Assessing our untapped energy resources

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Geological Survey of Northern Ireland

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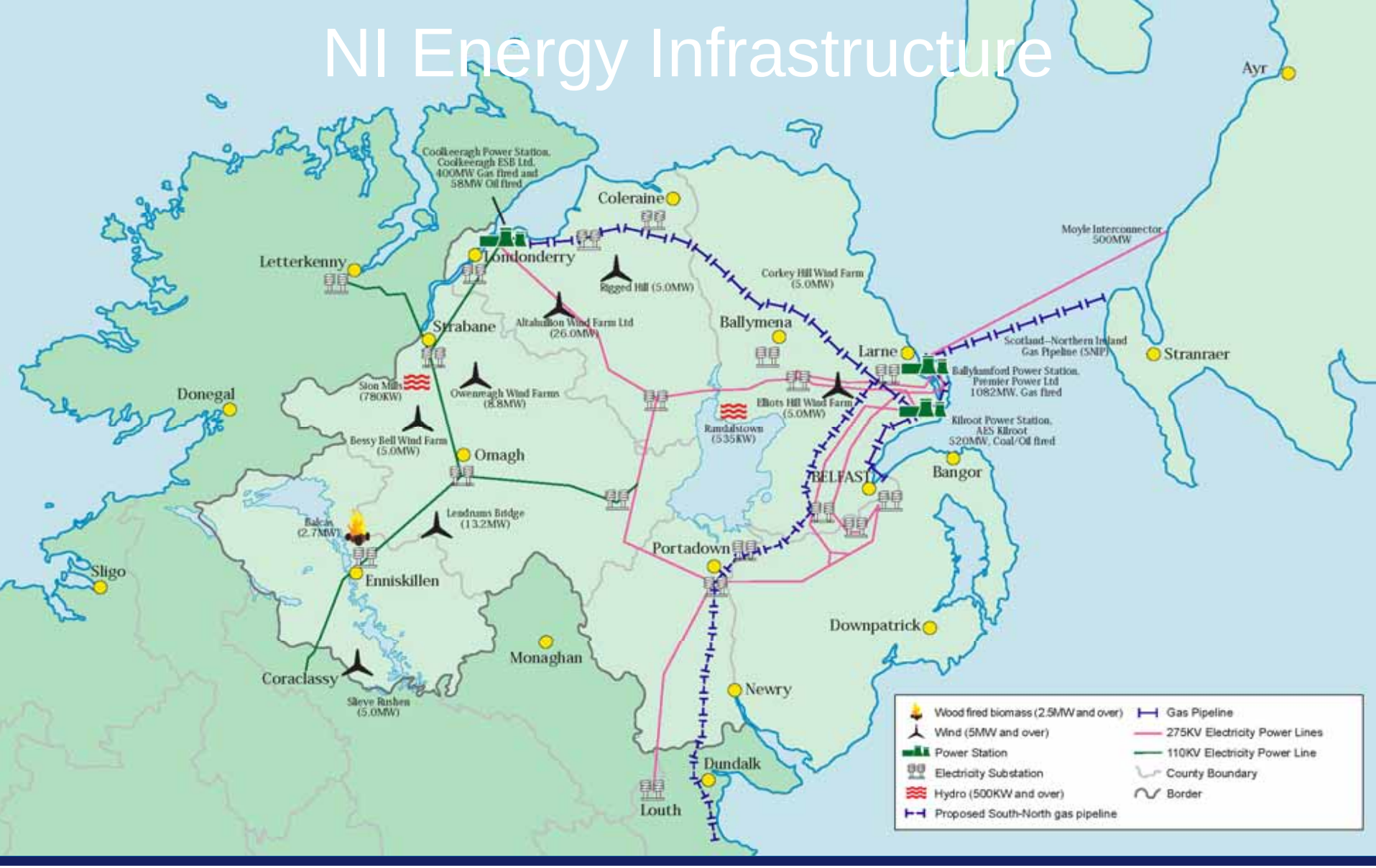
Talk Outline

- Northern Ireland energy market
- Oil and Gas Exploration
  - Description
  - Exploration risks
- Application of Tellus data to oil and gas exploration
  - General
  - Examples
- Geothermal energy resources

NI Energy Infrastructure



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Elements of petroleum exploration play

