New timing constraints on the metallogenic evolution of western Tasmania

Dr Sheree Armistead

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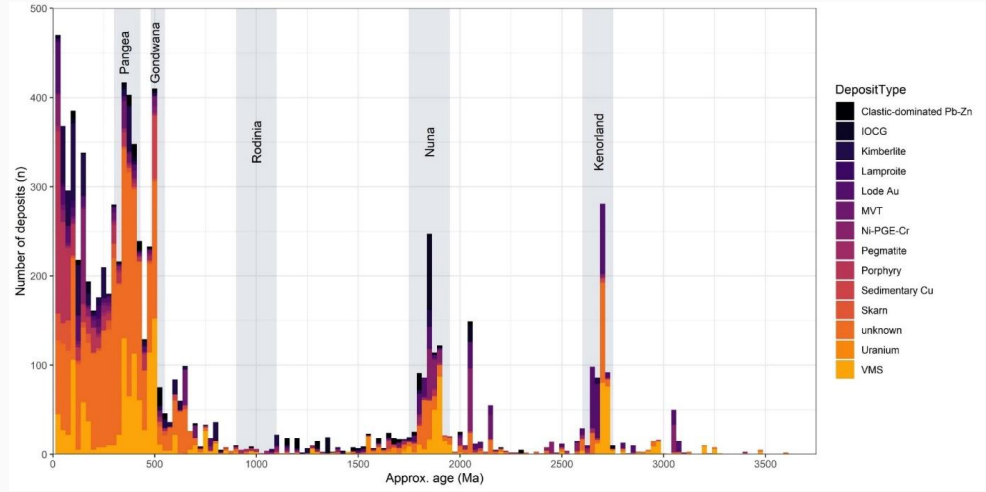
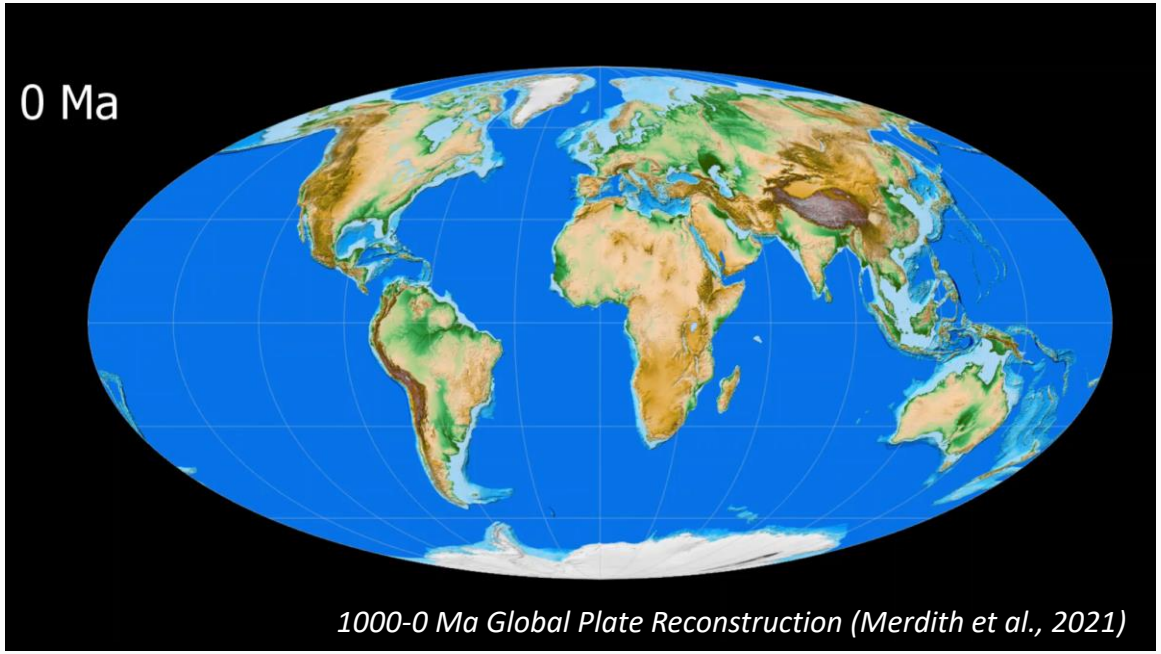
CODES
CENTRE FOR ORE DEPOSIT AND EARTH SCIENCES

UNIVERSITY of TASMANIA

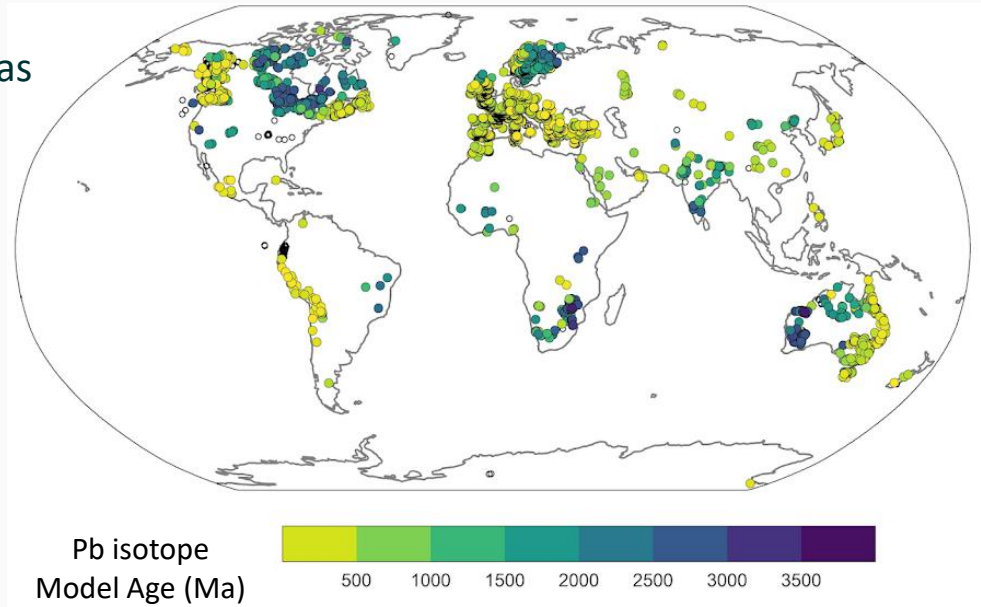
Research interests

- Supercontinents & tectonic reconstructions
  - Neoproterozoic evolution of central Gondwana (PhD UAdelaide)
  - Archean tectonics and links to mineralisation (Postdoc Geological Survey of Canada & Laurentian University)
- Geochronology and isotope geochemistry
  - Detrital and magmatic zircon U-Pb, Hf geochronology
  - Pb isotopes from ore deposits
  - Monazite, apatite, titanite, rutile, allanite, garnet, calcite etc. etc. UTas





