

# GEOLOGICAL CHARACTERISATION OF DEEP GEOTHERMAL SYSTEMS IN SW ENGLAND



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*GeoAtlantic Project Virtual Conference  
20<sup>th</sup> May 2020*

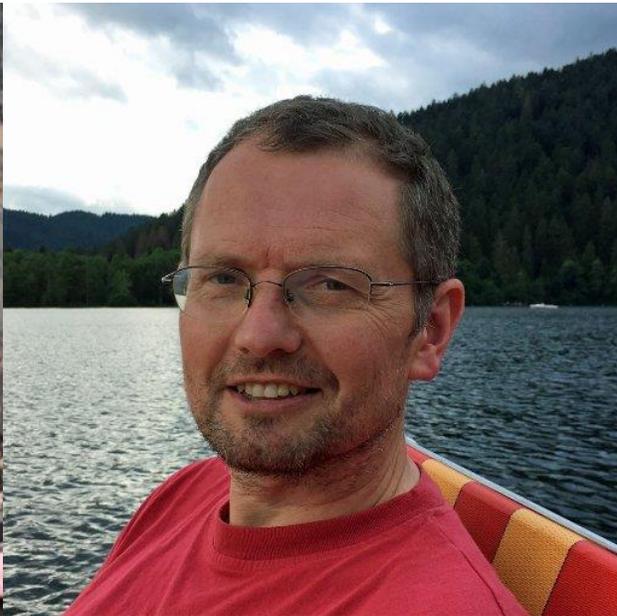