Elements

Organic-rich **source** rock

Permeable **reservoir** rock

Impermeable **caprock**

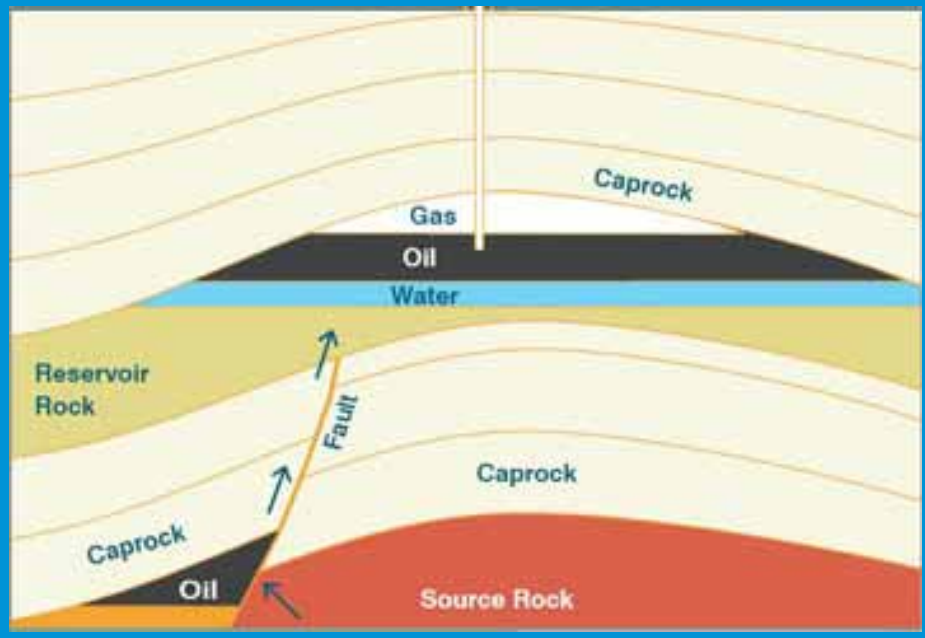
Efficient **trap**

Processes

Source maturation

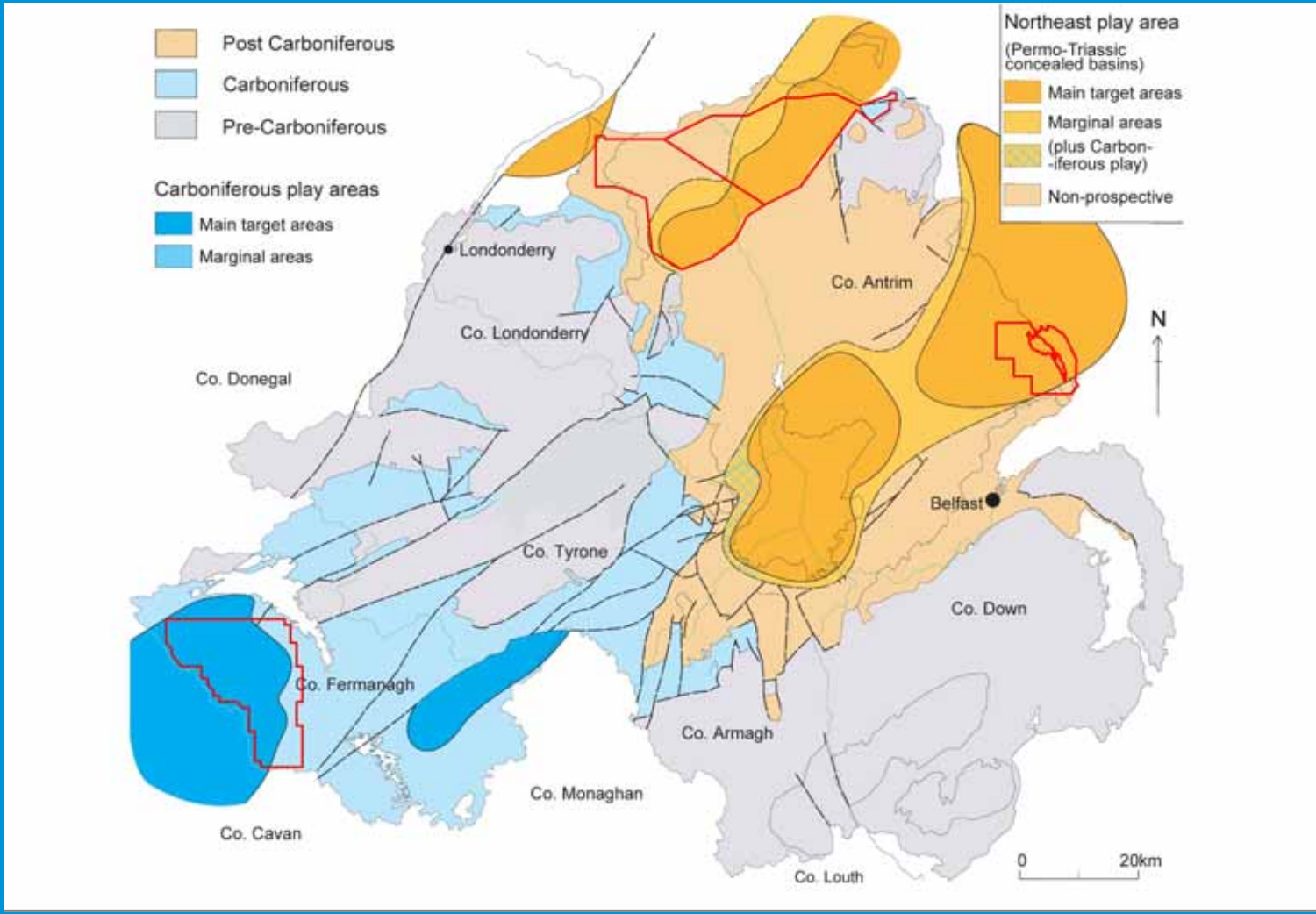
Trap formation

Hydrocarbon migration



Relative timing of processes is crucial!

Petroleum exploration play areas and current licences



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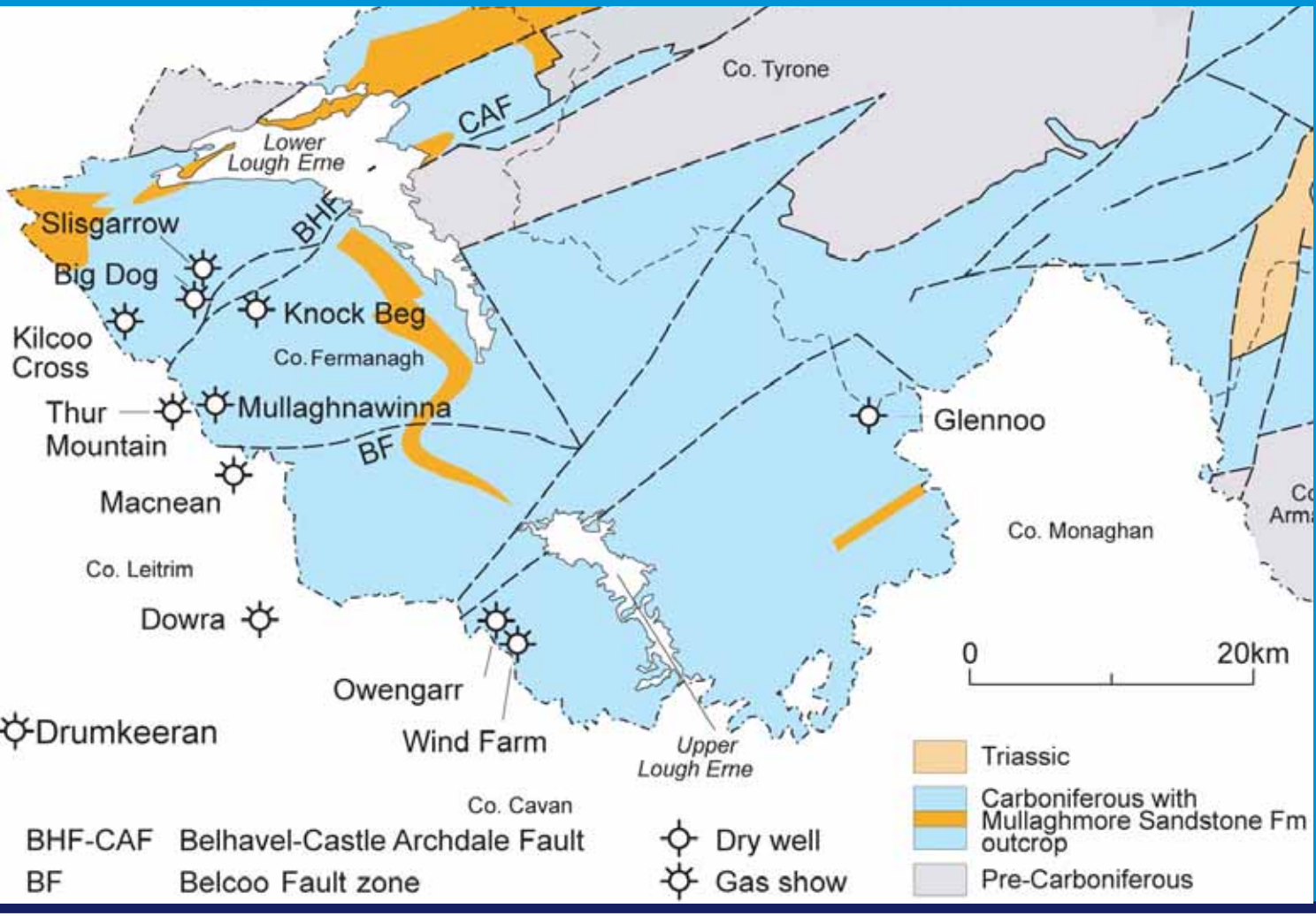
Exploration in the Northwest Irish Carboniferous Basin



Source

Carboniferous shale

Reservoir

Carboniferous sandstone

Caprock

Carboniferous shale

Traps

1. Anticlines
2. Flower structures
3. Basin-centred gas

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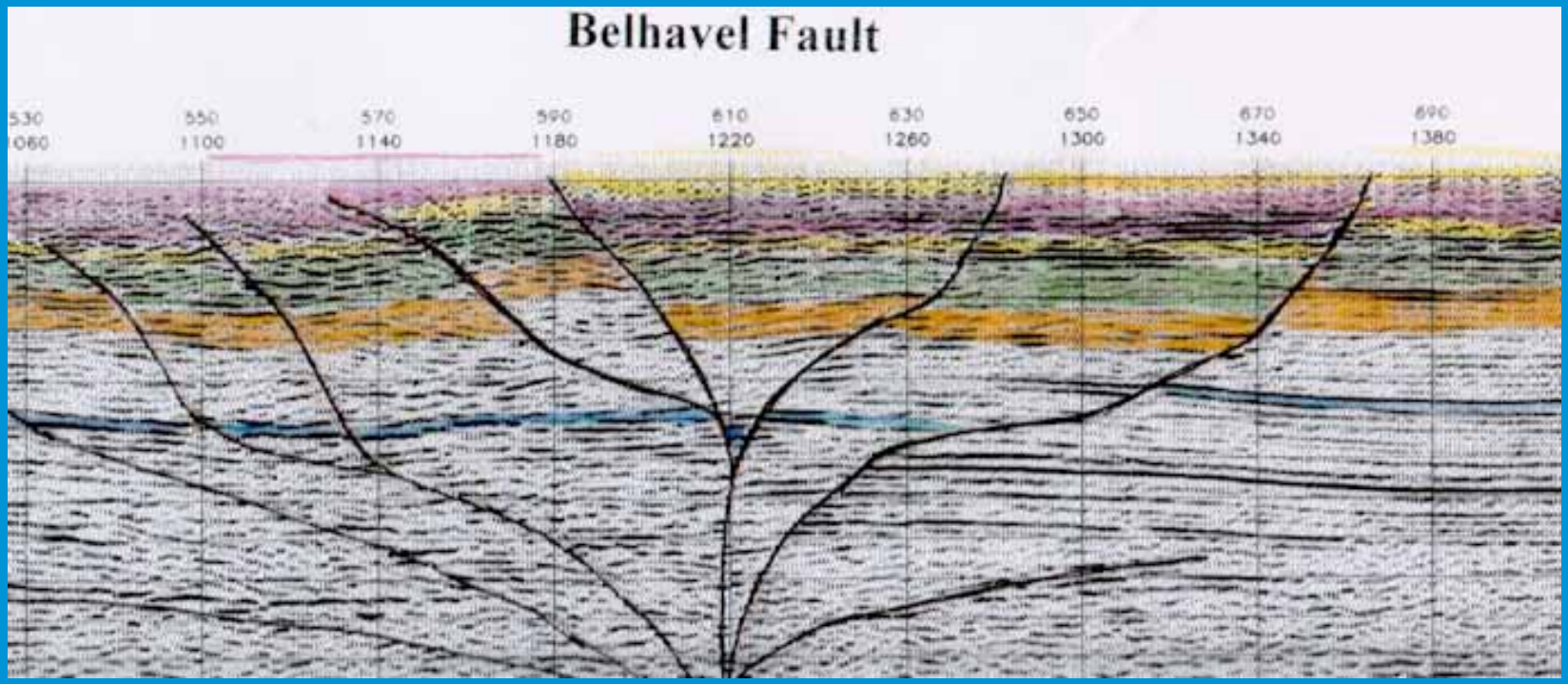
Flower structure from Belhavel - Castle Archdale fault system



