between channel orientation and underlying tectonics
- Good imaging of Dykes over northern extension achieved on the PSTM
- Interpret and include in PSDM velocity model (RTM)
- Impact the GRV on western side of Rhyl field

Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

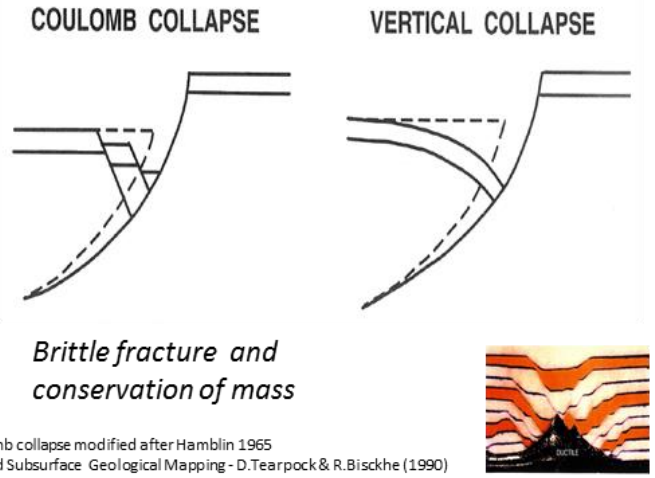
Triassic Pull-Aparts : SNS v EIS



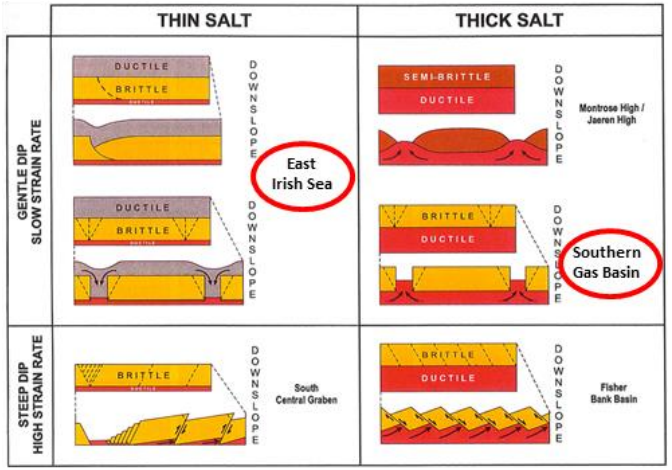
Courtesy of CGGV



Brittle on Ductile and Thin salt



Coulomb collapse modified after Hamblin 1965
Applied Subsurface Geological Mapping - D.Tearpock & R.Bisckhe (1990)



Rift-Raft tectonics of gravitational tectonics from the Zechstein basins of northwest Europe, Petroleum Geology Conference Series, 5 P201-213. Penge J, Munns J, Taylor B, & Windle T

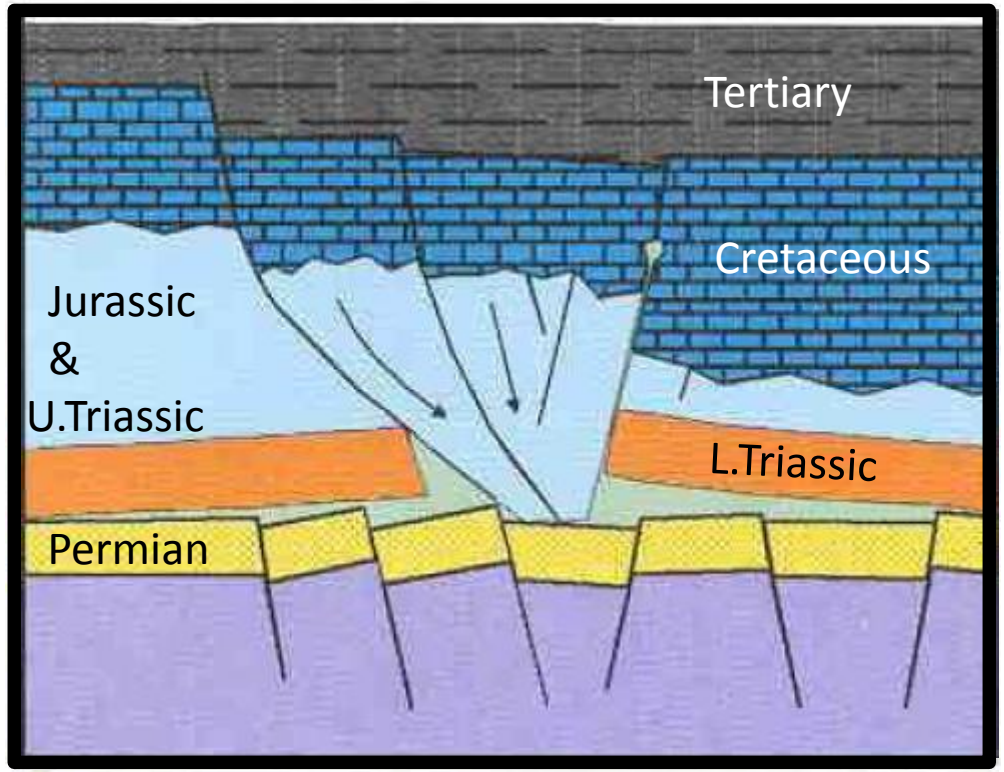
Basic Geology
= Extension followed by compression

Therefore expect to see Compressional **AND** Extensional faulting

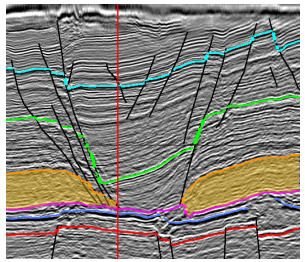
SNS Lower Triassic Pull-Apart

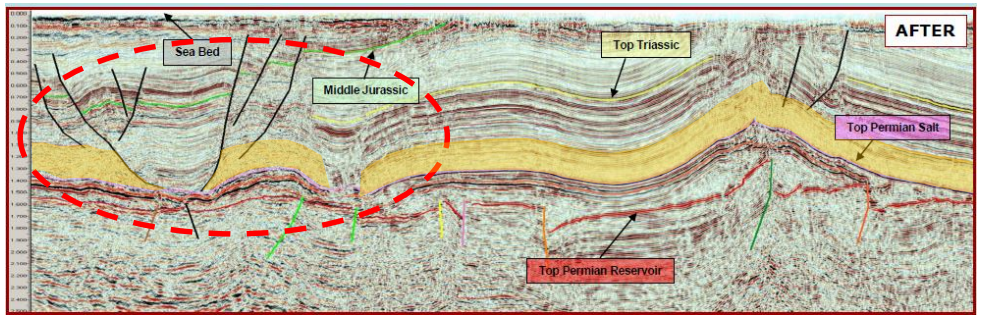
Southern Gas Basin (Quadrant 48)

- Tertiary muds
- Cretaceous chalk
- Jurassic & U.Triassic mudstones & halite
- L.Triassic sandstones
- U.Permian halite
- L.Permian sandstones
- Carboniferous sandstones & mudstones