@SWgeoscience



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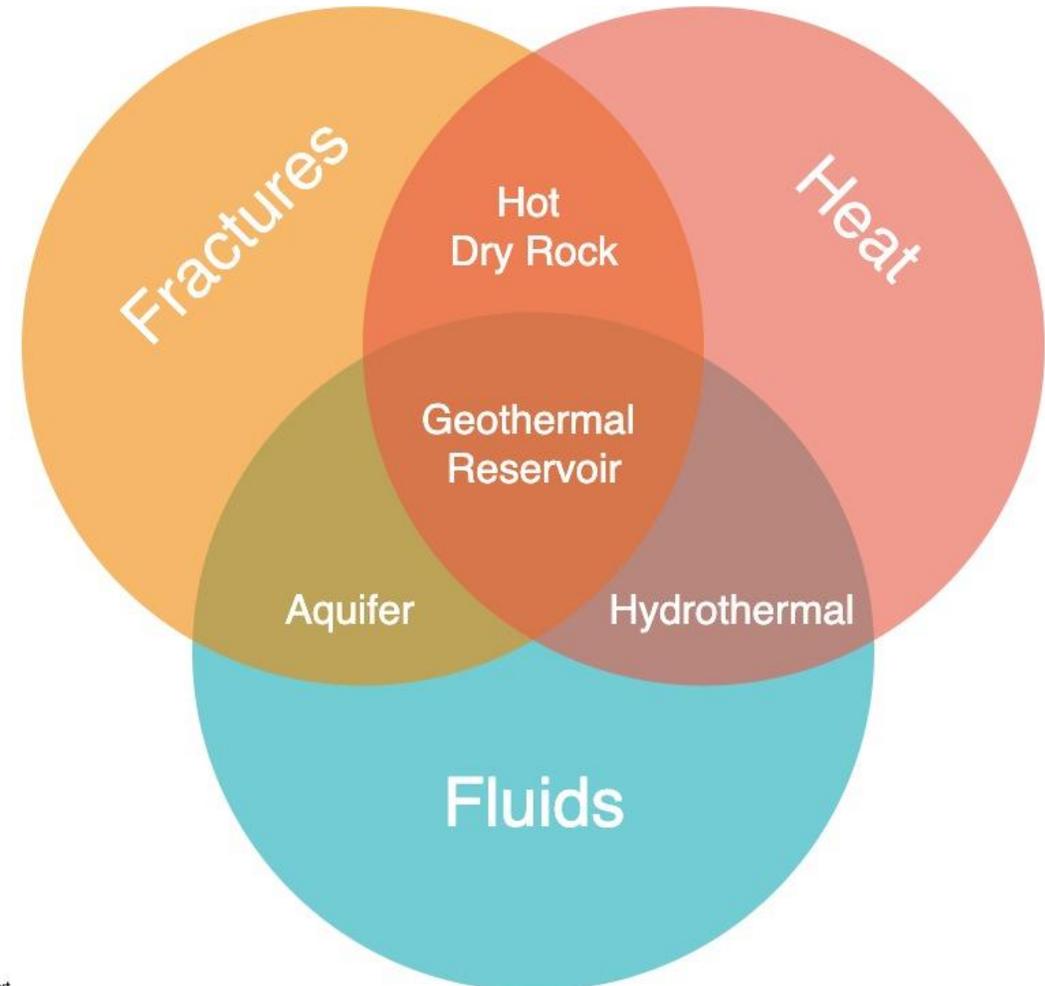
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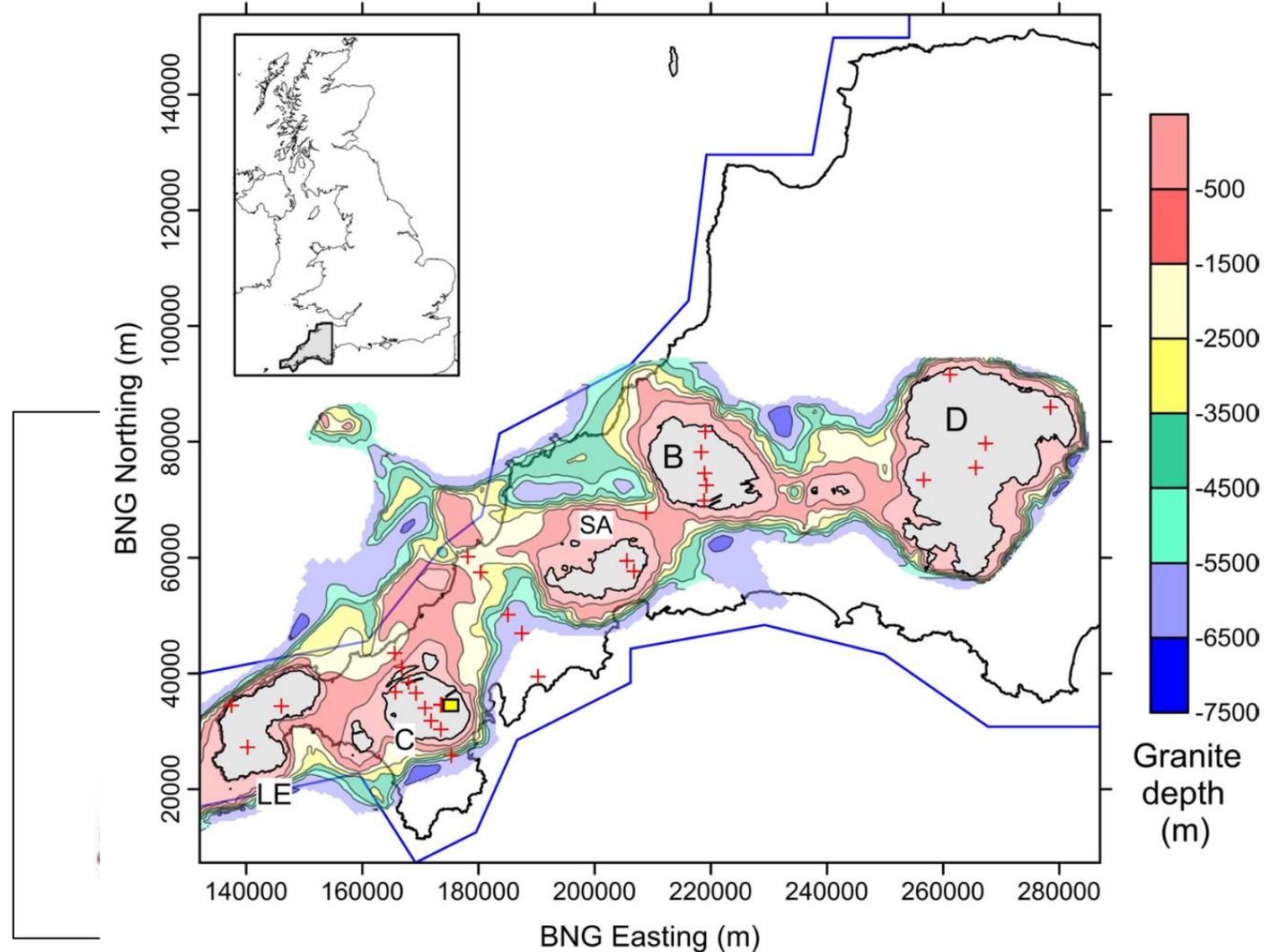
# GEOLOGY AND DEEP GEOTHERMAL ENERGY