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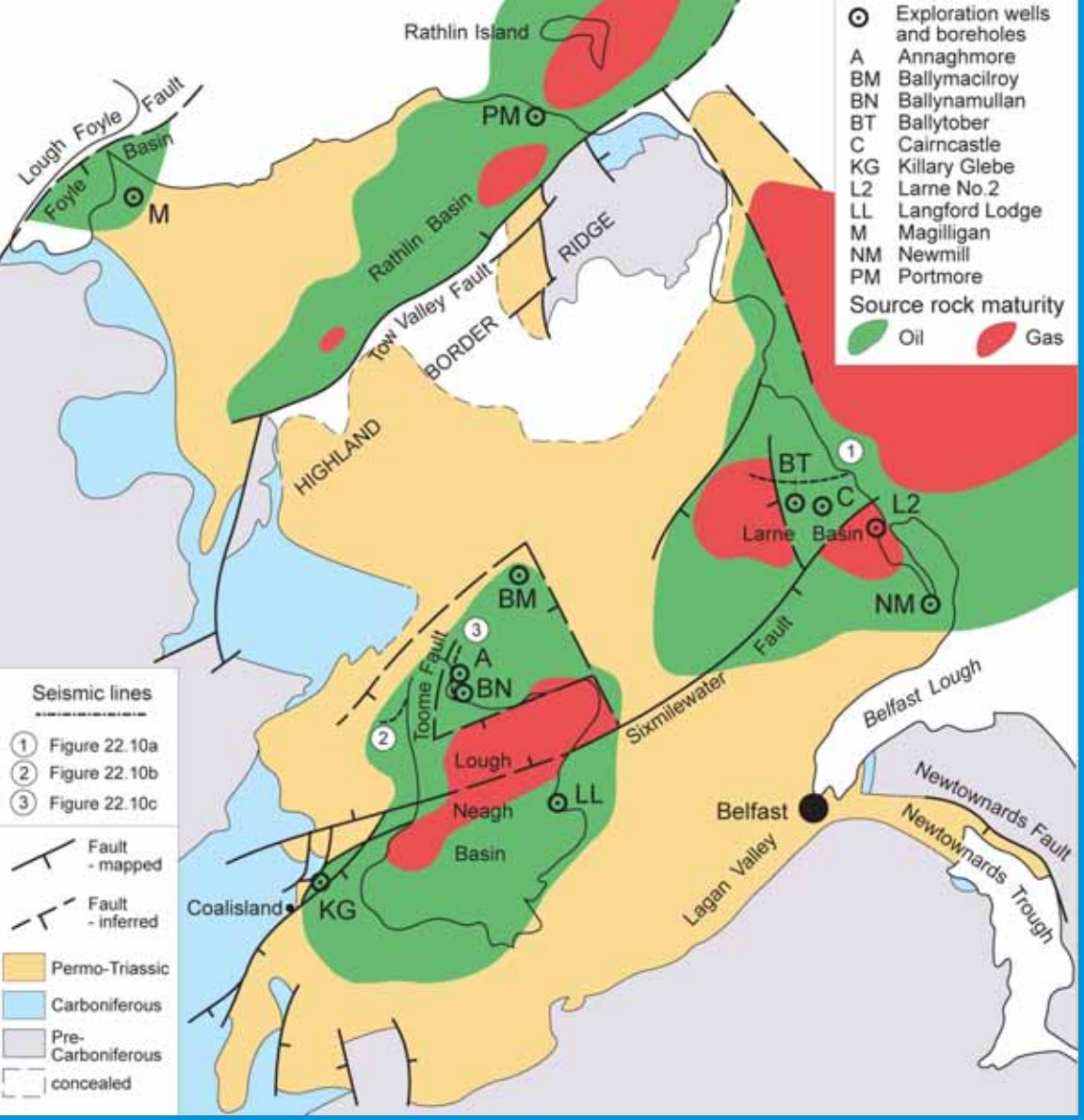

Northeast Permo-Triassic Basins

Source: Carboniferous coal/shale

Reservoirs:

1. Carboniferous sandstones
2. Early Permian sandstones
3. Triassic SSG sandstones

Caprocks:

1. Carboniferous mudstones
2. Late Permian salt/mudstone
3. Triassic MMG salt/mudstone

Traps:

1. Tilted fault blocks
2. Anticlines
3. Fan deposits

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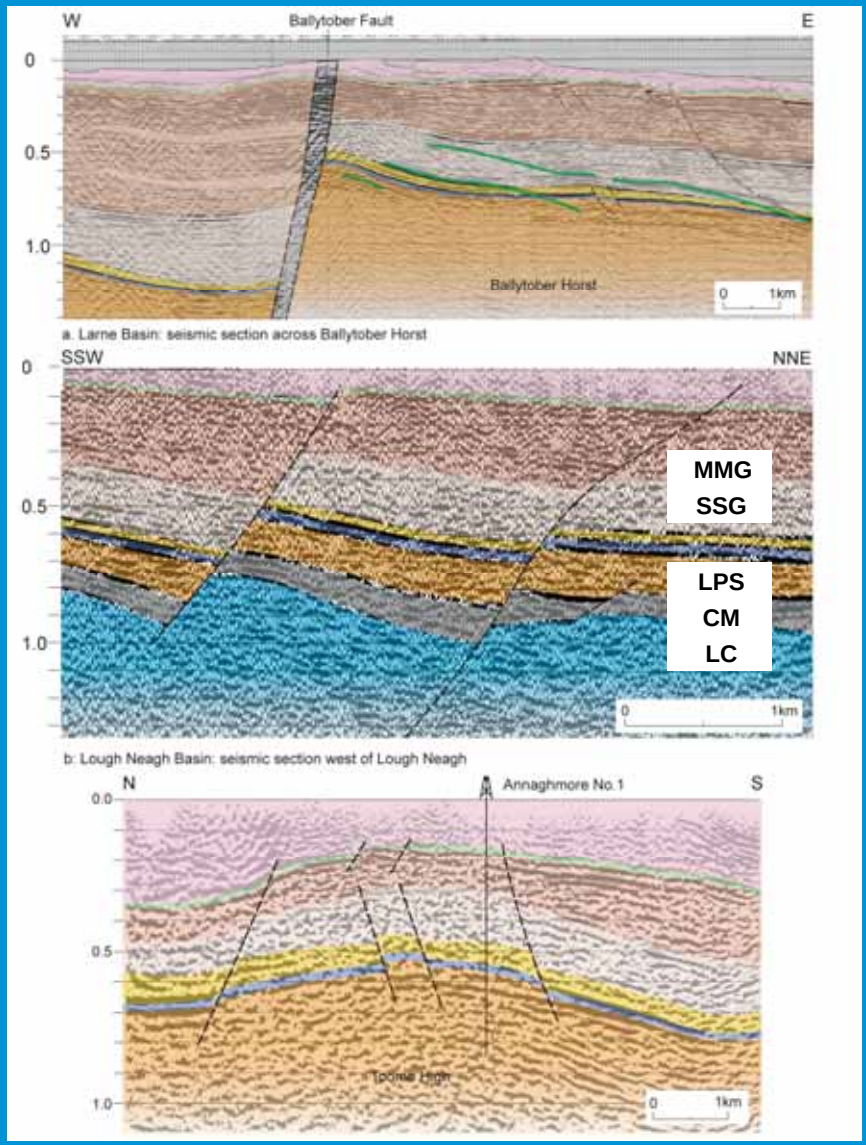

Structural traps in the Permo-Triassic Basins

MMG	Mercia Mudstone Group (Caprock)
SSG	Sherwood Sandstone Group (Reservoir)
LPS	Lower Permian Sandstone (Reservoir)
CM	Coal Measures (Source)
LC	Lower Carboniferous mudstones (Source)

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Exploration risks/ negative factors