1000-0 Ma Global Plate Reconstruction (Merdith et al., 2021)



Newly refined databases of global ore deposits and Pb isotopes (Collaboration with Bruce Eglington, University of Saskatchewan)

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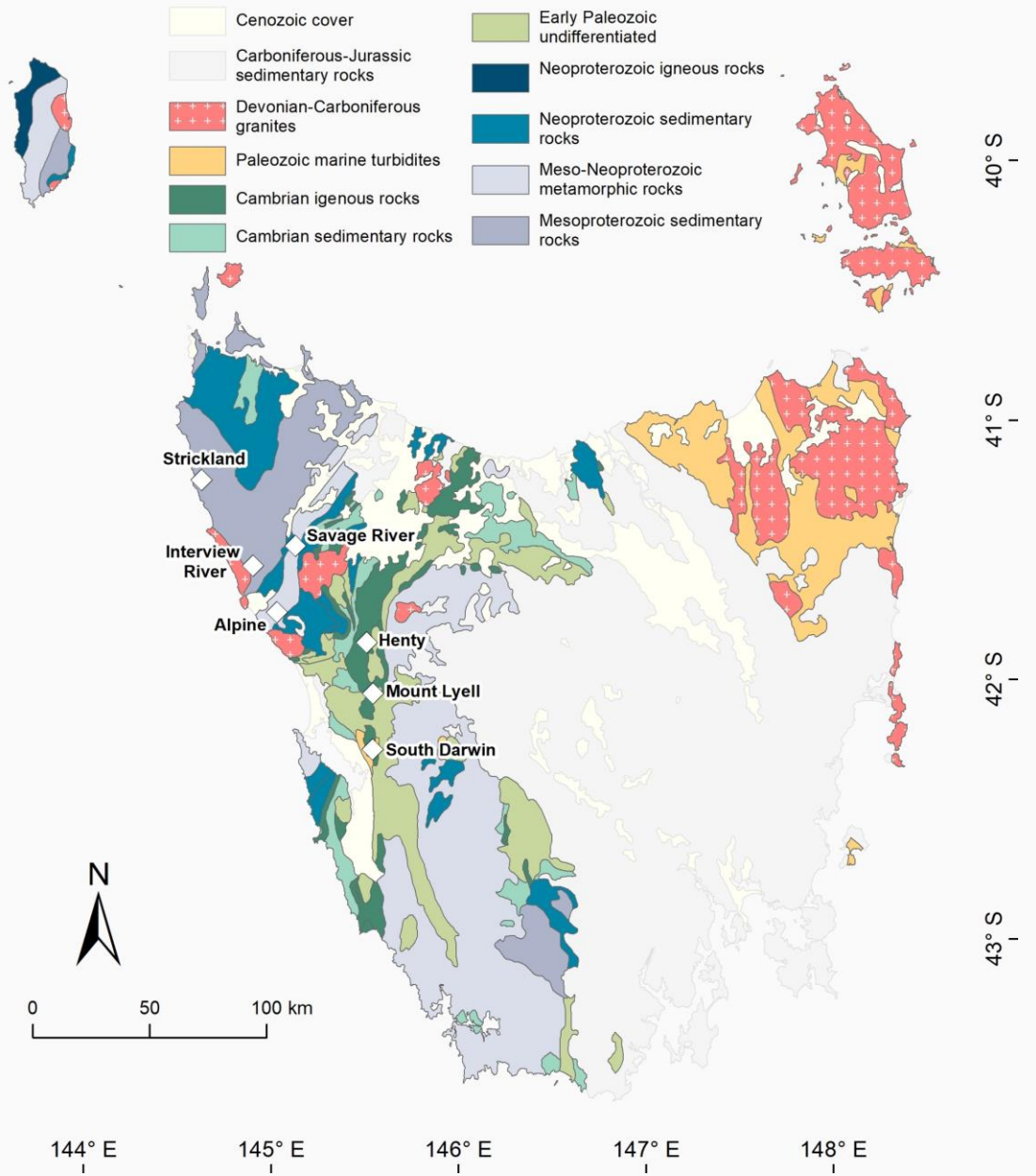
New project overview

- New two-year project funded by Geoscience Australia's Exploring for the Future program
- Aim: to collect new geochronology data to constrain the timing of mineralisation in different western Tasmanian terranes
- Collaboration with new IOCG project led by Jeff Steadman to look at Alpine deposit
- Particular focus on understanding mineral potential in the Proterozoic Rocky Cape tectonic element