- A geothermal energy project requires three key aspects.
- Of these three, fractures and heat are of utmost importance which are driven by natural fractures and a high geothermal gradient, respectively.
- A skilled engineer and reservoir geologist can add fluids to an existing reservoir and this is how many deep geothermal projects are expected to work.



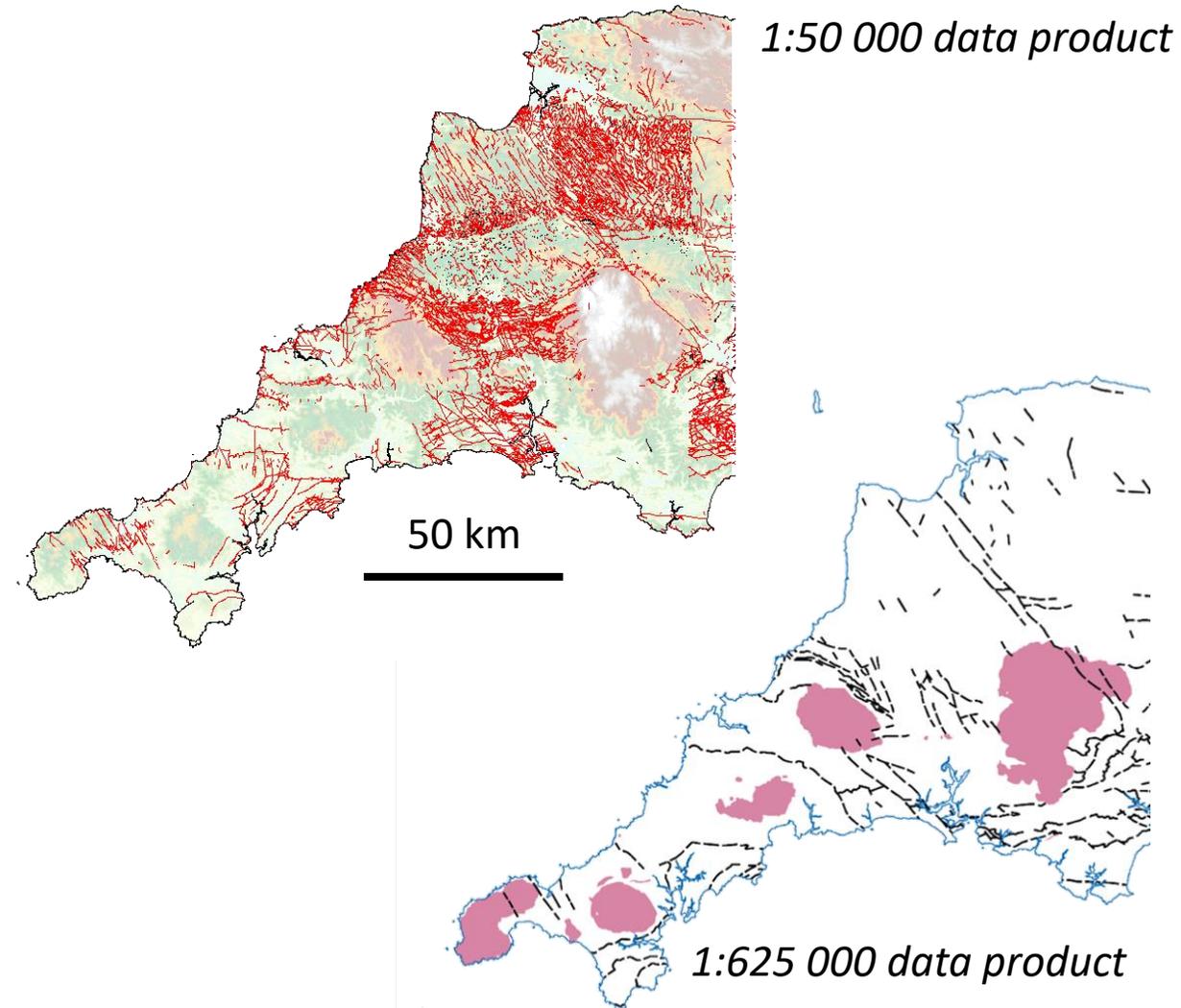
# THE HEAT

- SW England has an unusually high heat flow
- Heat is driven by the granite, and at depth it is hot due to element decay
- The problem is predicting what this granite is like at these depths

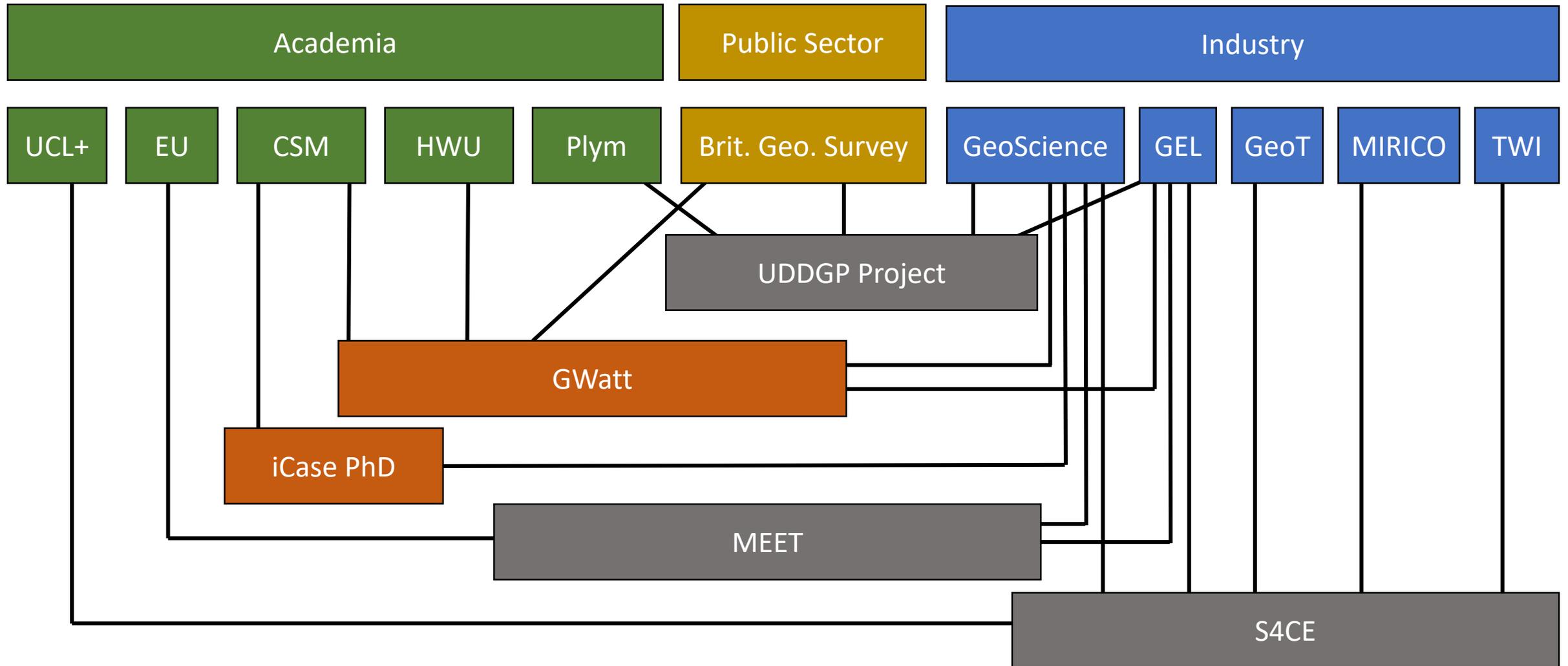


# THE FRACTURES

- We know that the rocks in SW England are highly faulted
- At the present day, we know that fractures in a NW-SE orientation are most likely to host open fractures
- There are lots of maps at different scales
- The problem is that they don't always map the same features