Southwest play area

Low permeability ‘tight’ reservoir

Identification of traps

Timing of migration and trap formation

Northeast play area

Poor imaging of sub-basalt structure

Source rock – distribution and maturity

Timing of migration and trap formation

Post-migration leakage

Applications of Tellus data to oil & gas exploration

Tellus geophysical data is used to

- Map faults – deduce structural history
- Refine mapped geological boundaries
- Identify igneous intrusions

Can also be used for

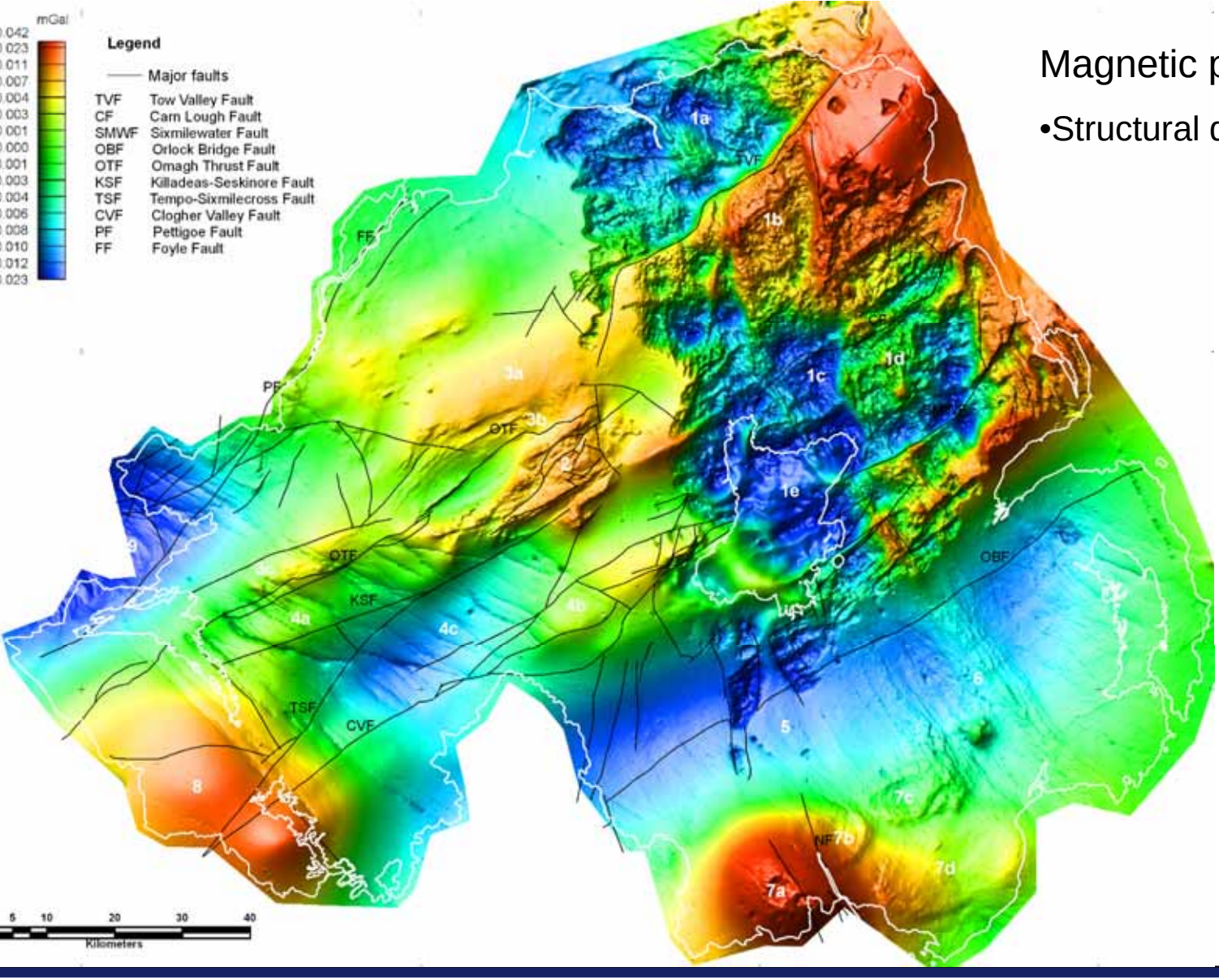
- Depth to basement modelling
- Integration with other geophysical data (seismic, gravity) to produce more realistic exploration models

Total magnetic intensity

- Magnetic domains
- Major lineaments
- Intrusions
- Dyke swarms

Magnetic pseudogravity

- Structural domains



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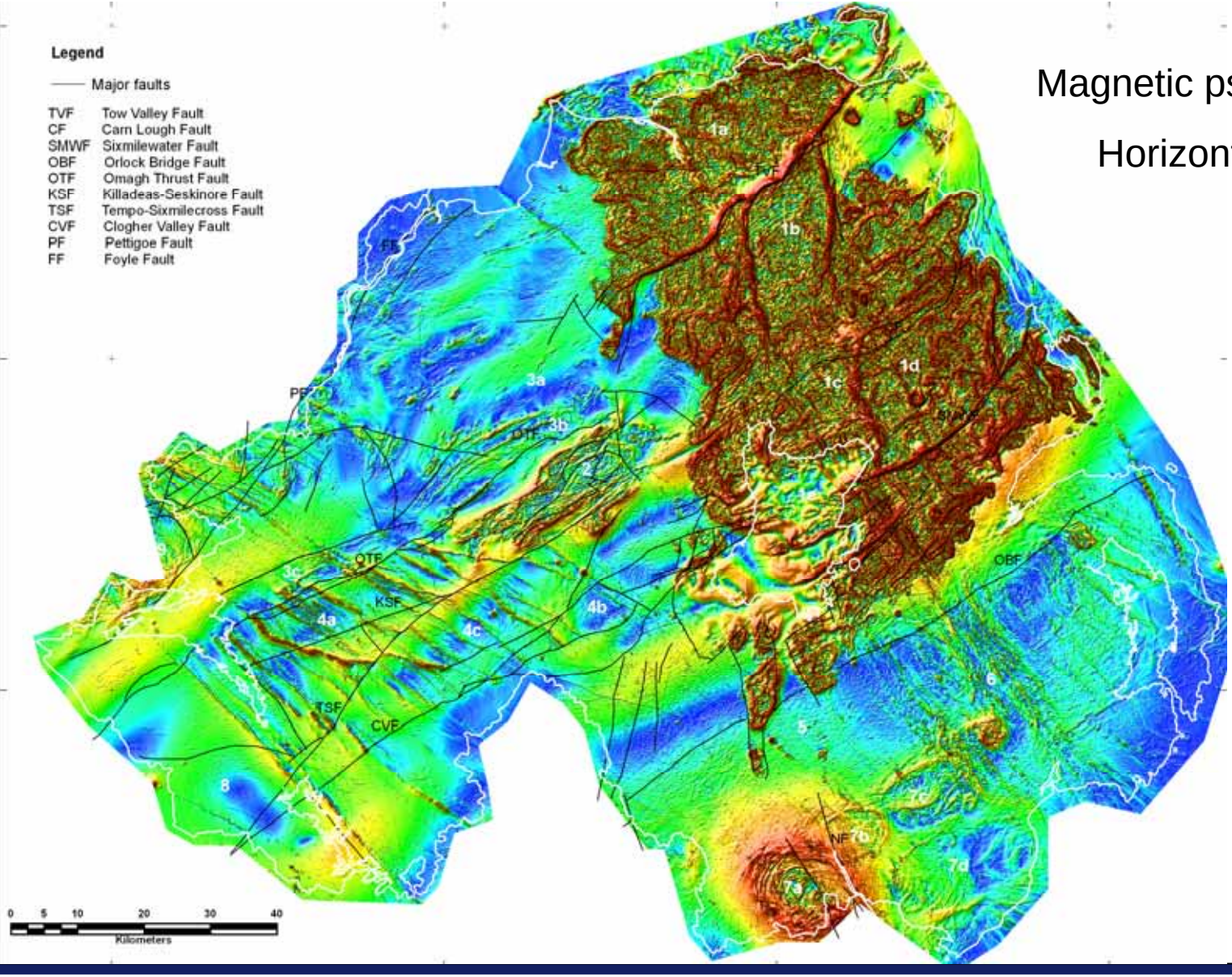