Basic Geology
= Analogues
(Bunter in SNS is Sherwood in EIS)





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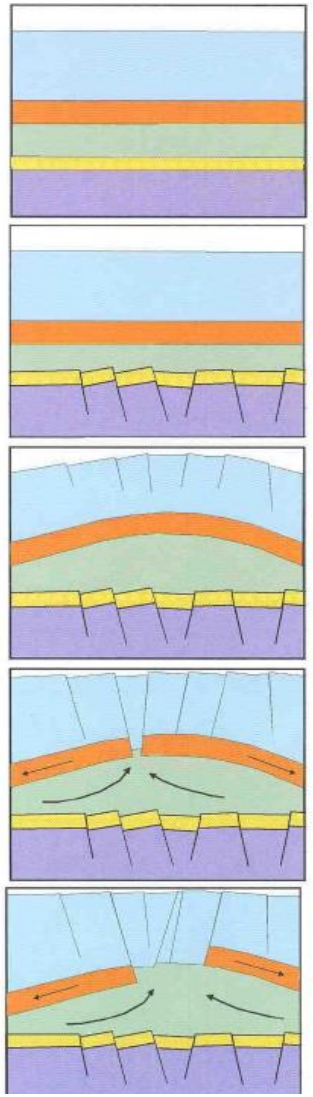
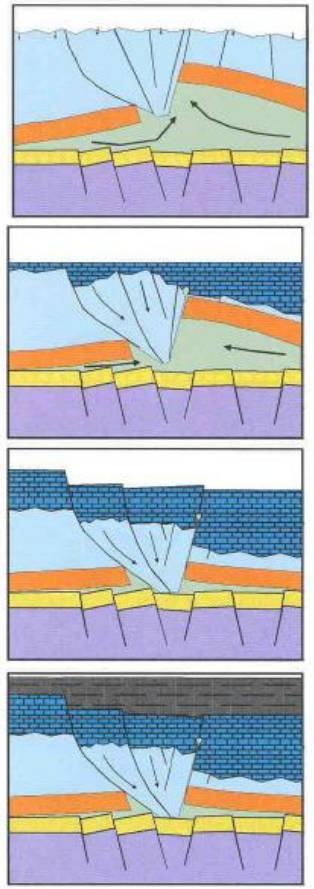
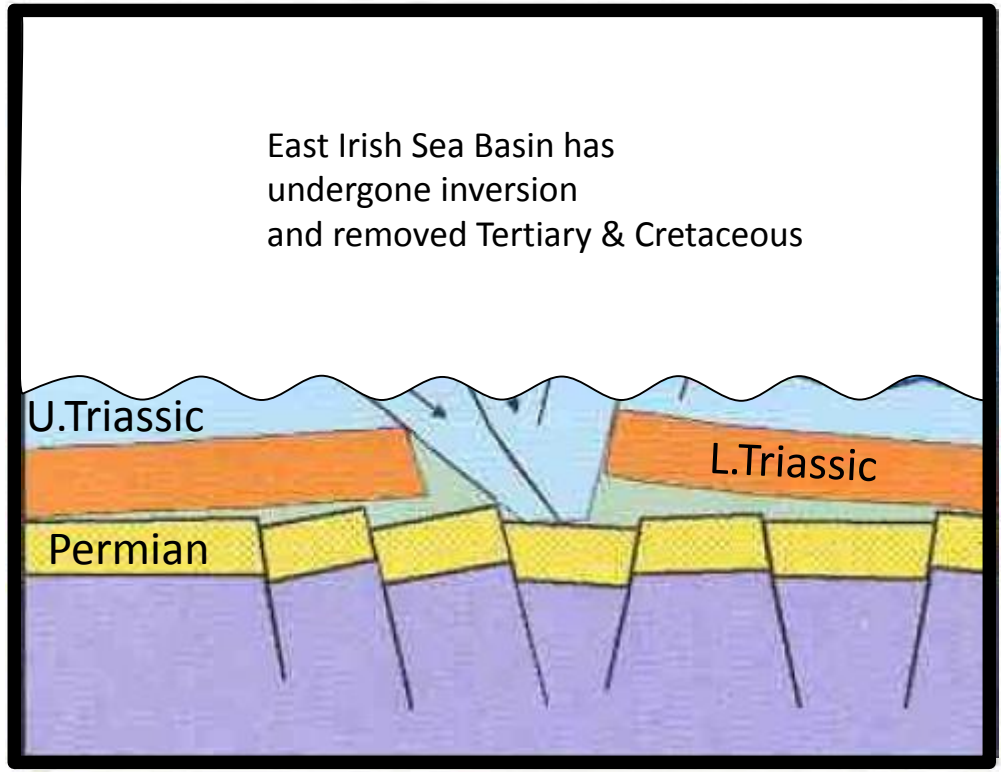
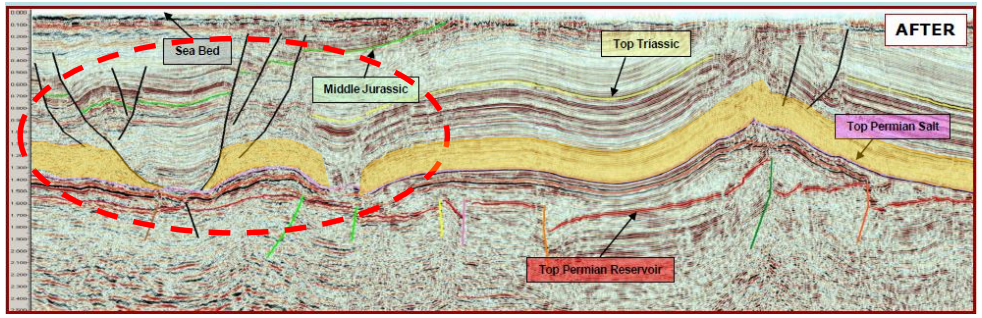




Quadrant 49 Triassic 'Pull Apart'