# RESEARCH NETWORK



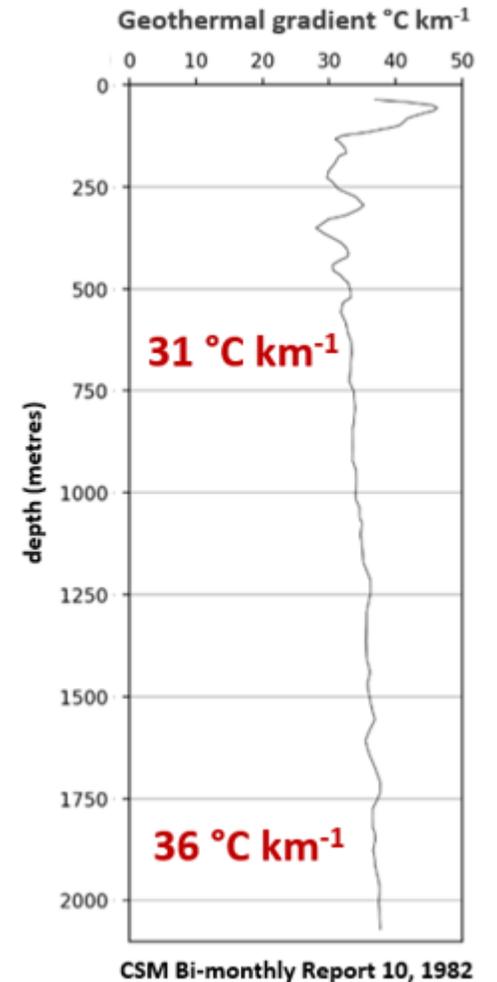
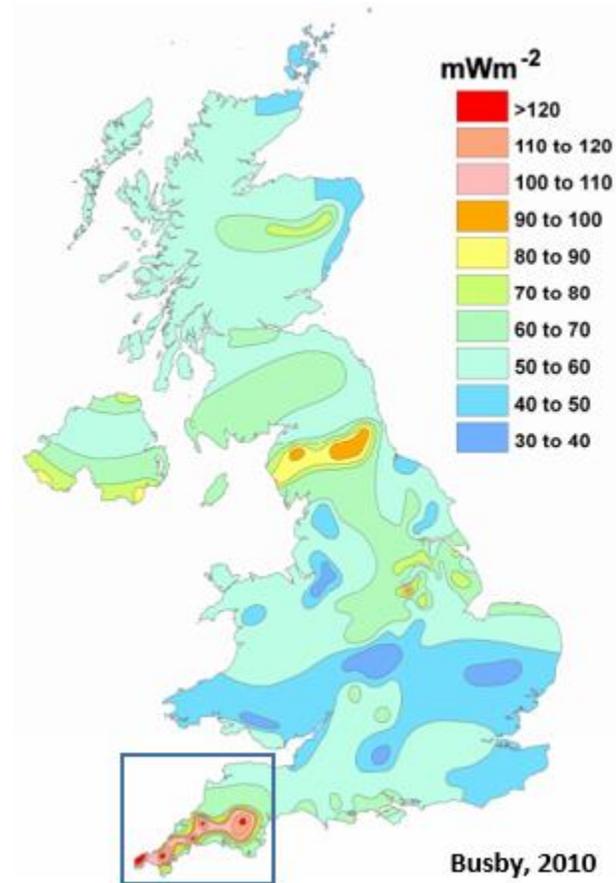
# NERC iCASE PhD PROJECT

What are the causes of high heat flows and temperature gradient in SW England? These are related to:

- lithospheric structure
- radioelement distribution with depth
- In-situ thermal conductivity

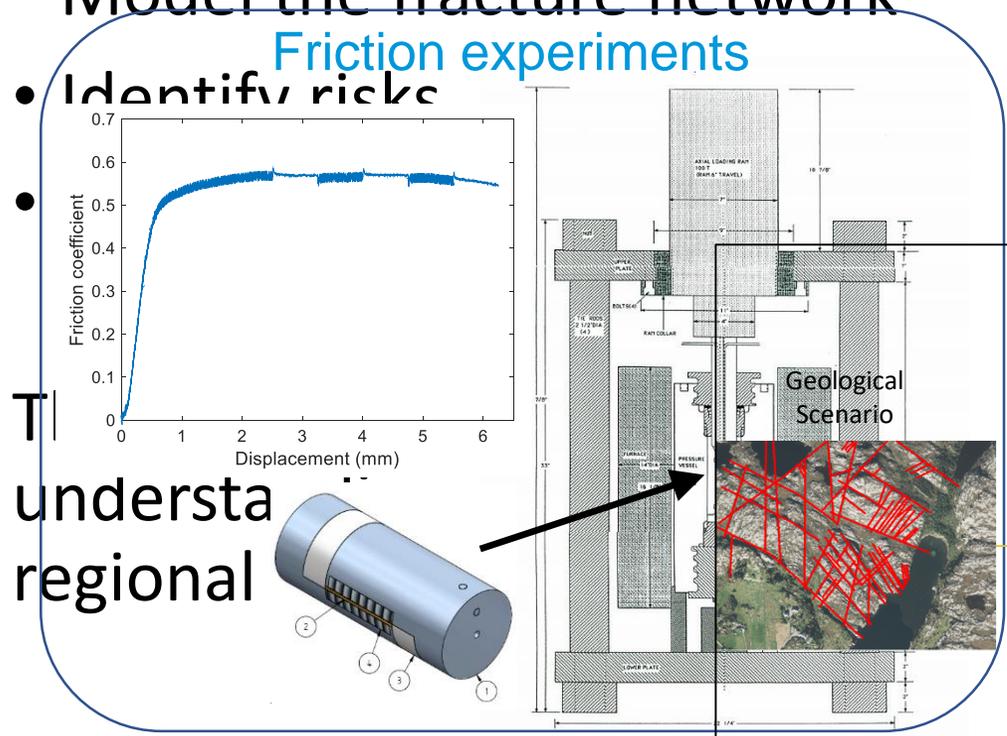
## Aim:

- To improve the thermal resource model for the Cornubian Batholith
- To understand the source of the high heat flows
- Give an insight into the magmatic processes