Magnetic pseudogravity

Horizontal gradient

- Lineaments
- Boundaries

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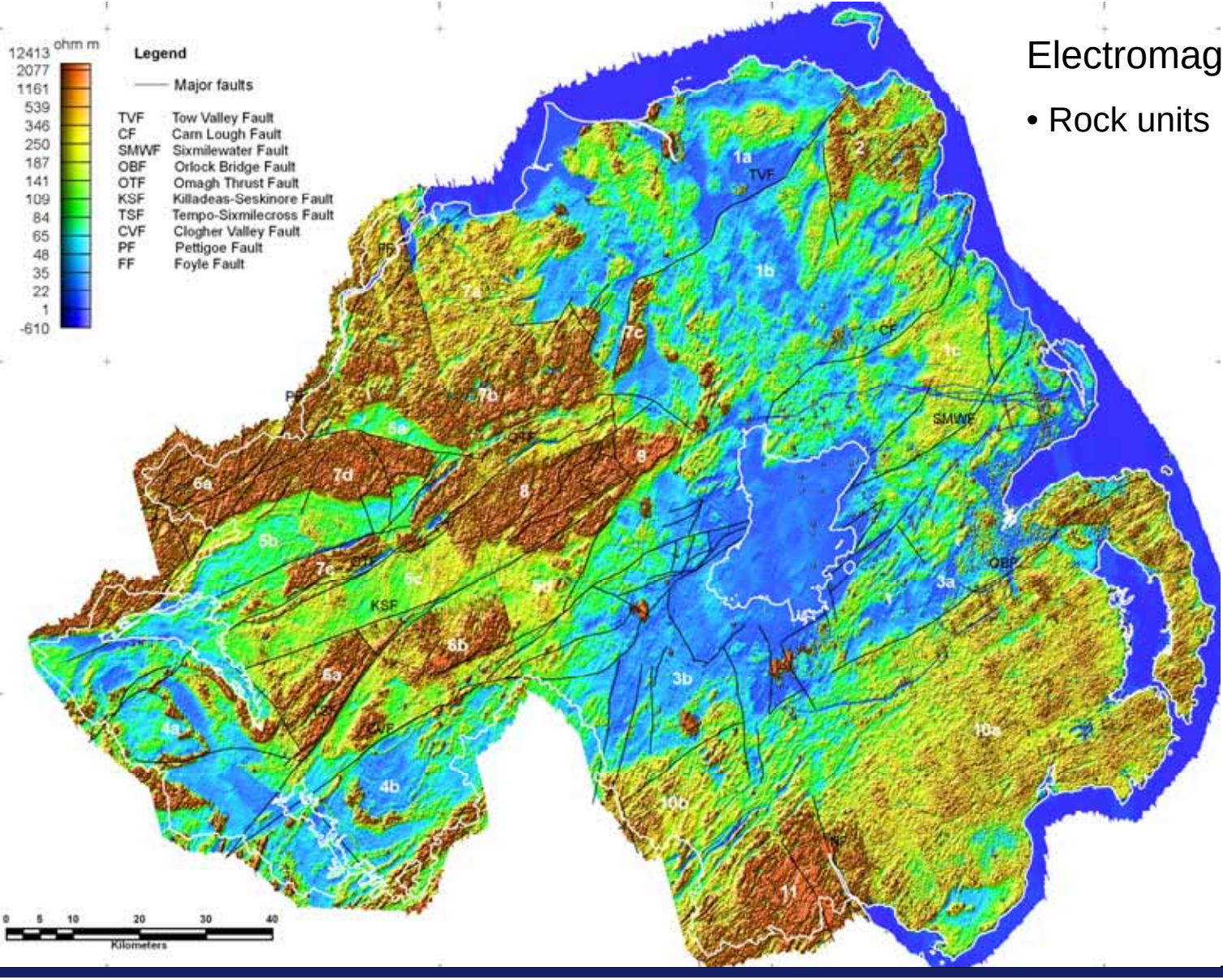
Electromagnetic (EM) data

- Rock units



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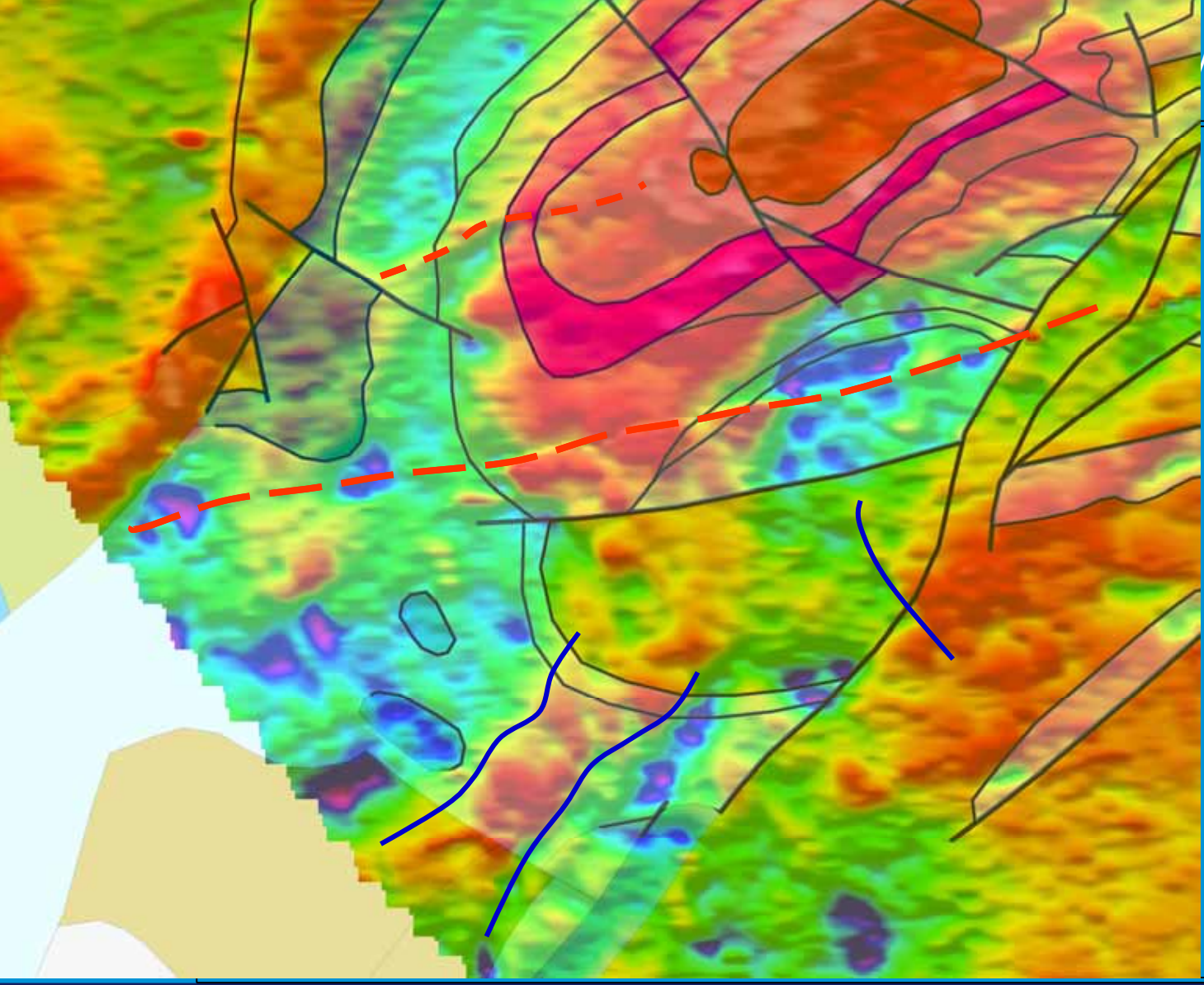