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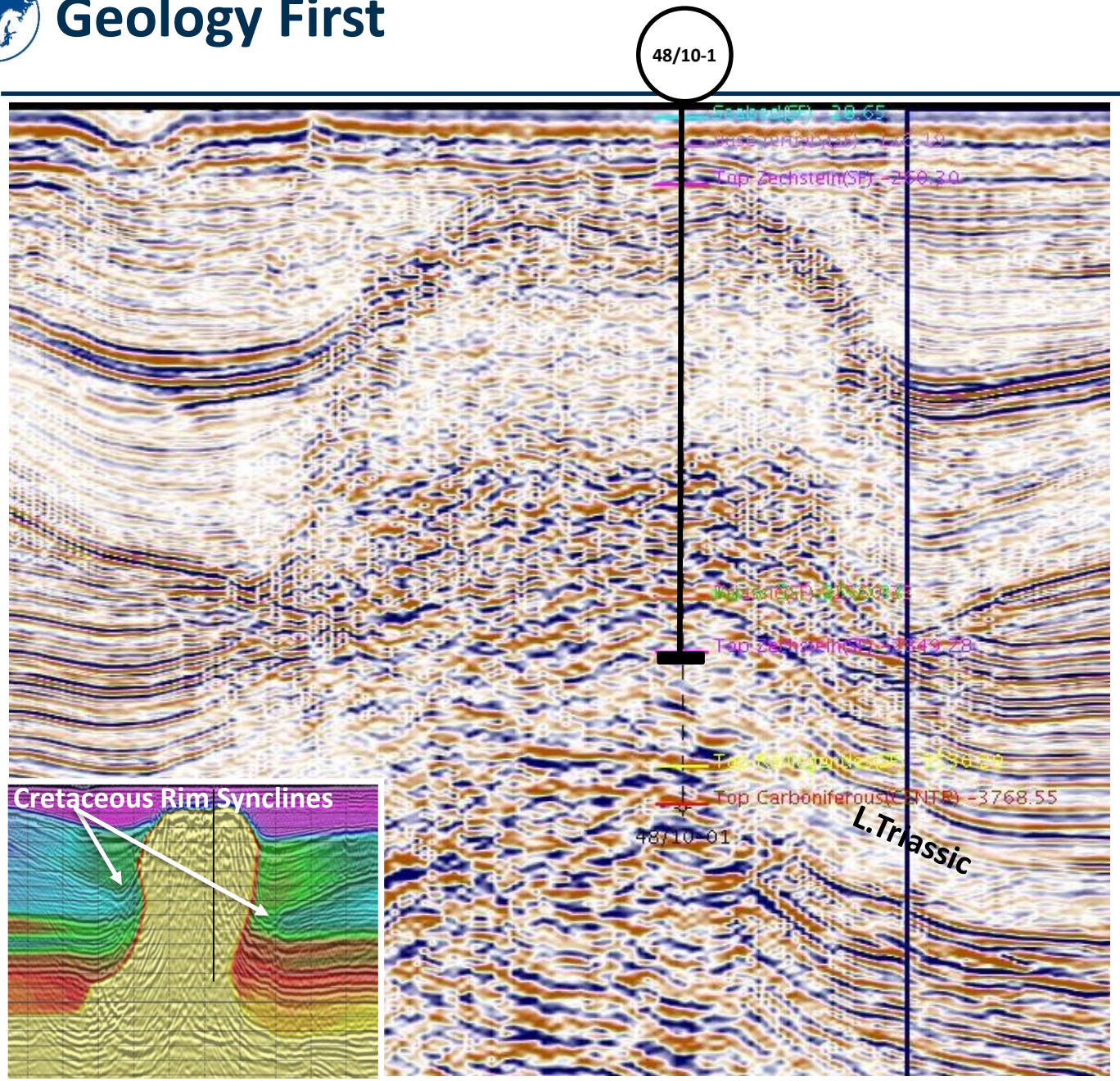
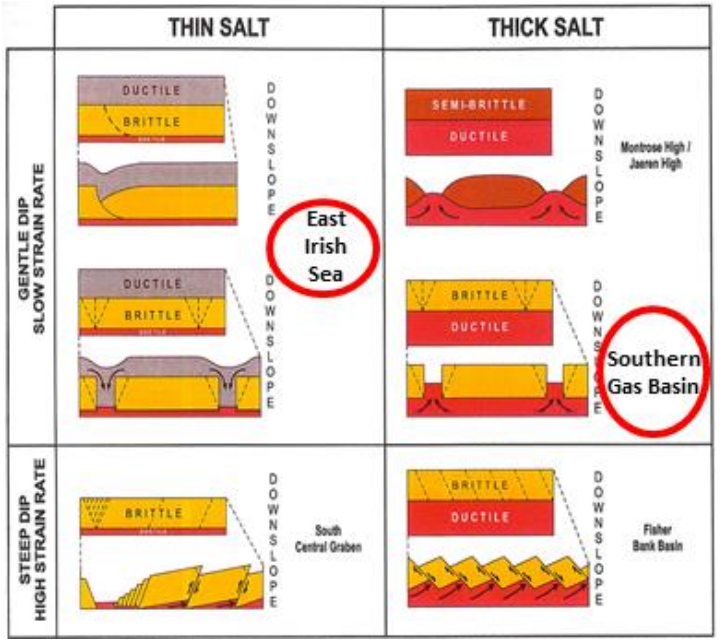
Geology First



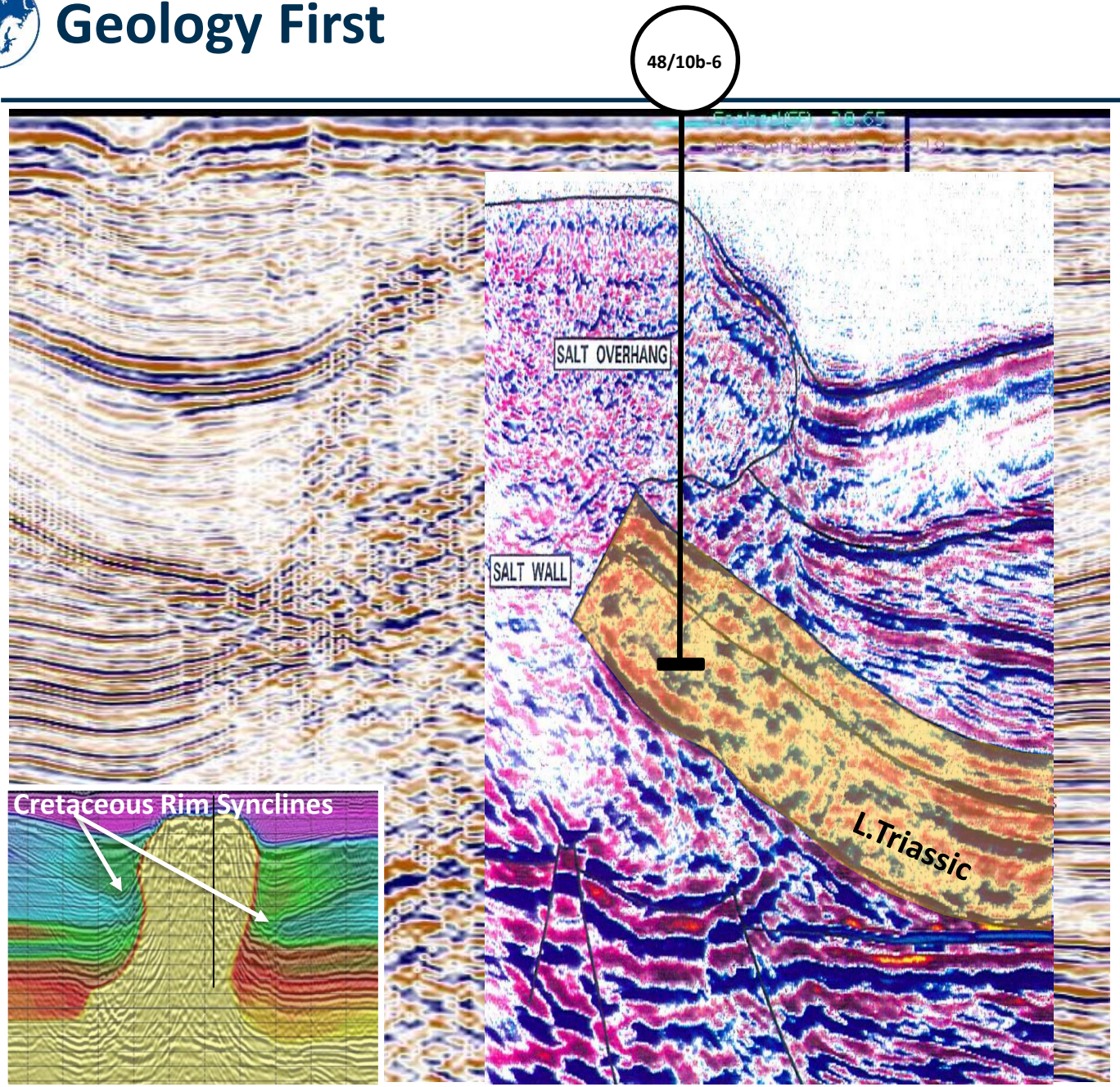
Southern Gas Basin (Quadrant 48)