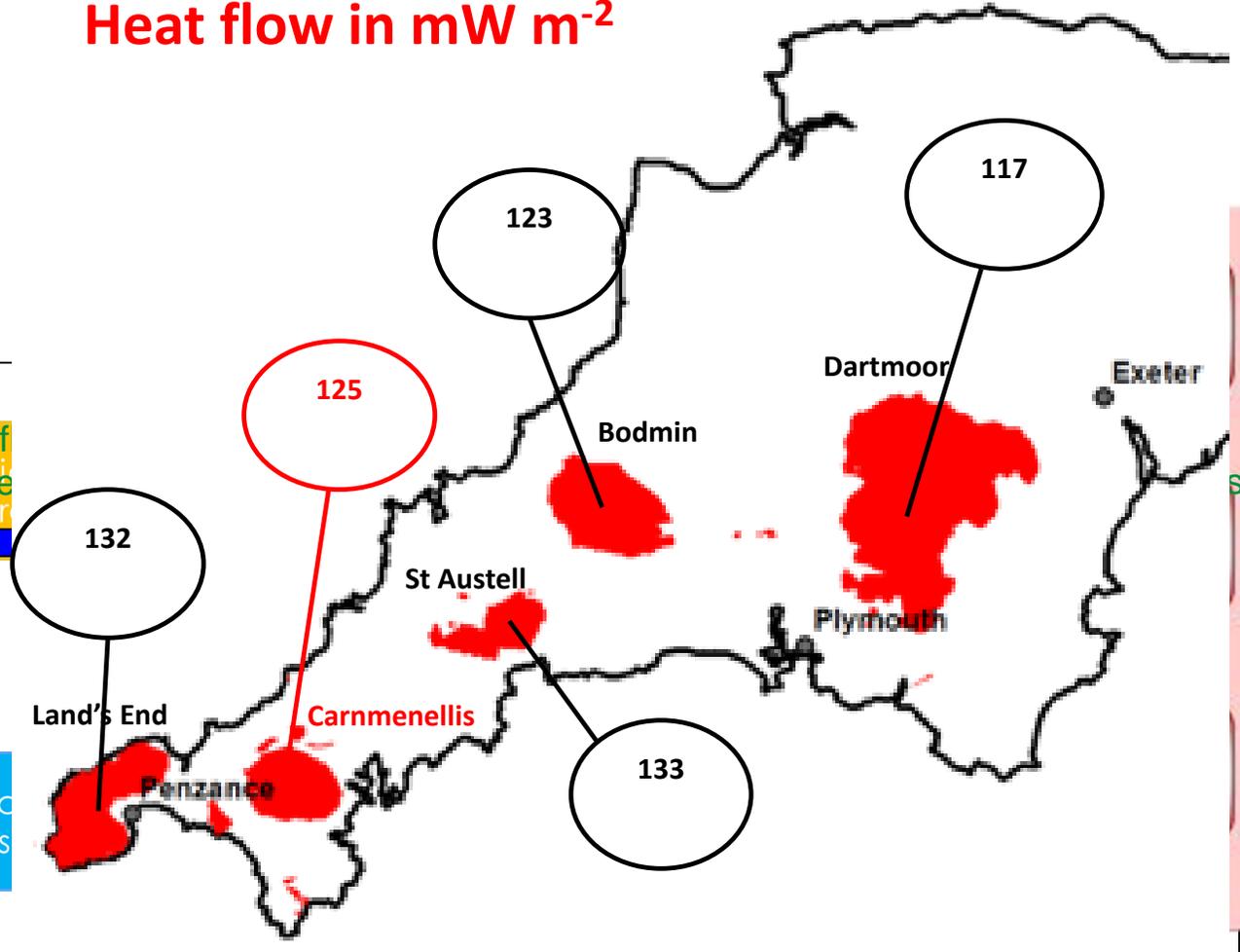


# GWATT PROJECT OVERVIEW

- Study the character of fractures
- Model the fracture network
- Identify risks



Heat flow in  $mW m^{-2}$

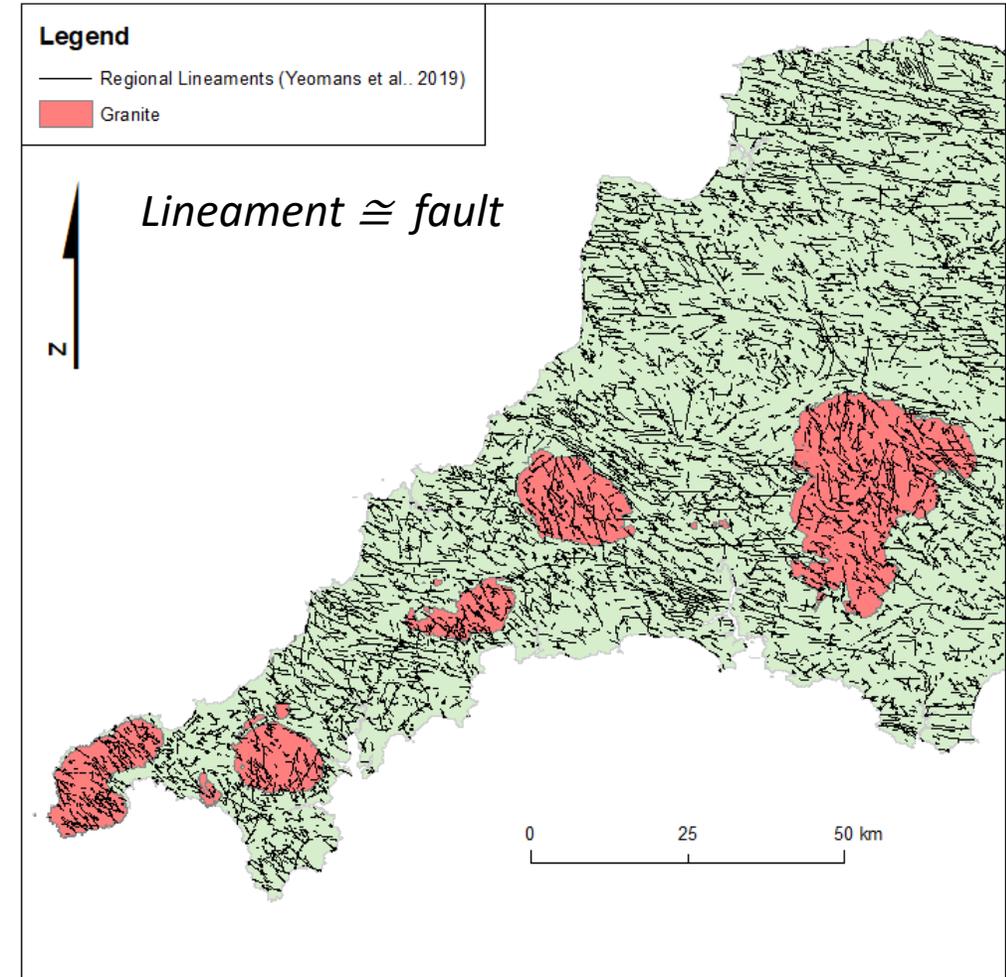


(1) Model each geological scenario

# GRANITES AND FAULT ZONES IN SW ENGLAND

Complicated geological history but dominated by faults and granites:

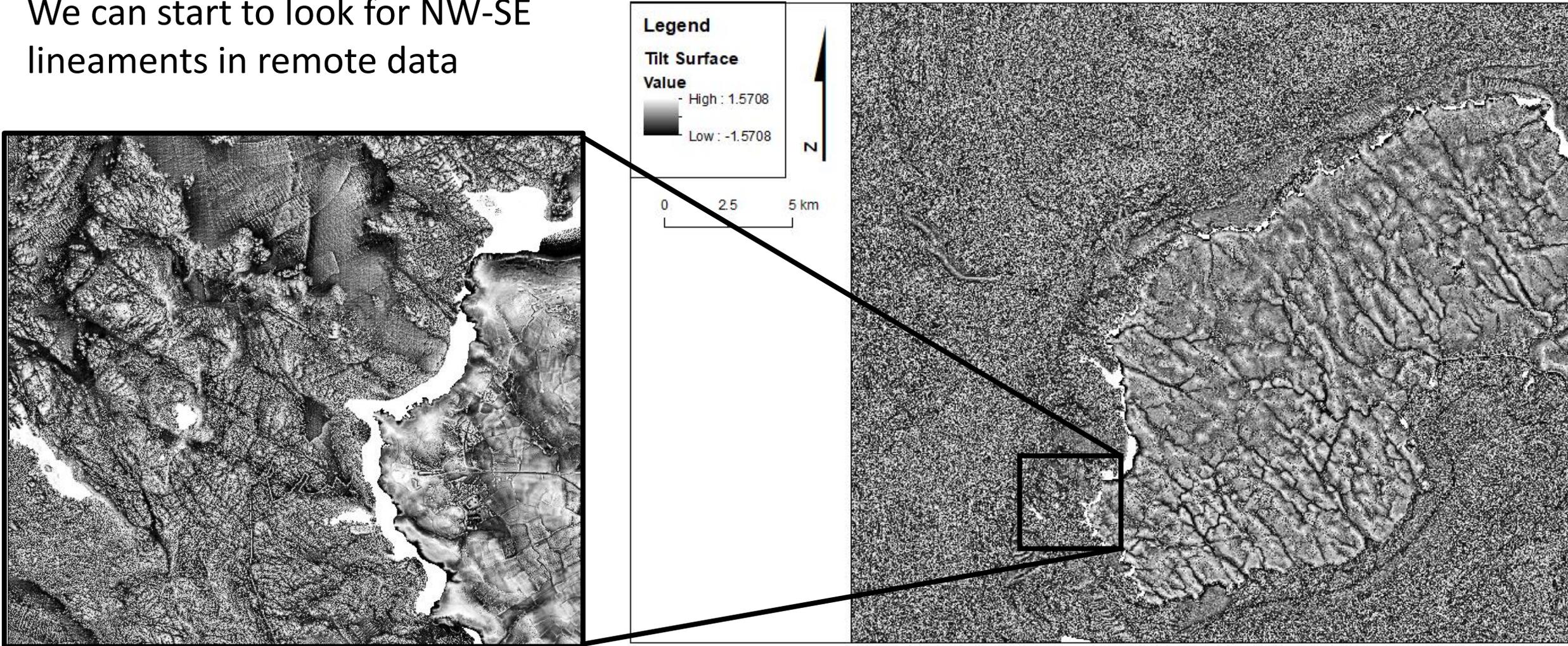
- Fault zones have formed at various times over last 300+ million years in many orientations
- Tendency for fault zones, once formed, to be re-activated.
- These processes can either enhance or destroy permeability



Sources: Yeomans et al. (2019). *Comput. Geosci.*

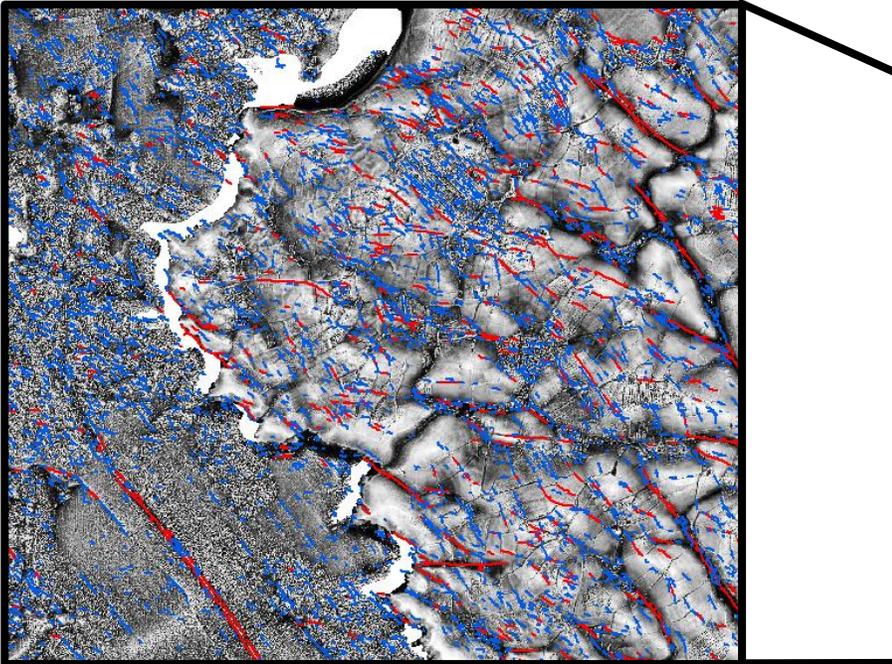
# GRANITES AND FAULT ZONES IN SW ENGLAND