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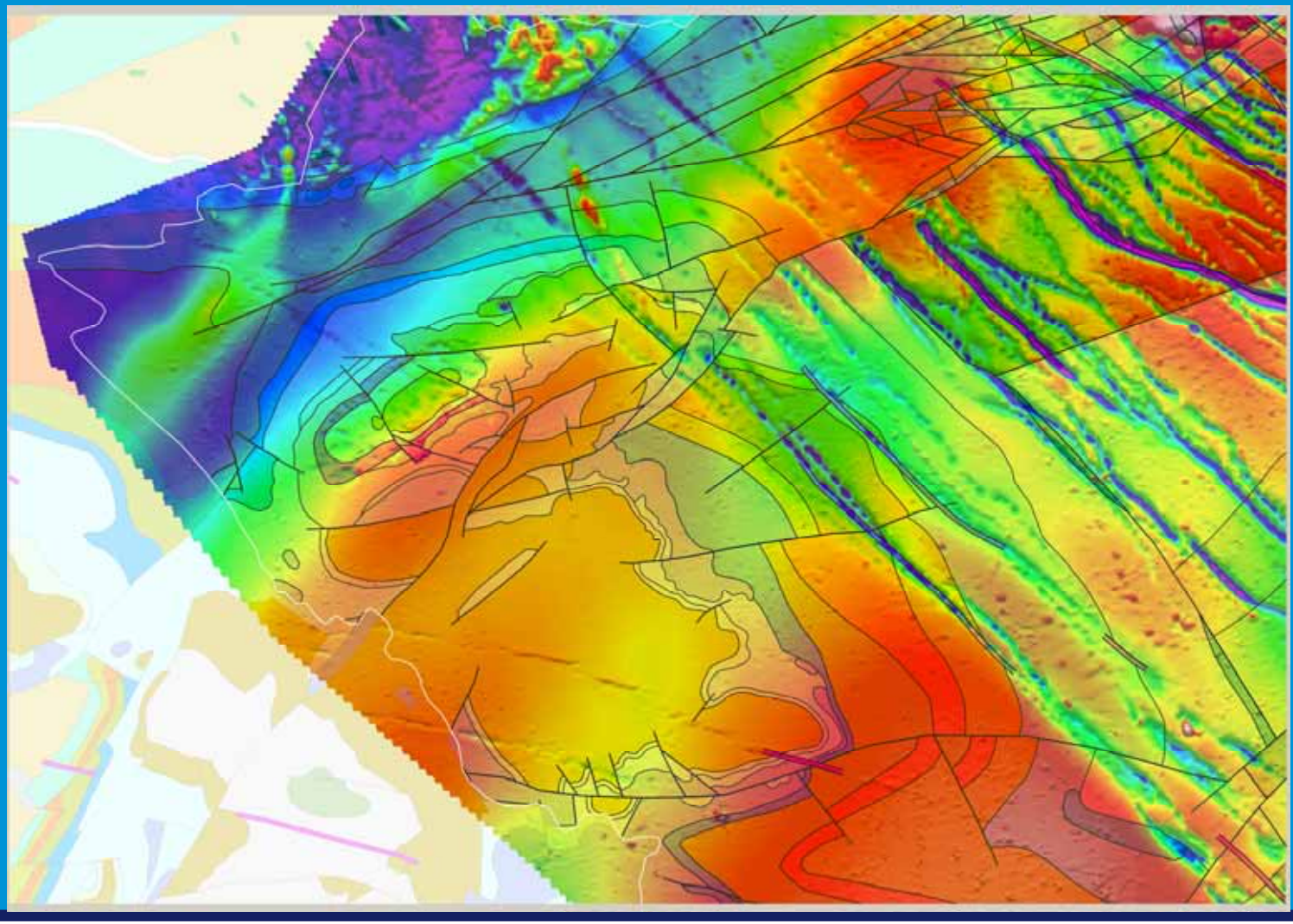
Fermanagh – total magnetic intensity and geology



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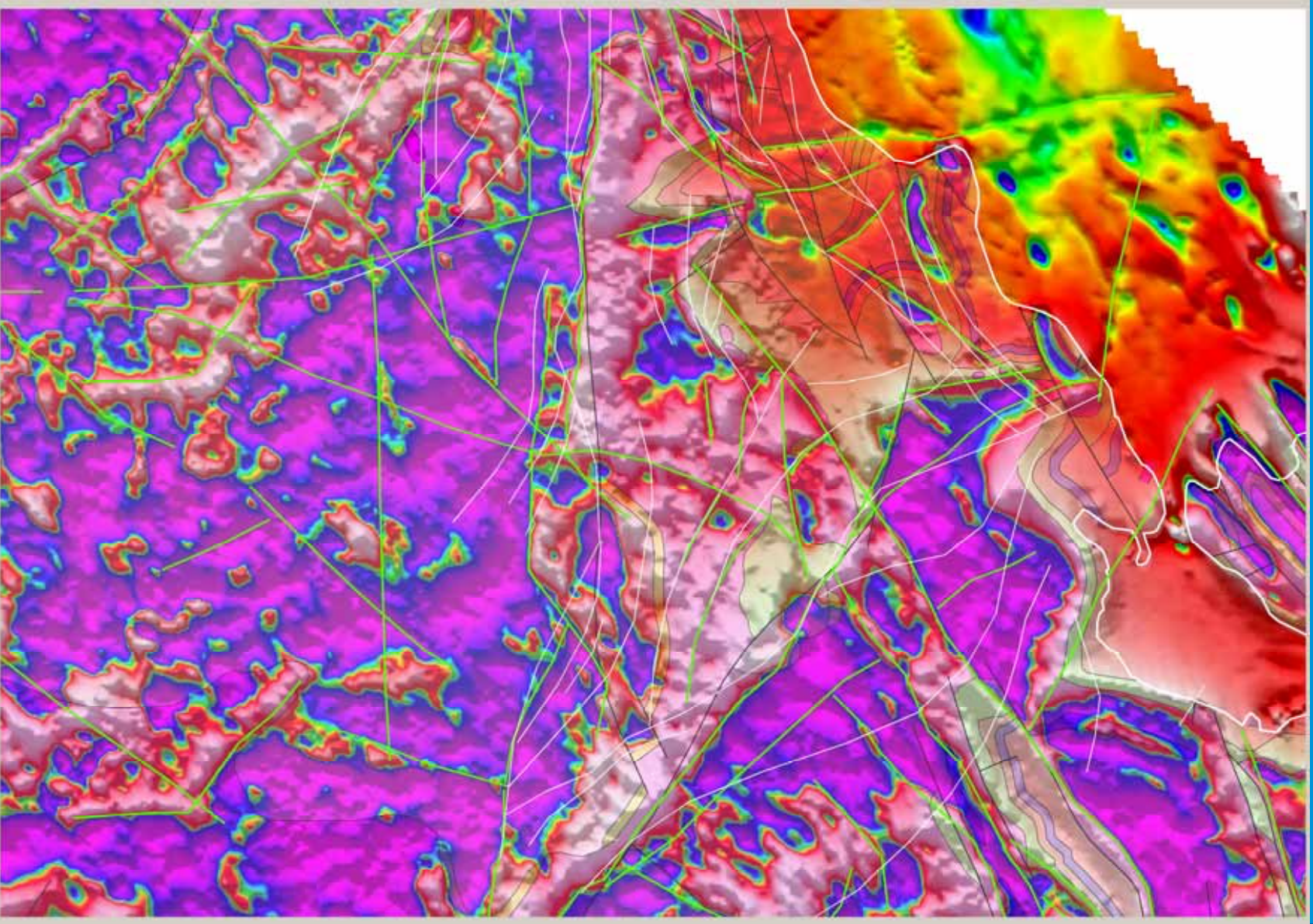

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Larne Basin

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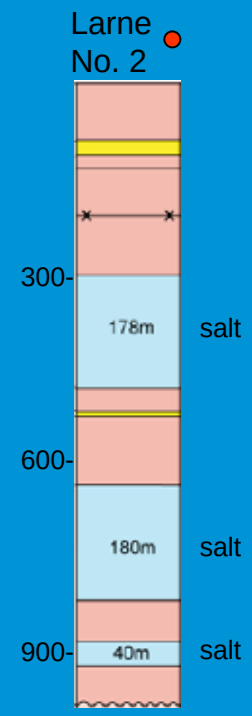
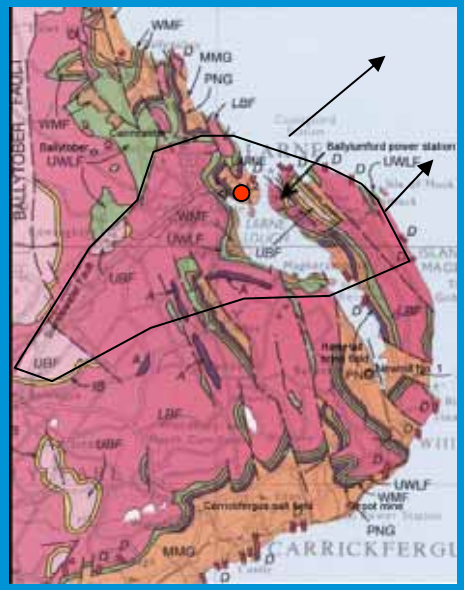
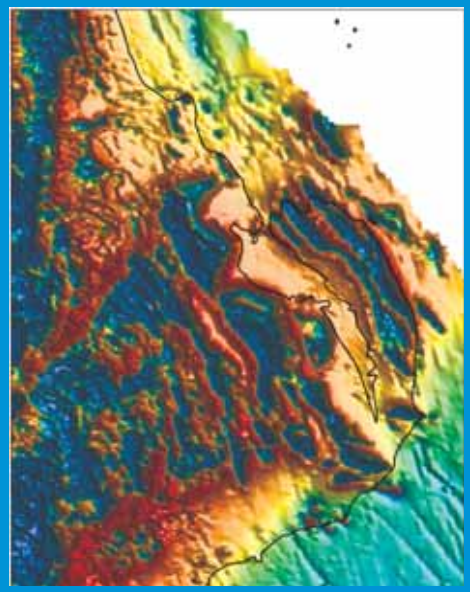
Underground gas storage in salt beds – Larne and Islandmagee