Basic Geology

= Conservation of Mass



Geology First



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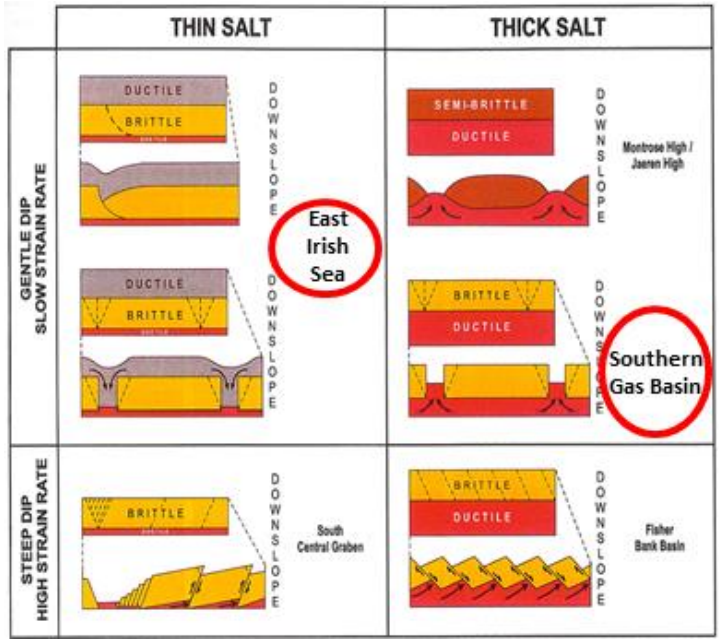
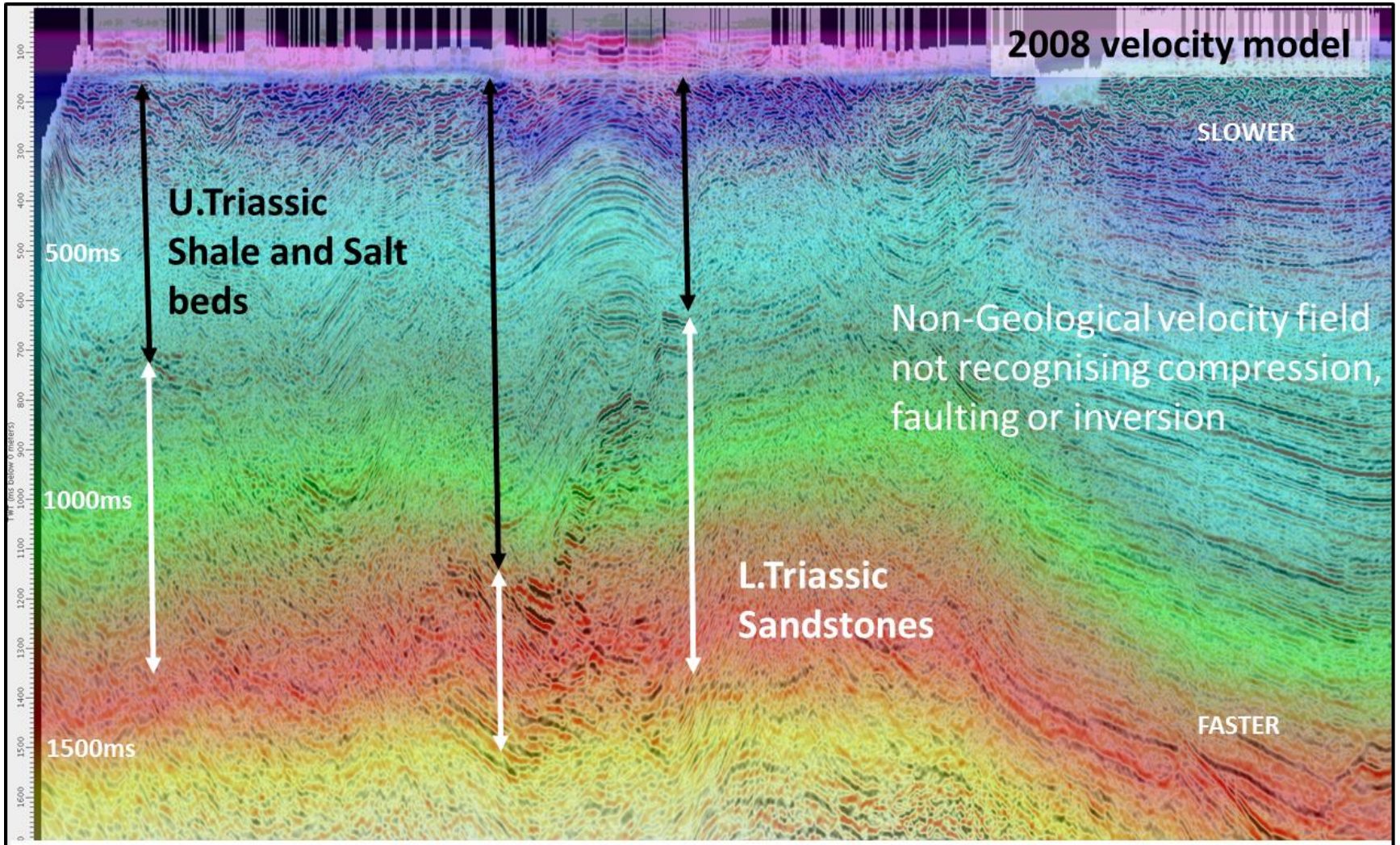


Smooth Migration Velocities



Old velocity model assumed simple velocity field
Halite beds create anomalous velocities not previously considered