We can start to look for NW-SE lineaments in remote data

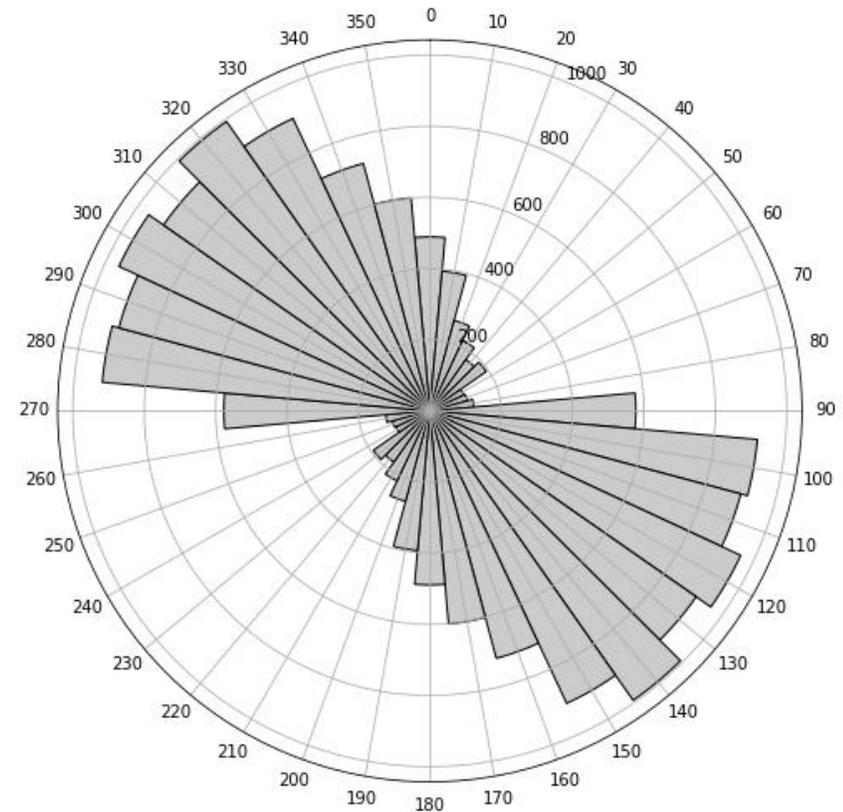


# REGIONAL REMOTE DATA

Multiscale approach detects broader onshore *and* finer offshore features



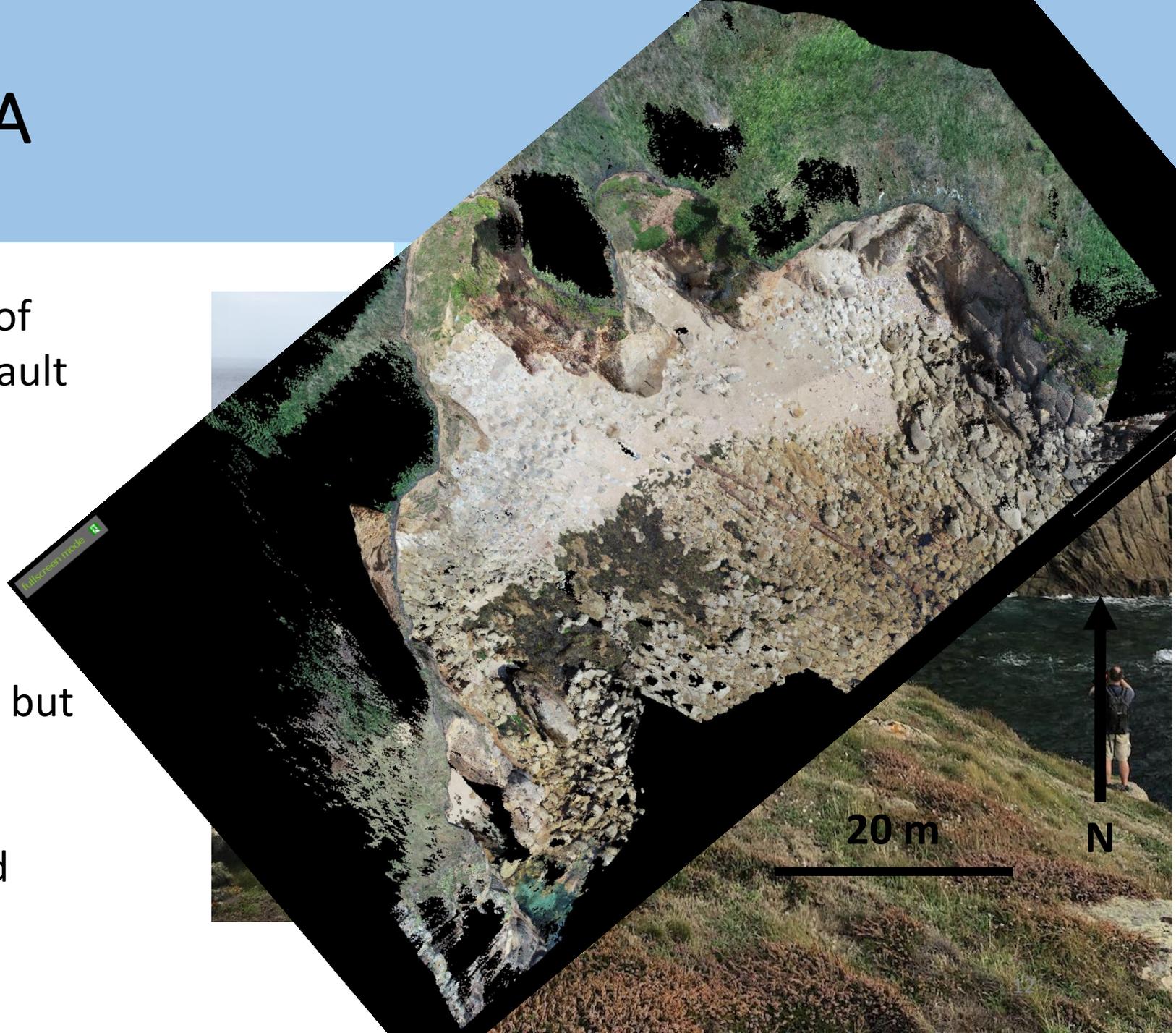
LiDAR and Bathymetry Lineament Data  
Rose Diagram of the lineaments in Land's End area