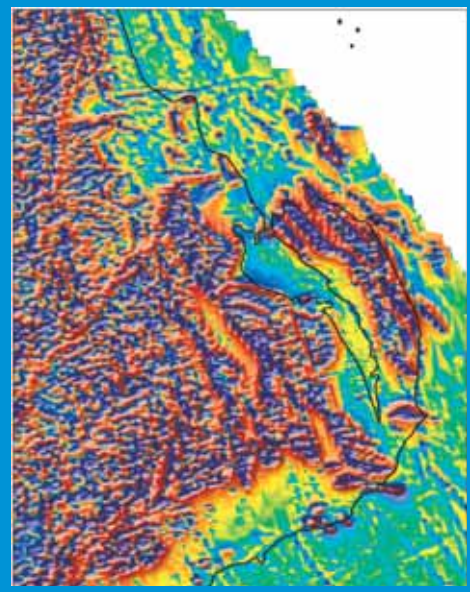




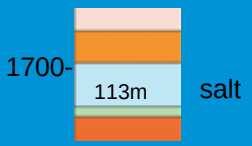
Geology



Magnetics RTP



Magnetics 1st Vert. Deriv.



Caverns need to avoid faults and basalt dykes

Tellus data will improve the structural mapping in the prospective areas

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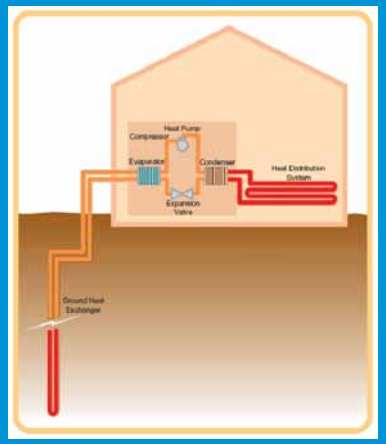
Geothermal energy resource potential

Types of geothermal resource	Applications
Shallow geothermal (<300m; <25°C)	**HEATING-COOLING**
• Ground Source Heat Pumps/ Borehole Heat Exchangers	**SINGLE BUILDINGS**
• Aquifer thermal energy storage	
Low enthalpy medium to deep geothermal	**DIRECT USE/CHP**
• Hydrothermal aquifers (1500 – 3500m; <140°C)	**DISTRICT HEATING**
High enthalpy deep geothermal energy (>5000m; >180°C)	**POWER GENERATION**

Distribution of geothermal resources in Northern Ireland

Shallow geothermal

Ground source heat pump technology

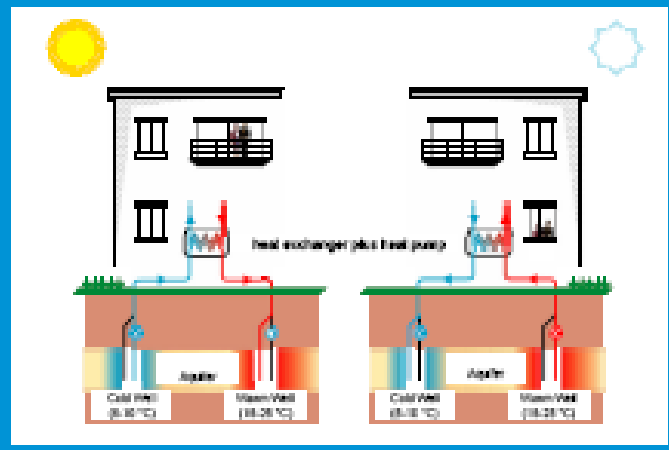


www.kyotoinhome.info/UK/heat_pumps/basic_principles.html

www.downwithco2.co.uk/ground_source_heat/ground_source_heat_pumps_page.html

Almost everywhere in Northern Ireland

Aquifer thermal energy storage



Restricted to good aquifers

This technology is supported by Government funding – e.g. Reconnect

Action Renewables
the future of energy, today

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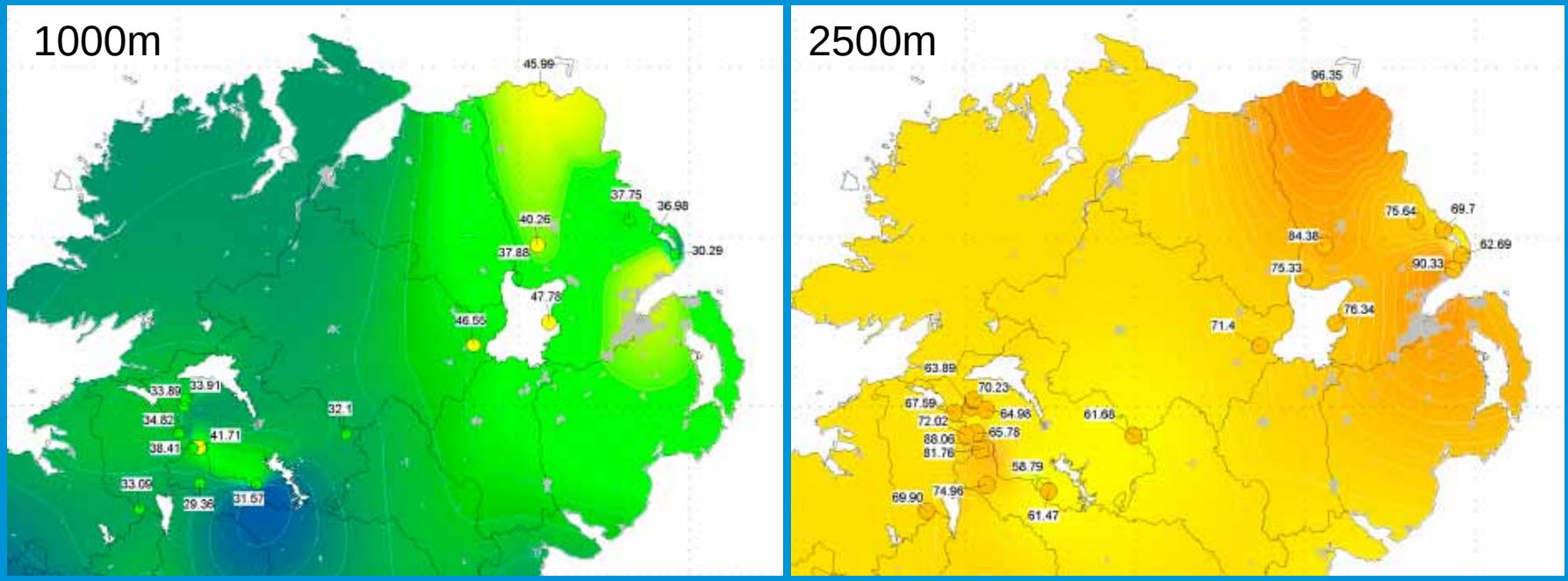
Distribution of geothermal resources in Northern Ireland

Low enthalpy geothermal energy resources



Measured and modelled temperatures at 1000m and 2500m depth (Kelly et al. 2005)

