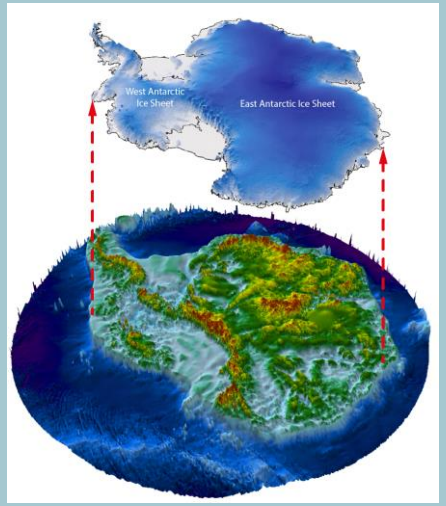
Antarctic geological Boundary Conditions (ABC)

Our aim is to use the geomorphological and geological record to understand ice behaviour in Antarctica.

Key questions:

1. What are the subglacial properties and processes relevant for past and future ice dynamics?
2. What is the role of geological controls and erosion and sedimentation on ice sheet dynamics?
3. How do glaciological, geological and geophysical records inform us about ice sheet and landscape?



Objectives:

- To improve maps of modern subglacial and offshore topography, bathymetry and geology – interpreting the landscape in respect of past and present ice flow.
- Develop improved reconstructions of past topography and bathymetry
- Enhance understanding of the distribution of water at the base of the ice (links to geothermal heat flux sub-committee).
- Integrate and ‘translate’ geologic and topographic characteristics into continent-wide data and machine-learning products to be used in ice sheet models.

ABC work packages (suggestions to discuss)

WP1. Reconstructing past ice extent and retreat from offshore bathymetry and stratigraphy:

- Assimilate marine geophysical (esp. seismic) and core data to produce 3D maps of sedimentary architecture.
- Interpreting the offshore landscape in respect of past and present ice flow using bathymetric and seismic data.
- Using the above to understand patterns of erosion and deposition.
- Linking to work of Chronology/Proxy Sub-committee.

WP2. Reconstructing past ice flow regimes from subglacial topography:

- Satellite data, RES and potential field data analysis to map subglacial and sub ice shelf topography/bathymetry in increased detail.
- Development of machine learning methods for integrating data and mapping subglacial topography.
- Using the above to understand patterns of erosion, protection and deposition in the landscape.

WP3. Develop erosion/provenance database:

- Bring together/review all Antarctic offshore sediment (e.g. IRD) provenance studies and connect to patterns and timing of ice flow and erosion changes.
- Develop approaches to sediment provenance “fingerprinting” and its application to interpretation of ice sheet change

WP4. Mapping and characterising subglacial geology:

- Using potential field data, landscape morphology information and outcrop/subglacial sampling techniques to map and characterise geology complimenting SCAR GeoMAP beneath the ice.
- Interpret potential fields and/or subglacial geology map in terms of friction, heat production, porosity, density etc.
- Use machine learning analysis of post-glacial landscapes to connect paleo geological knowledge with the subglacial environment.

ABC work packages (suggestions to discuss)

WP5. Enhancing understanding of the influence of water upon landscape evolution via modelling and geophysical data analysis:

- Using RES data and outcome from geology characterisation project to understand presence of water and therefore its influence on landscape evolution and ice flow.
- Understand likely ability of the ice-sheet bed to sustain active hydrogeology, and investigate potential for influence on ice sheet dynamics
- Link to Heat Flux subcommittee (or pass to Heat Flux subcomm?).

WP6. Develop and test models of glacial erosion and deposition with different controlling forces:

- Couple/incorporate erosion and deposition processes into existing ice sheet models.
- Modelling programme to investigate specific feedbacks with loading changes and ice sheet flow and grounding line stability.

WP7. Improving reconstructions of past topography and bathymetry:

- Use erosion model and geological/provenance database to understand topographic change.
- Apply geophysical modelling to understand vertical movements in the landscape in response to load changes and to explore distribution and activity of faulting.

WP8. Understanding interactions between the landscape and ice flow:

- Ice sheet modelling component to test influence of landscape evolution on ice flow (or spin out to wider community).
- Conduct tests on basal friction influence on ice and landscape evolution using the geologic map (WP4) as a constraint.

What next?

ABC kick-off discussion – early 2022 (look out for email)

- Ca. 2hr online meeting to discuss possible work packages + people
- Identify spatial gaps in understanding

4th Geomorphological Template for Past Antarctic Ice Dynamics (GeTPAID) Workshop – mid 2022 in Durham, UK and online (look out for email)

- Addressing knowledge and interpretation of Antarctic subglacial topography

We need to engage with Modelling theme

- Explore a workshop (e.g. What do modellers need from boundary conditions?)

What do we need?

- More geologists! Onshore and offshore expertise.
- Continued discussion with Proxy, modelling and heatflux communities
- If you have not already done so – sign-up: https://tinyurl.com/AntGeolBC
- Or email Stewart.Jamieson@durham.ac.uk for more information
- Tell us about any projects that align to this or apply for grants and PhD studentships to address your areas of interest

Steering Committee

- Emma ‘Mickey’ Mackie (Stanford University, USA, ECR, topography, machine learning) – Co-Chair
- Stewart Jamieson (Durham University, UK, landscape evolution/modelling) – Co-chair
- Yasmina Martos (NASA, USA, subglacial geophysics)
- Anna Ruth Halberstadt (UMass-Amherst, USA, ECR, modelling, bethymetry)
- Xiaoxia Huang (Chinese Academy of Sciences, ECR, offshore seismics)
- Jaqueline Halpin (University of Tasmania, geology, provenance)
- Guy Paxman (Lamont Doherty Earth Observatory, USA, ECR, geophysical modelling)
- Alan Aitken (University of Western Australia, subglacial geology)
- Kirsty Tinto (Lamont Doherty Earth Observatory, USA, subglacial geophysics and RINGS-liason).