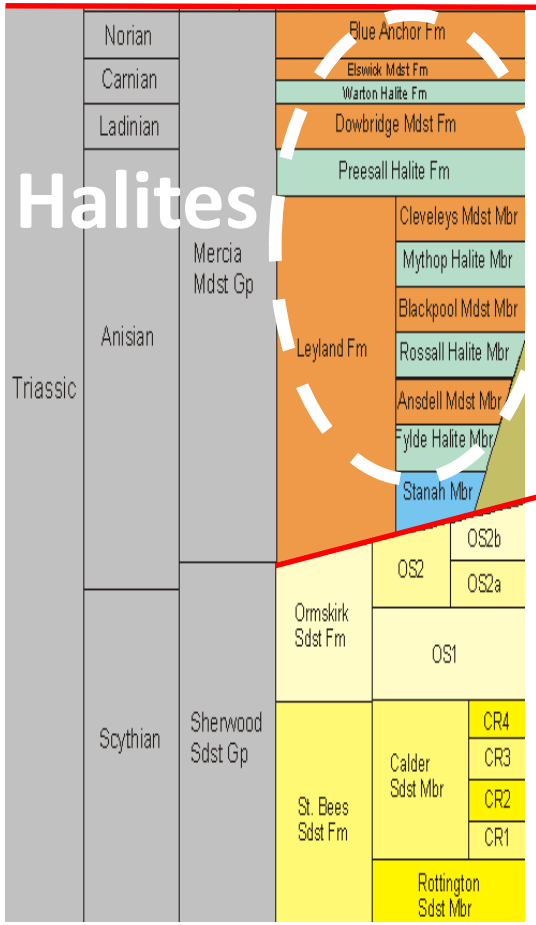
Basic Geology

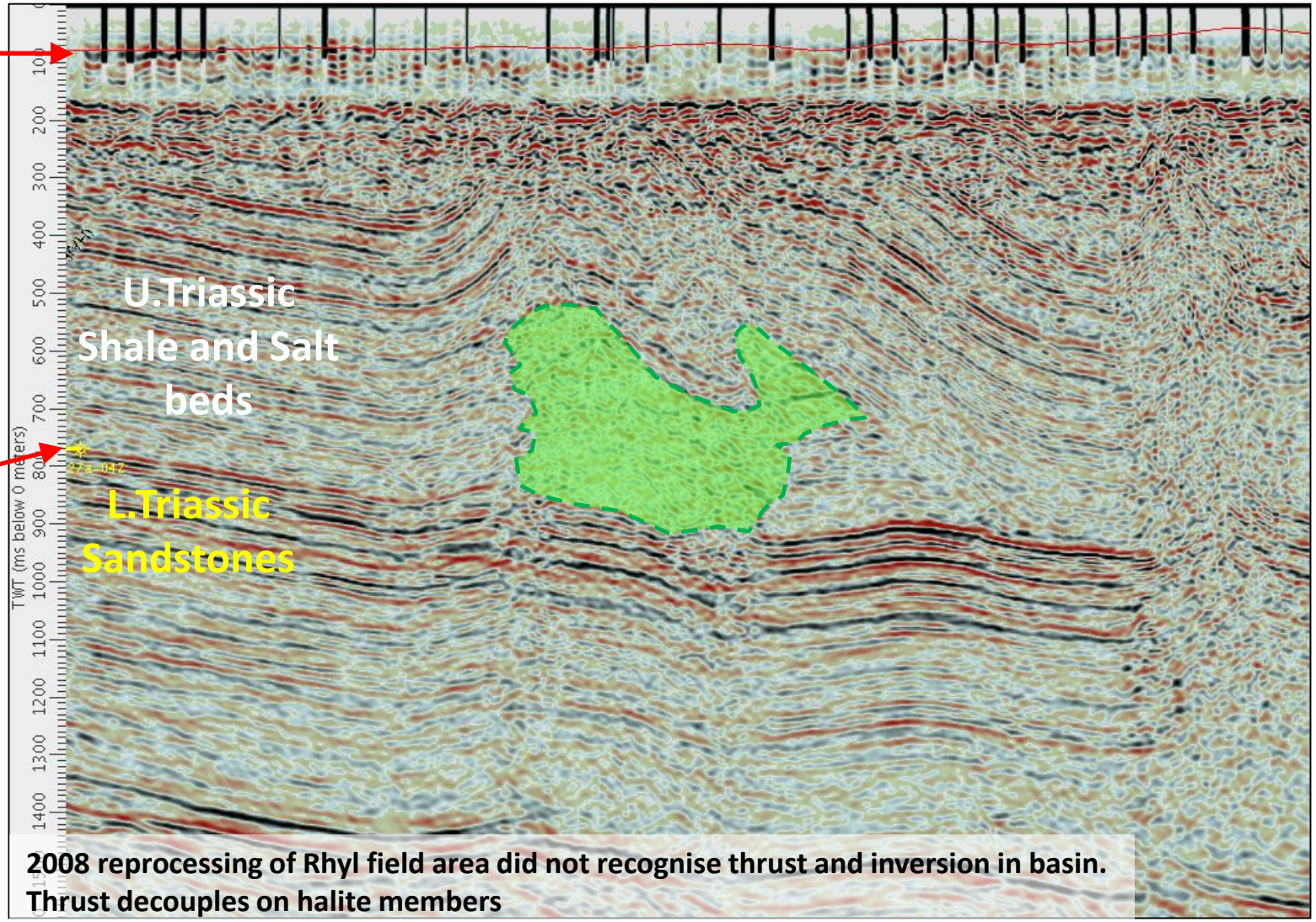
= Seismic Velocities are not same as Rock Velocities

Recognition of Structural Style

Basic Geology = Compression can create Thrust Faults

Brittle and lithified strata





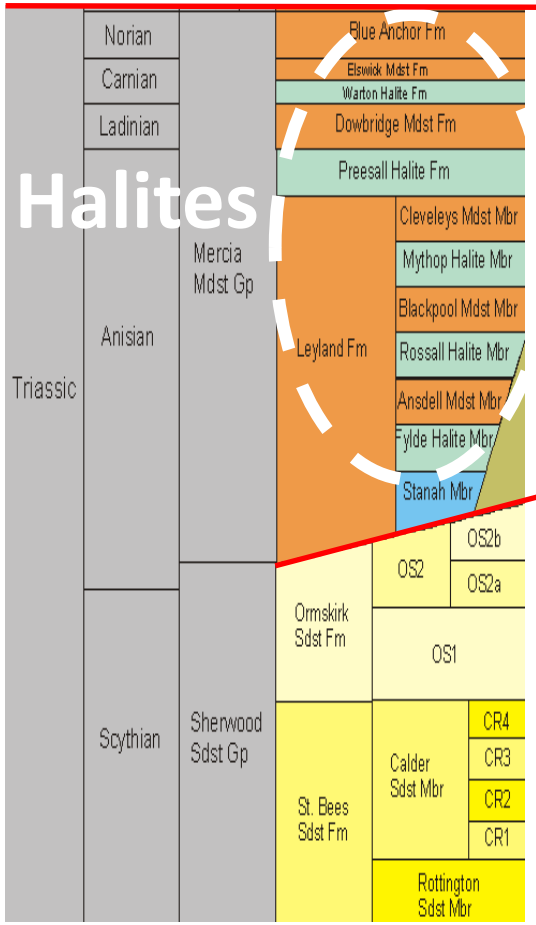
2008 reprocessing of Rhyl field area did not recognise thrust and inversion in basin. Thrust decouples on halite members