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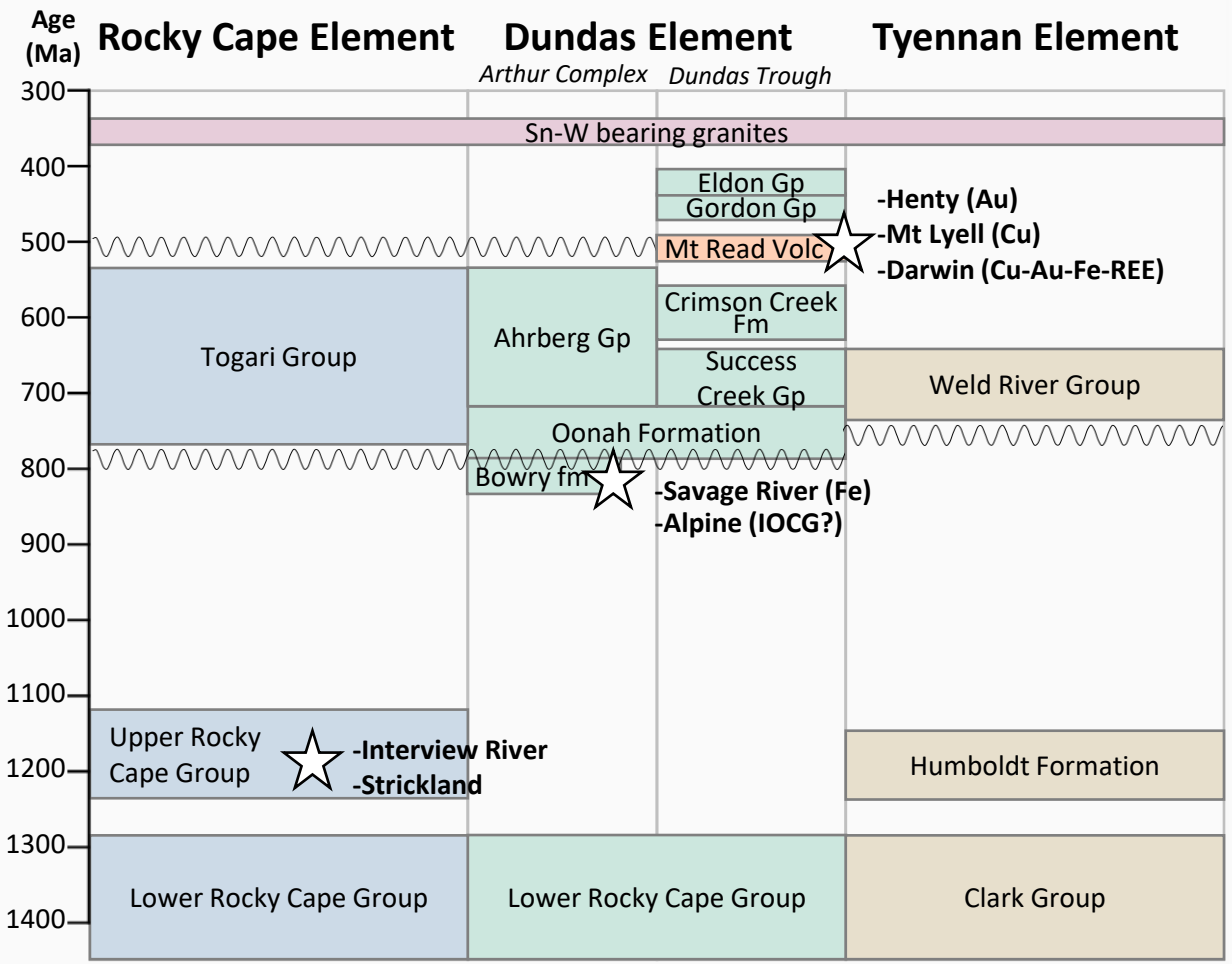
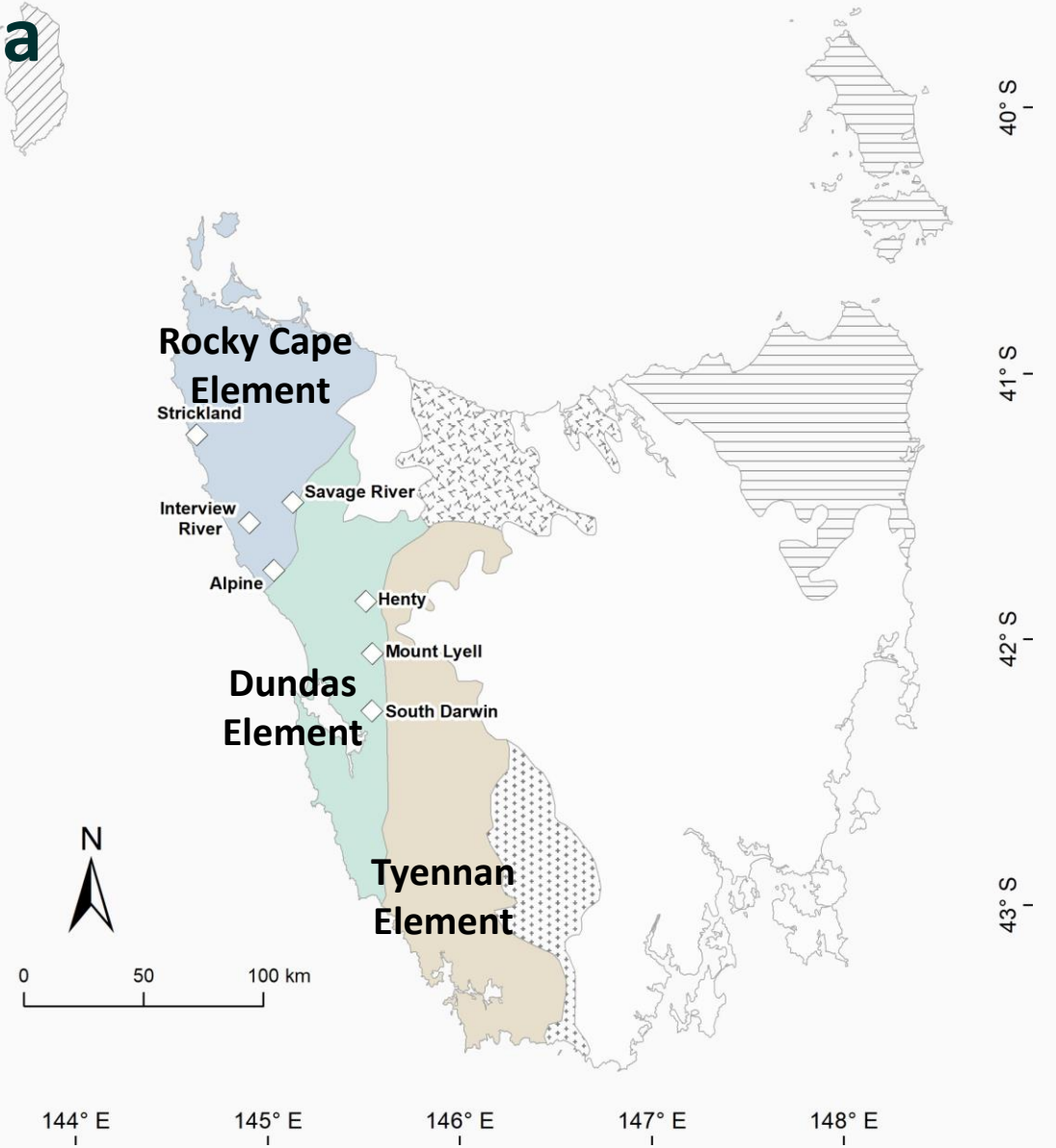
Tectonic elements of western Tasmania