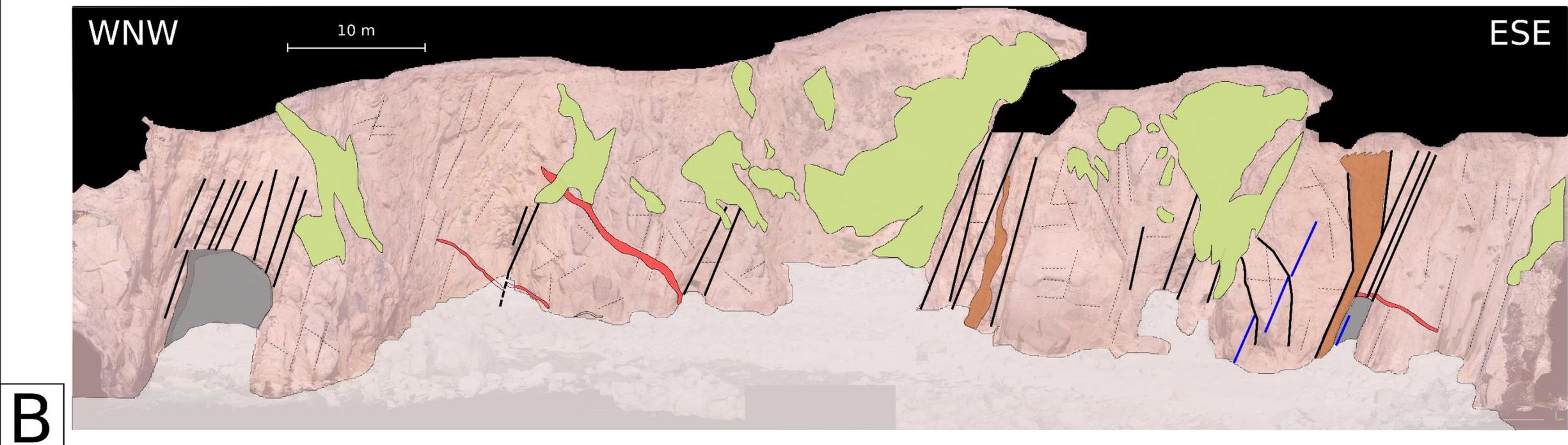


*Data with lineament lengths <150 m not included*

# LOCAL REMOTE DATA

- UAV-based photogrammetry of the Land's End-Porthgwarra Fault Zone
- DJI Phantom 4 drone, fully georeferenced, summer 2019
- Further locations are planned but weather dependent
- Used for remote mapping and field mapping

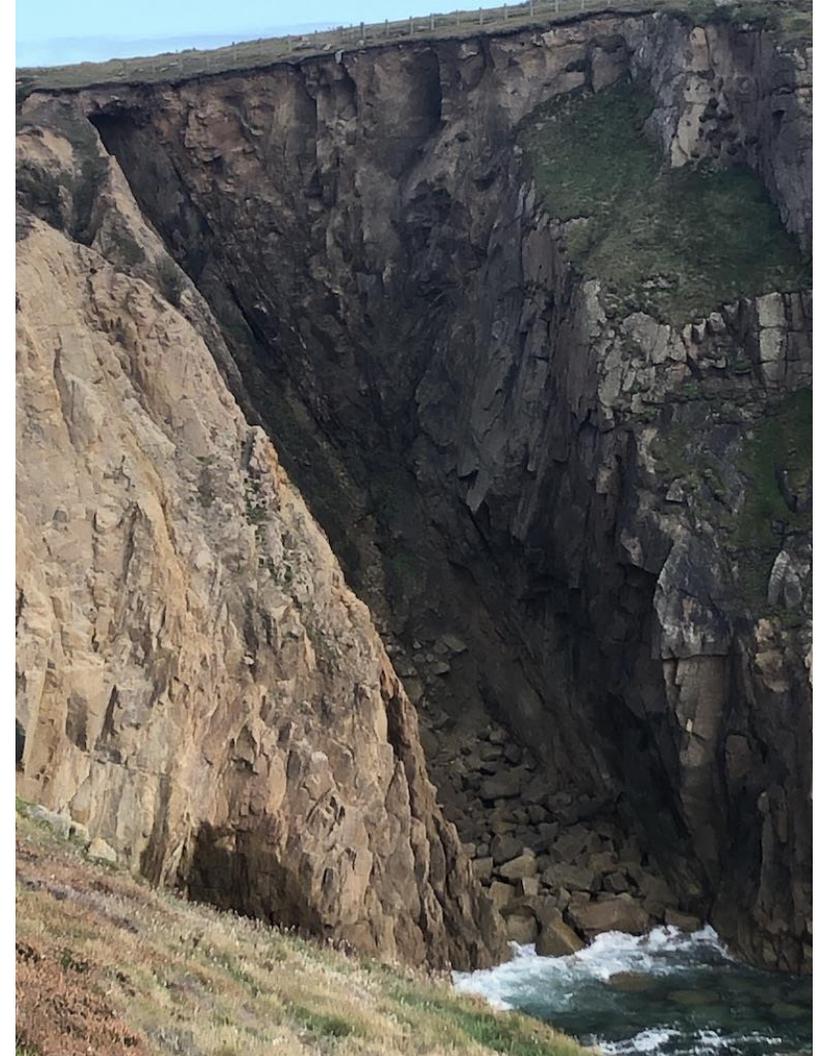




# WHAT'S IN THE FAULTS?



THE STRUCTURE CAN BE TRACED OVER >7 KM



# OTHER LOCALITIES FROM AROUND CORNWALL



# THANKYOU

- Natural fractures and hot granite drives deep geothermal energy systems
- We must use data at all scales to understand these systems
- There is a lot of potential for further development as we explore more of these favourable NW-SE fault zones