Potential resources in Rathlin, Larne and Lough Neagh sedimentary basins

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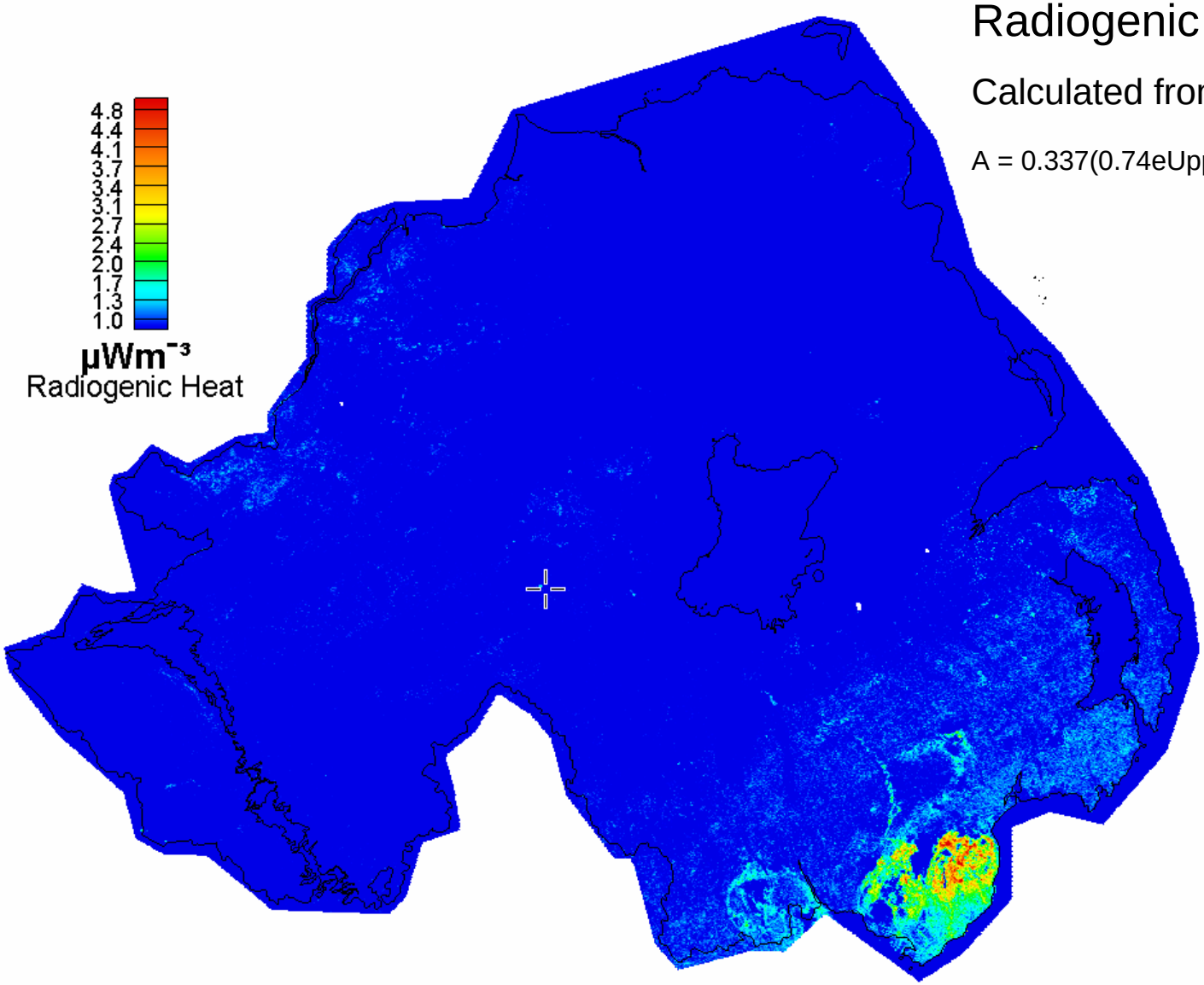
Radiogenic heat

Calculated from Tellus radiometric data

A = 0.337(0.74eUppm+.199eThppm+.26K%) μW/m³



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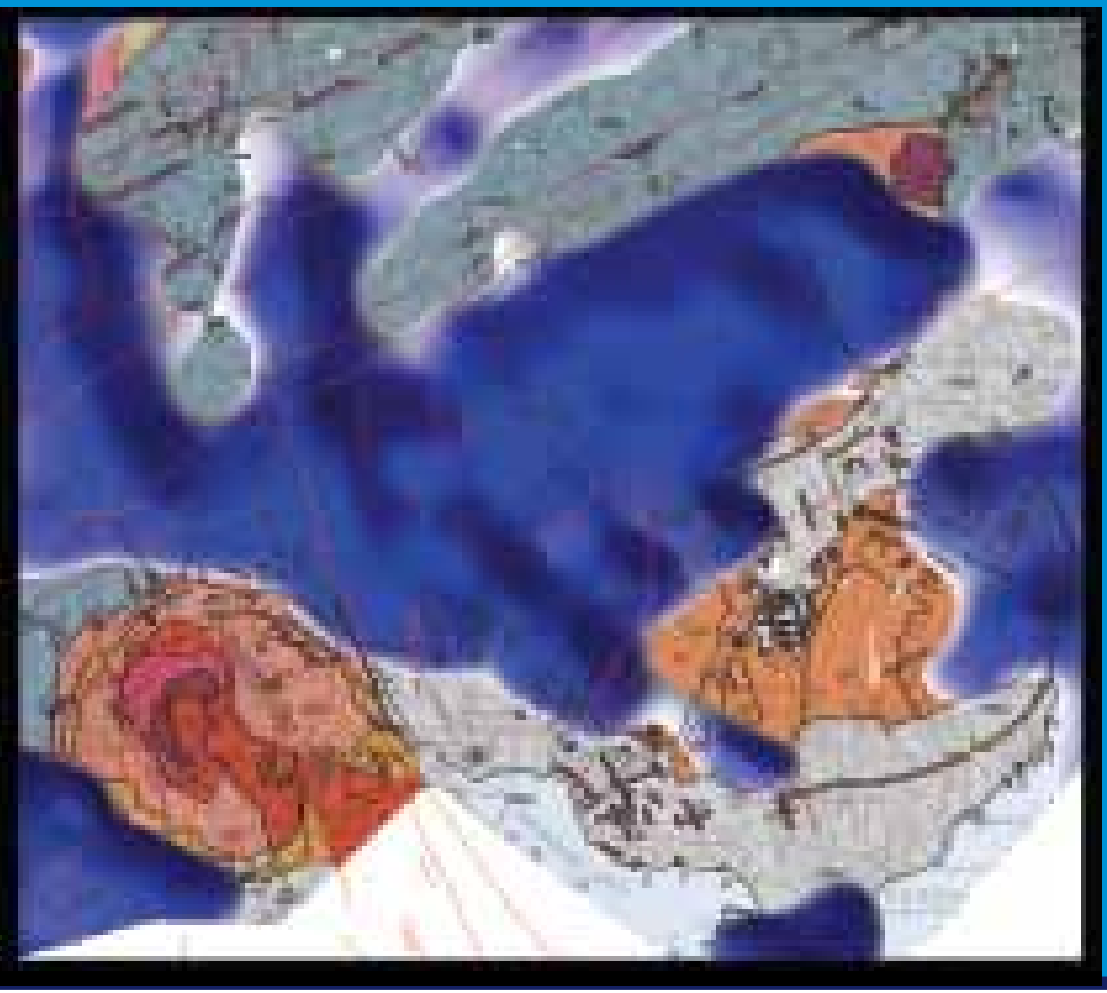
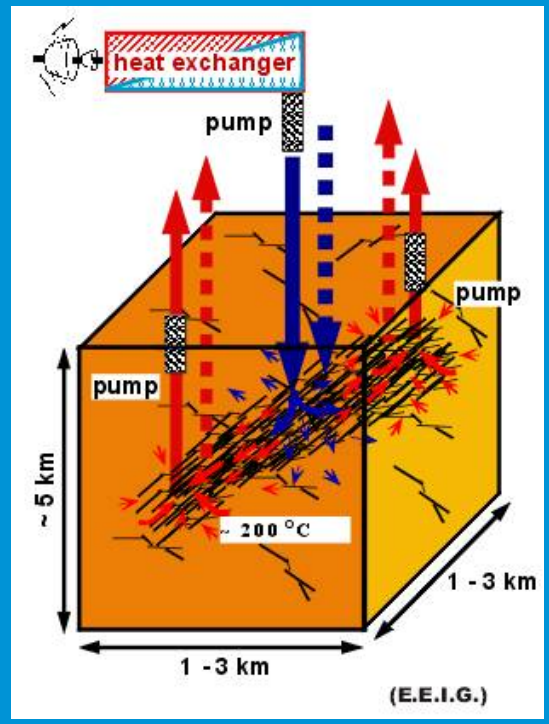
Mourne Mountains – radiogenic granites with geothermal energy potential



1. Shallow low enthalpy heat
2. Deep ‘Hot Dry Rocks’



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Conclusions

Tellus geophysical (and geochemical) data can help us to:

- refine 2D geological maps
- increase our understanding of geological structure and basin history
- produce 3D models of subsurface geology

These are important tools in exploration for hydrocarbons and geothermal resources

So far…	qualitative and regional interpretation
Next…	quantitative modelling and detailed interpretation

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