Modified from Mulder et al., 2018 and MRT Time-Space diagram for Tasmania 1998

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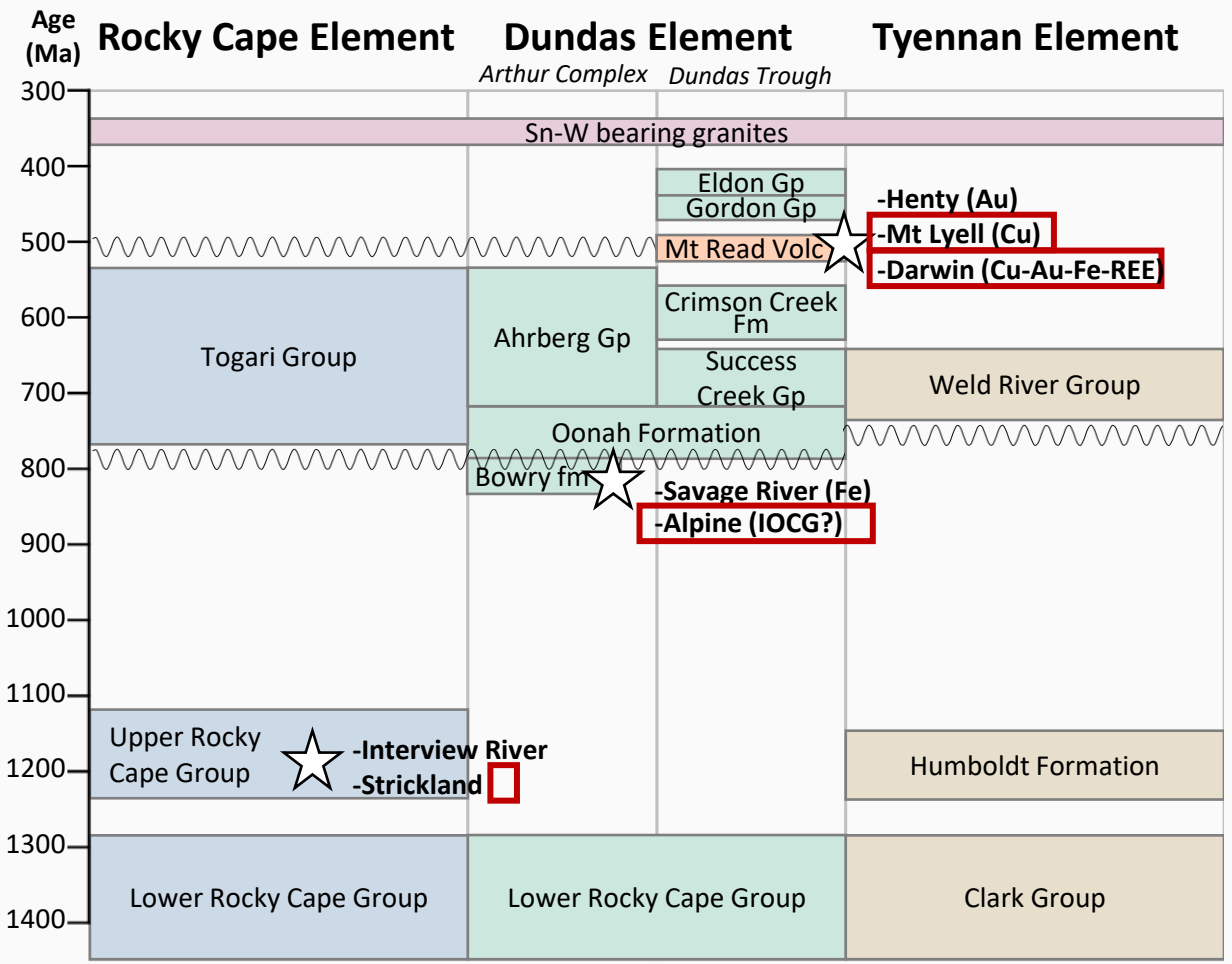