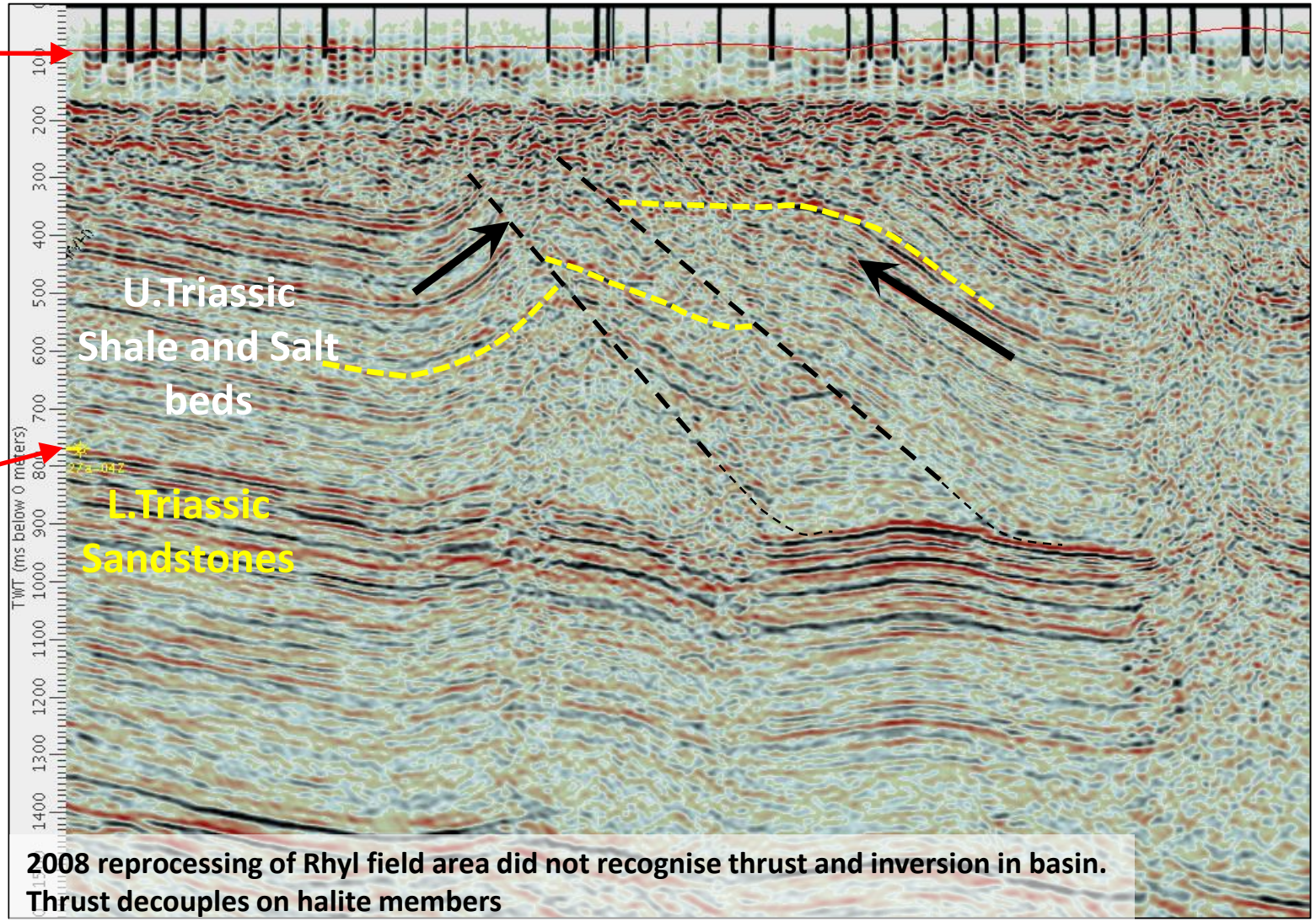
Some interpreters incorrectly interpret 'doming/pillowing' as salt movement

Recognition of Structural Style

Basic Geology = Compression can create Thrust Faults

Brittle and lithified strata





2008 reprocessing of Rhyl field area did not recognise thrust and inversion in basin. Thrust decouples on halite members

Structures actually result of reverse faulting due to compression

Combining Theory and Data

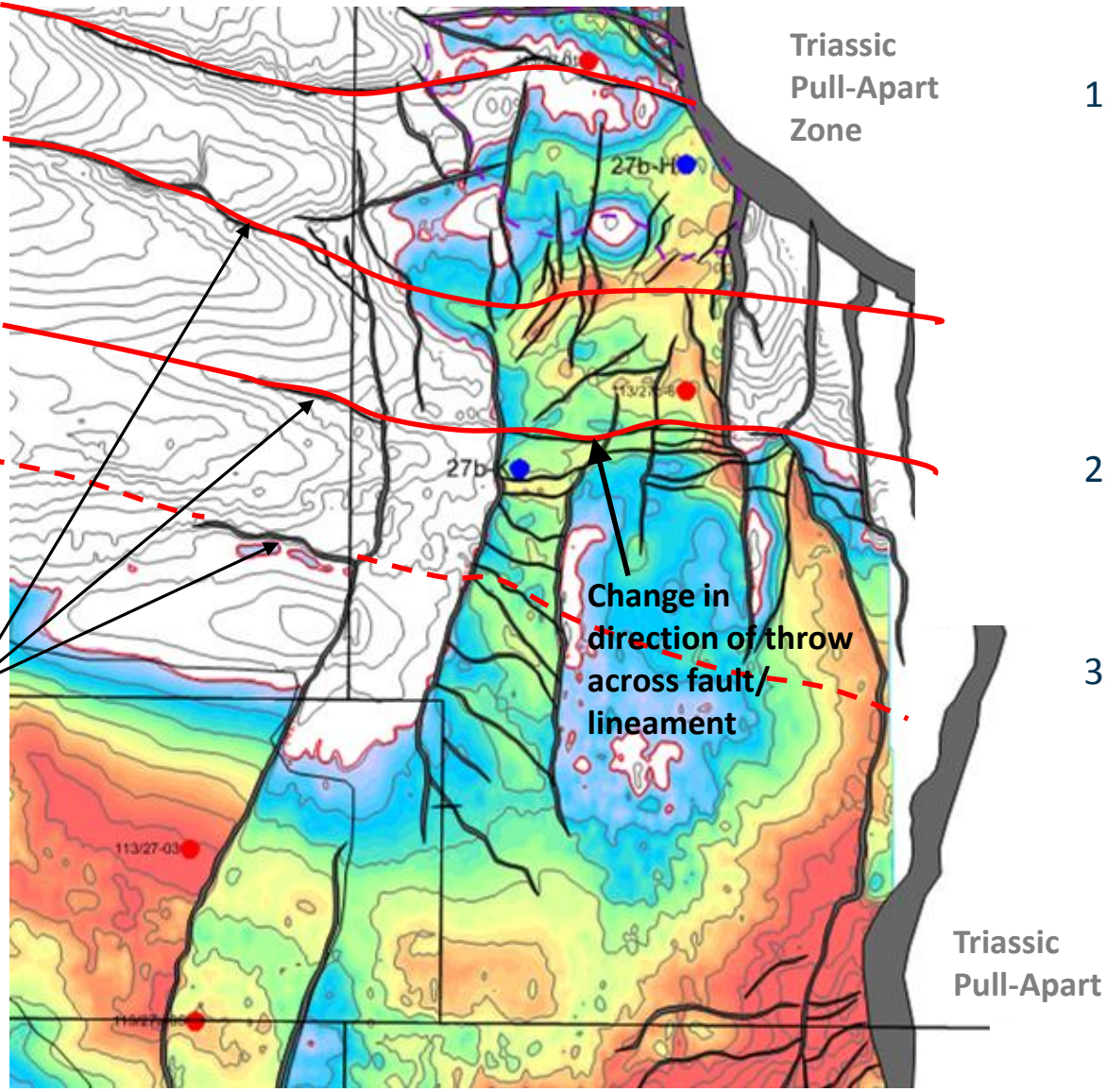
Shear fault or dyke?