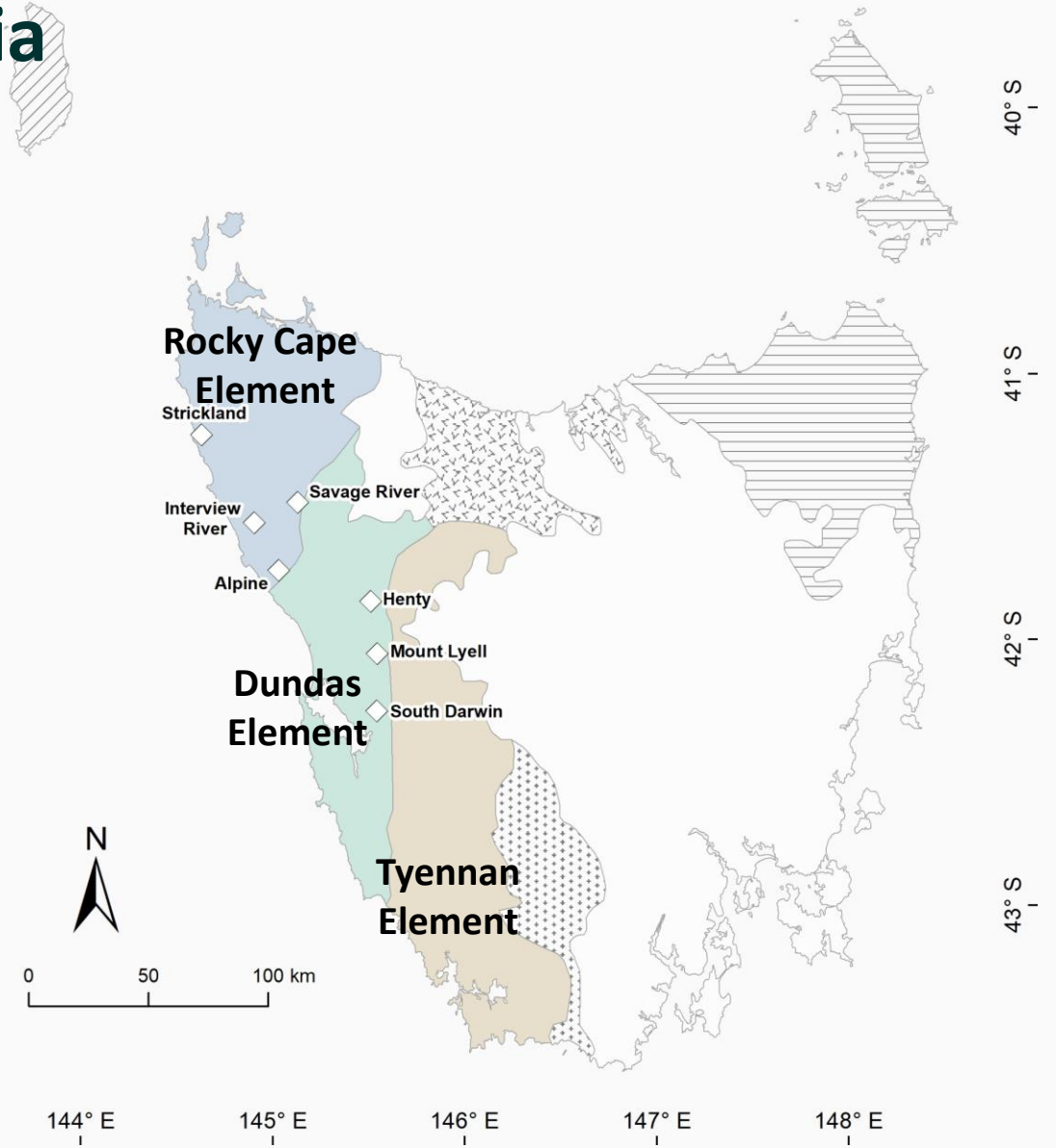

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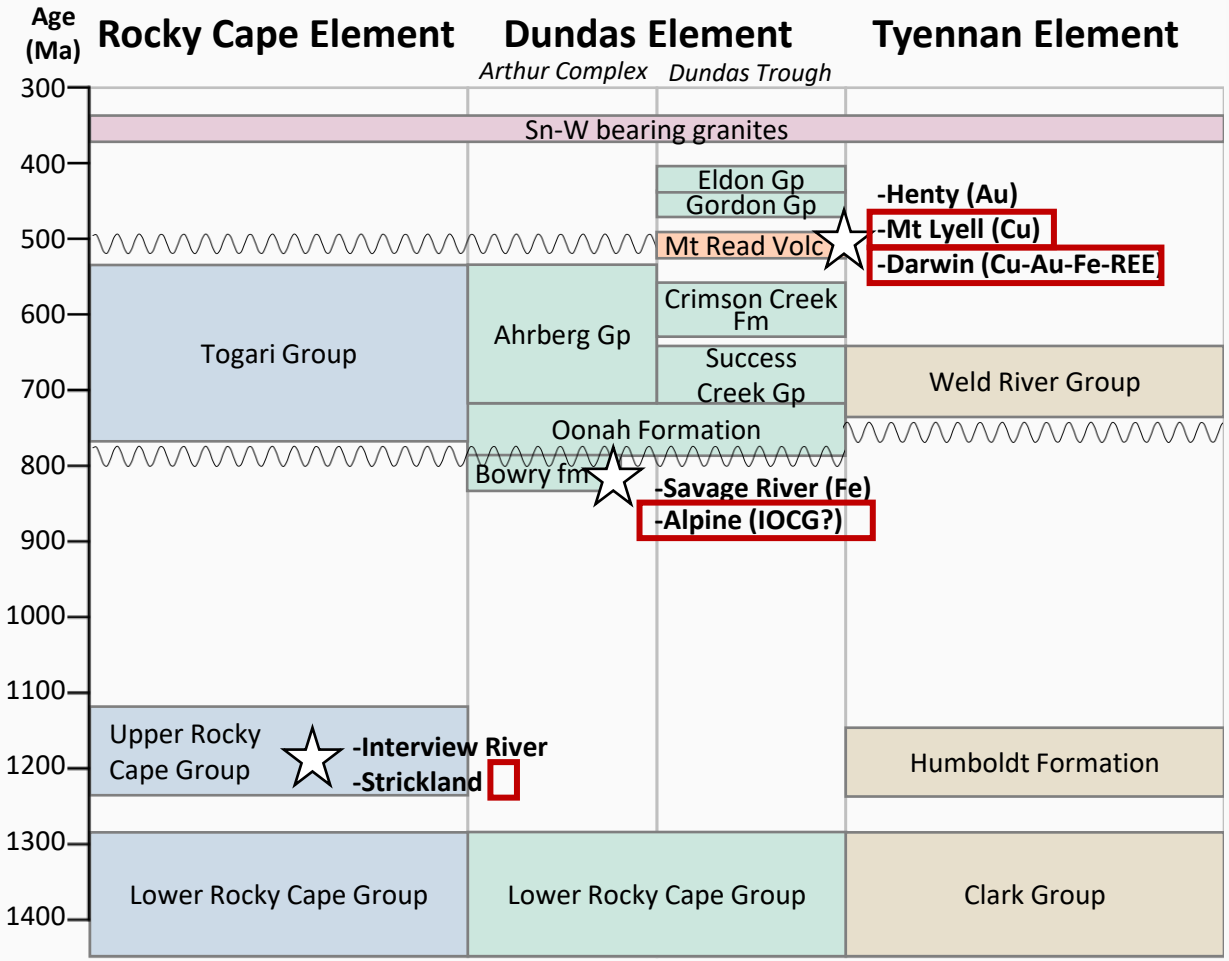

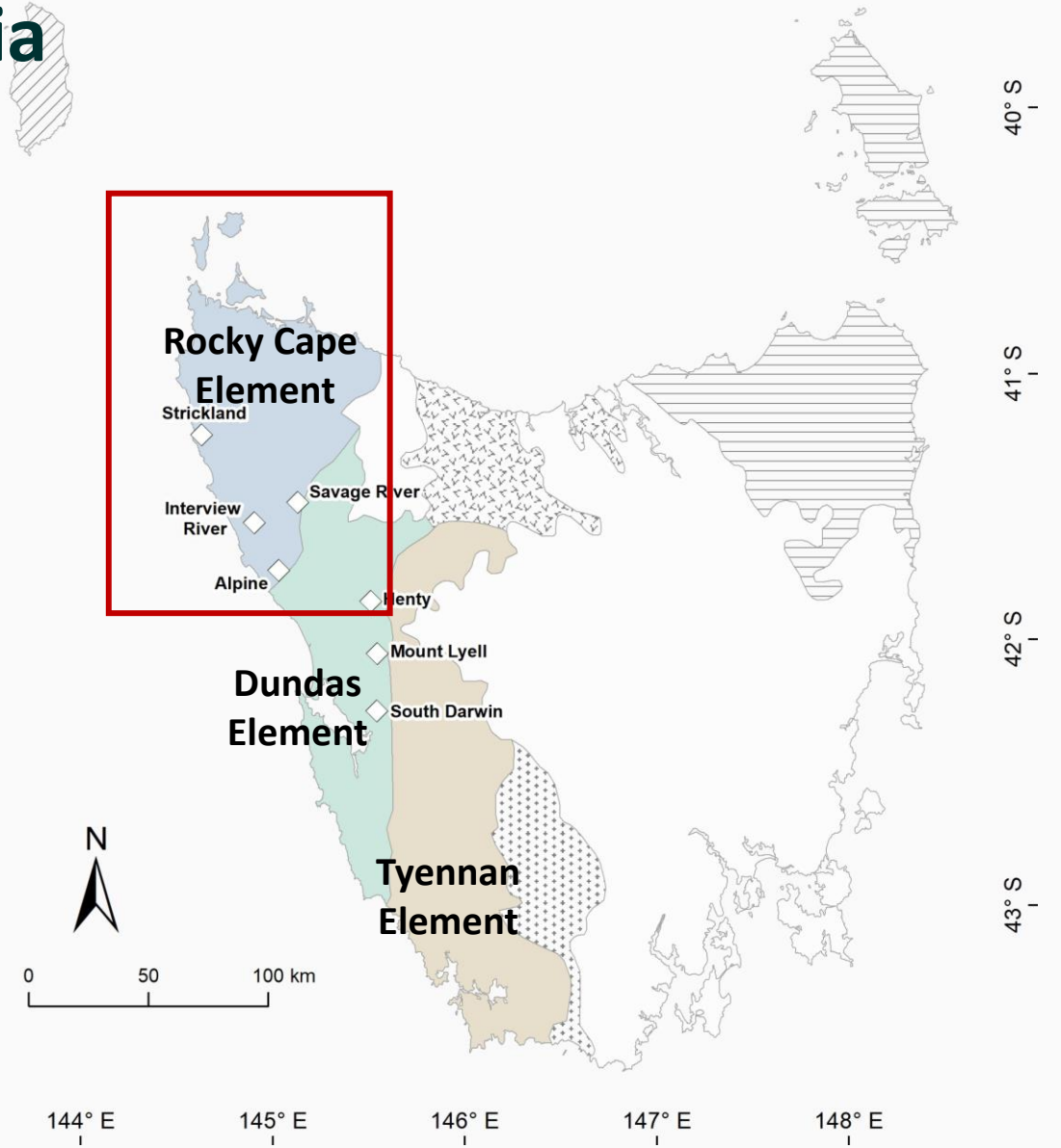

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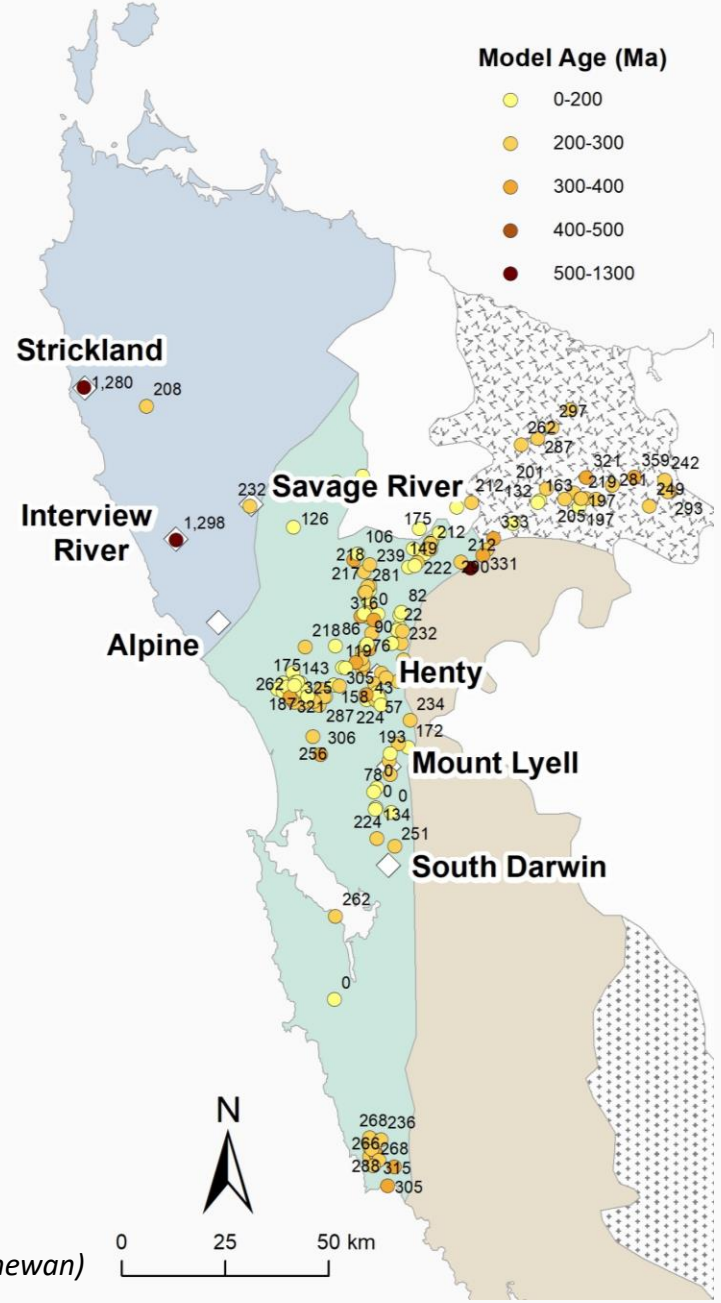
Rocky Cape Element – Pb isotopes

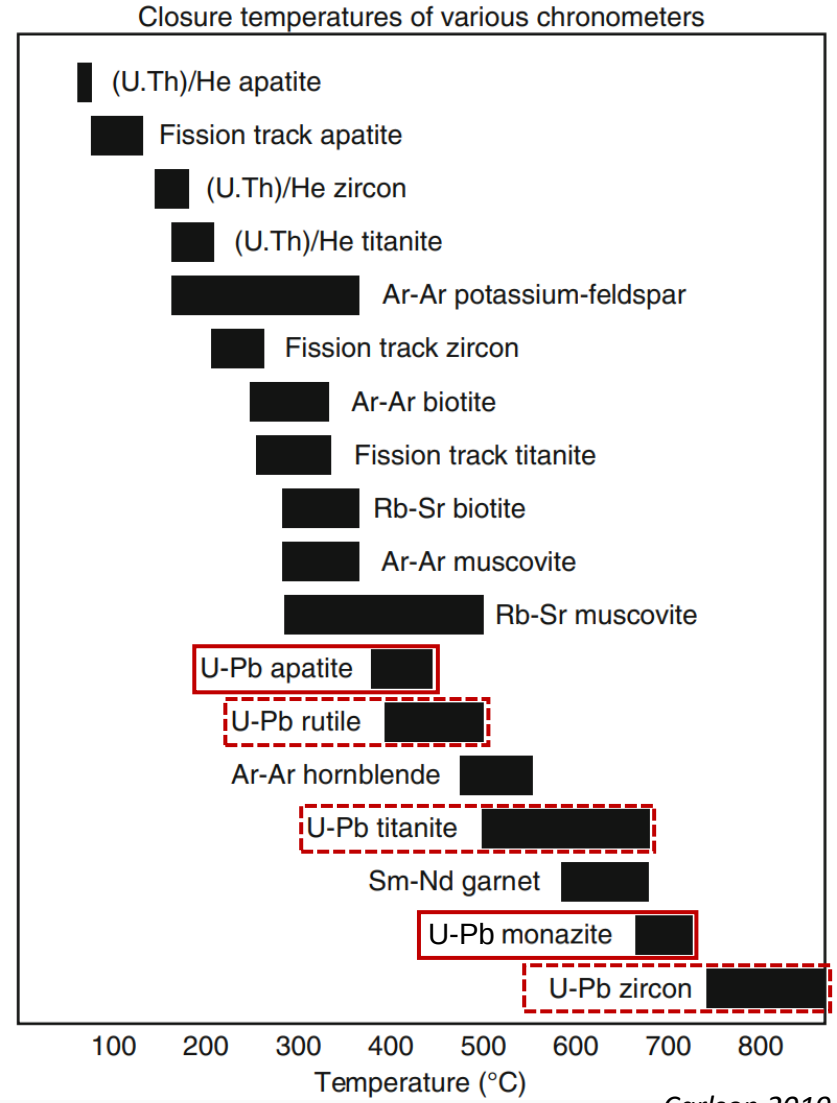
- Interview River & Strickland prospects hosted by the Rocky Cape Group
- They have Pb isotope model ages of c. 1290 Ma, however this is not a robust method for dating mineralisation
- Need to collect new samples from these prospects to target datable minerals (e.g. monazite, apatite) associated with sulphides
- Potential for sediment hosted Cu mineralisation in the Rocky Cape Group?



Pb isotope compilation by Bruce Eglington (University of Saskatchewan)