Shear fault or dyke?

Shear fault or dyke?

Possible Shear fault?

Negligible Throw across lineaments as mapped



1. East-west seismic discontinuities have negligible throw and are shear faults, not dykes as previously interpreted. (Dykes at Ramsey well exploited previously existing crustal weakness/shear)

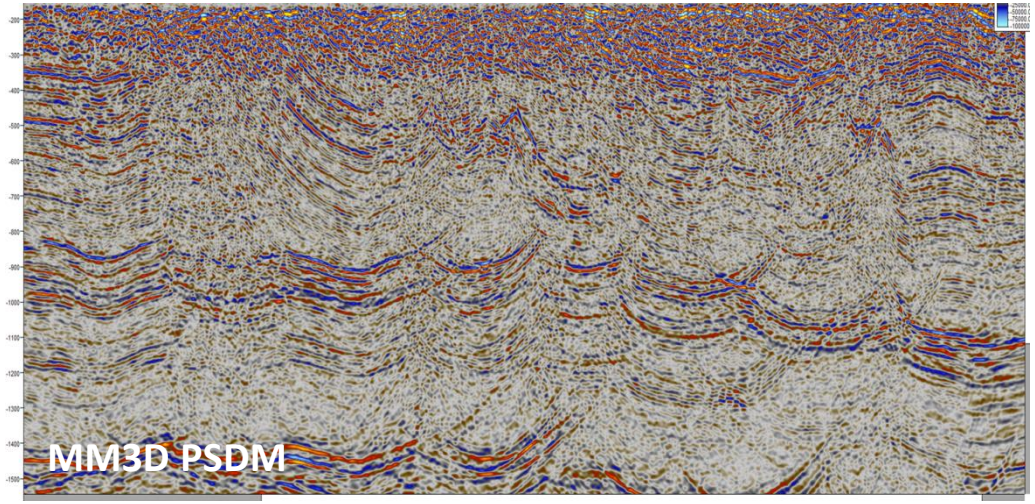
2. Shears set up by offset in Tynwald graben fault

3. Shears created as a response to compression following extension of the Tynwald graben

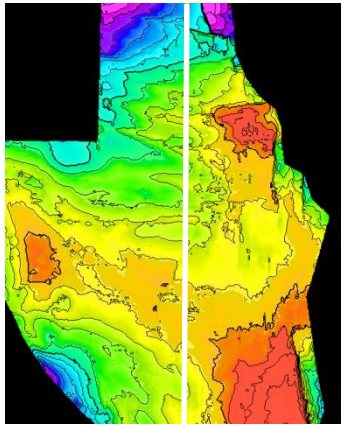
Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

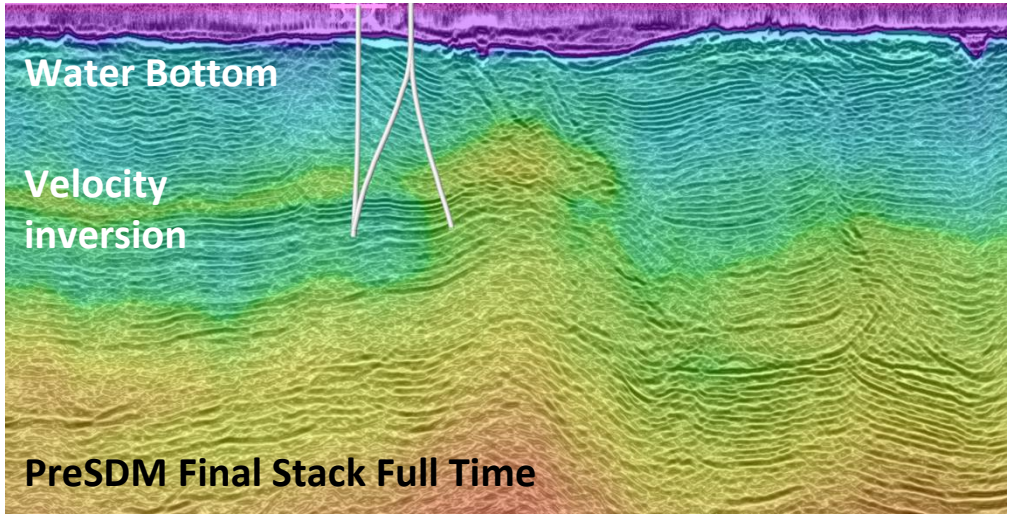
Geology v Processing

Original seismic did not reflect geology

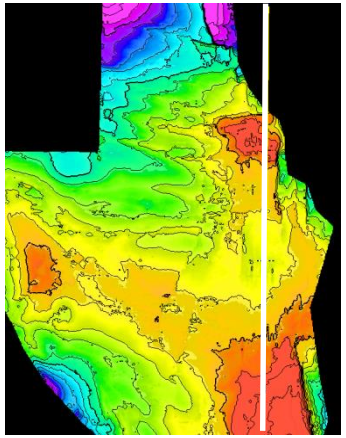


Point diffractions and migration smiles (velocity problems) at compressional shears and dykes





Improved image with velocity inversions and shorter period changes to velocity field. Dykes however still problematic



Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

Post Drill Mapping

Basic Geology

Fault terraces stepping back from Triassic Pull-Apart Graben

NORTH

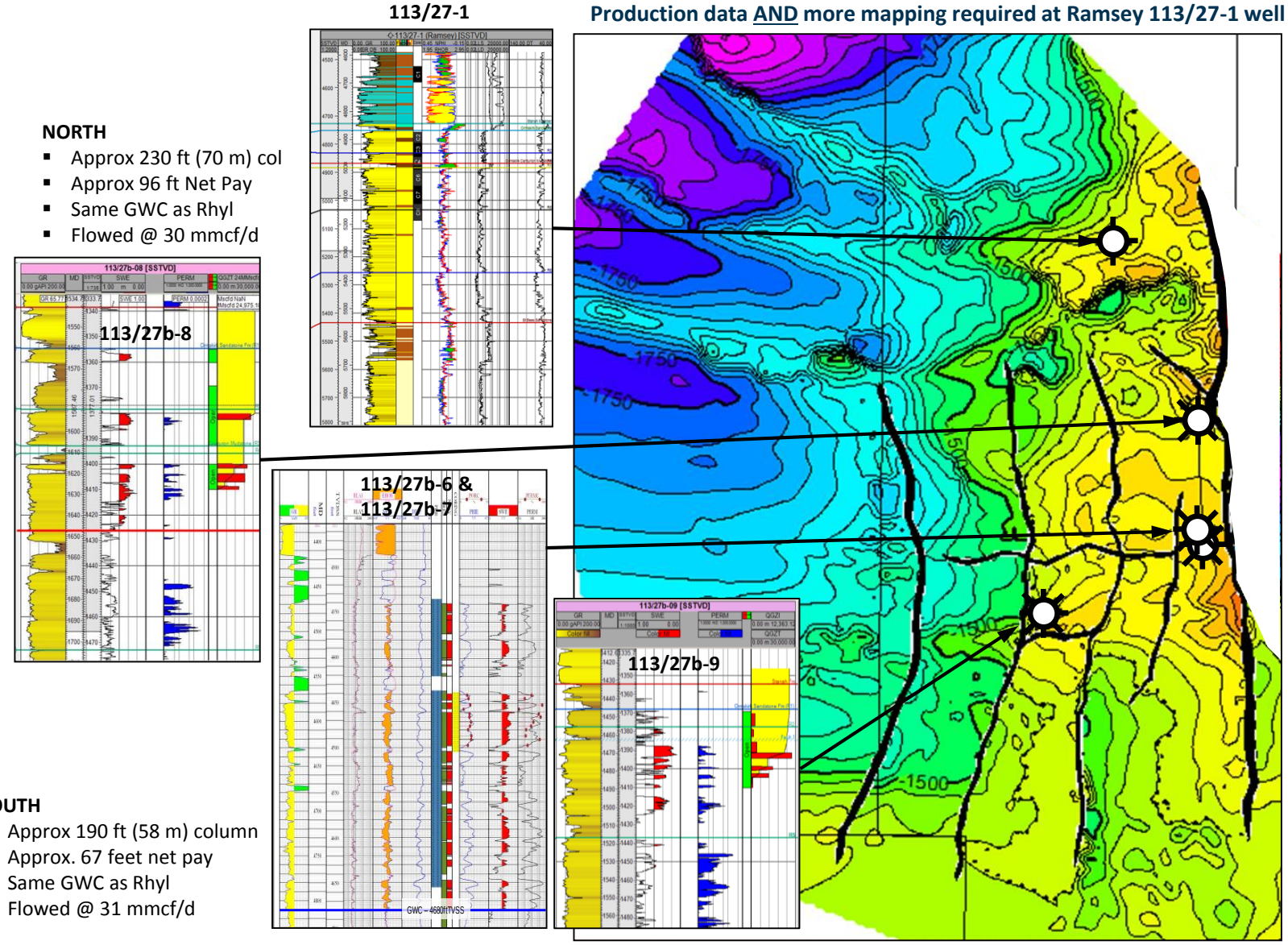
- Approx 230 ft (70 m) col
- Approx 96 ft Net Pay
- Same GWC as Rhyl
- Flowed @ 30 mmcf/d

Depth mapping improved by better understanding of:

- Volcanic Dykes
- Shallow channels
- Thrust faulting
- Migration apertures

SOUTH

- Approx 190 ft (58 m) column
- Approx. 67 feet net pay
- Same GWC as Rhyl
- Flowed @ 31 mmcf/d



Reference = Devex 2014 (http://www.devex-conference.org/programme_archives/presentation-archives.php)

Thank you

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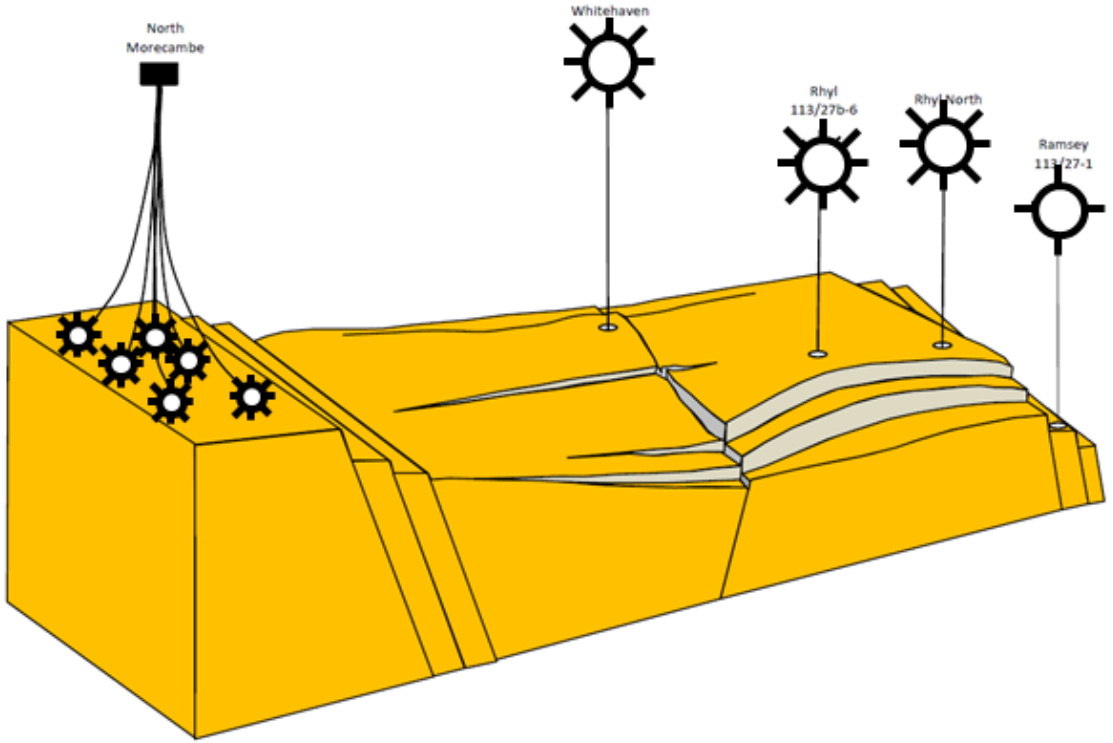

....and finally, friends & colleagues : Arnaud, Ayo, Blae, David, Dean, Ed, Iain, Jalal, Jeremy, Mick, Montse, Nick, Stela, Stephen, Tom, Vishal, Viv

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