Dating techniques planned

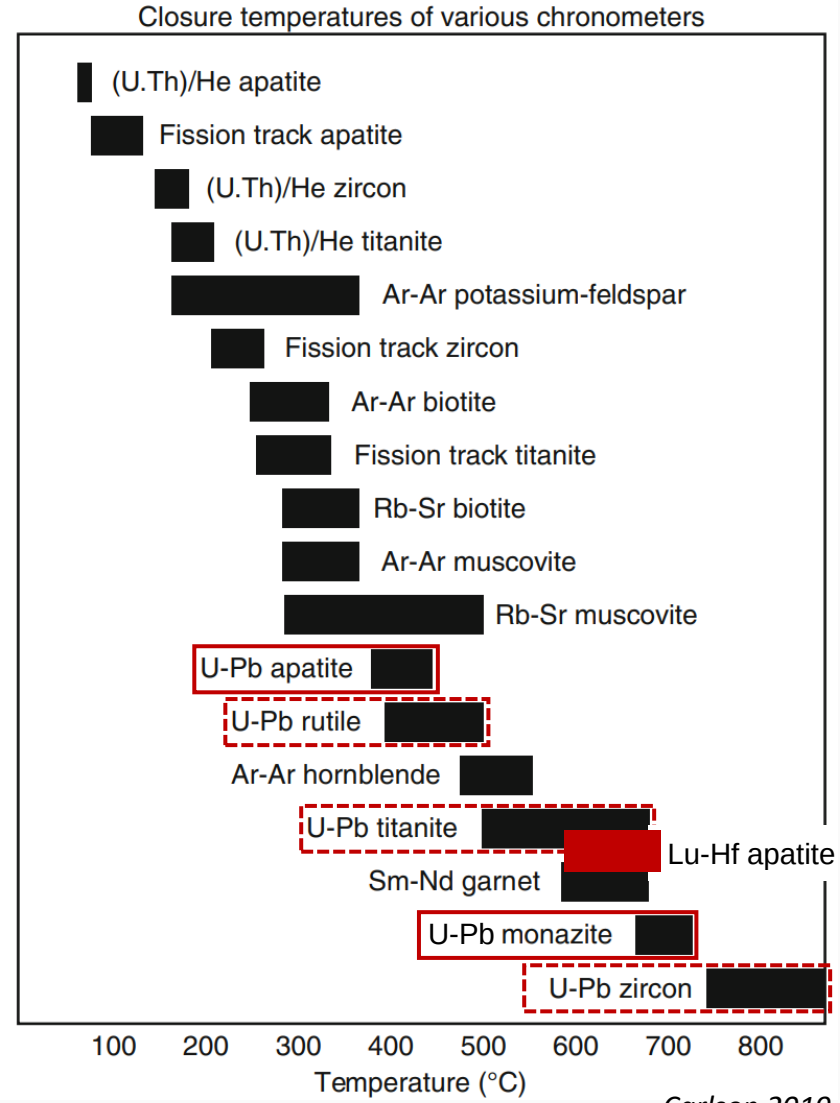
- By targeting different minerals, we are able to constrain the timing and temperature ranges for mineralisation
- Aim for datable minerals that are texturally related to ore minerals/sulphides



Carlson 2019

Dating techniques planned

- New dating techniques are rapidly evolving: e.g. new Lu-Hf dating of apatite (similar closure temperature to Sm-Nd in garnet) is being developed at the University of Adelaide – where we have sent several of our samples
- Lu-Hf dating in garnet is currently being developed at UTAS which presents exciting dating opportunities, particularly for metamorphic/metasedimentary rocks
- Will also use the SHRIMP at Geoscience Australia to target small grains that cannot be analysed using LA-ICP-MS



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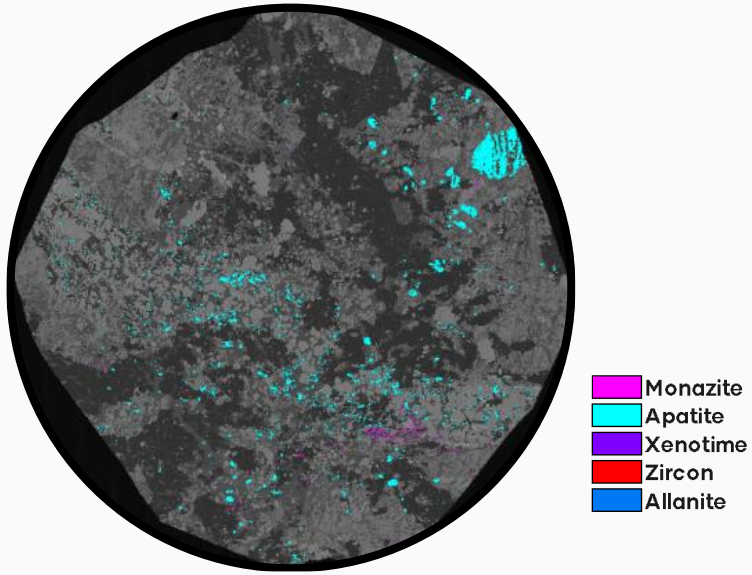
Monazite dating

- U-Pb and trace elements using LA-ICP-MS at UTAS
- Closure temperature 650-750 °C + (but can grow in low temperature settings)
- AMICS (automated scanning electron microscopy) mineral identification at Central Science Laboratory, UTAS:



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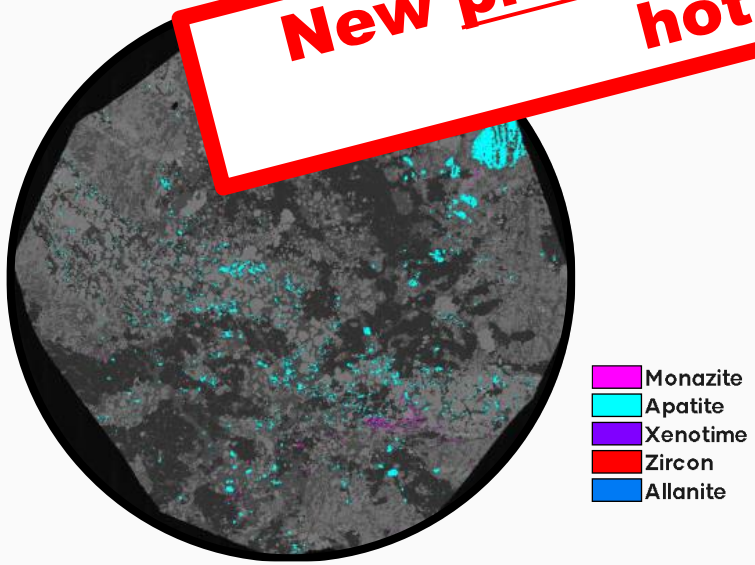

New preliminary monazite U-Pb data hot off the press

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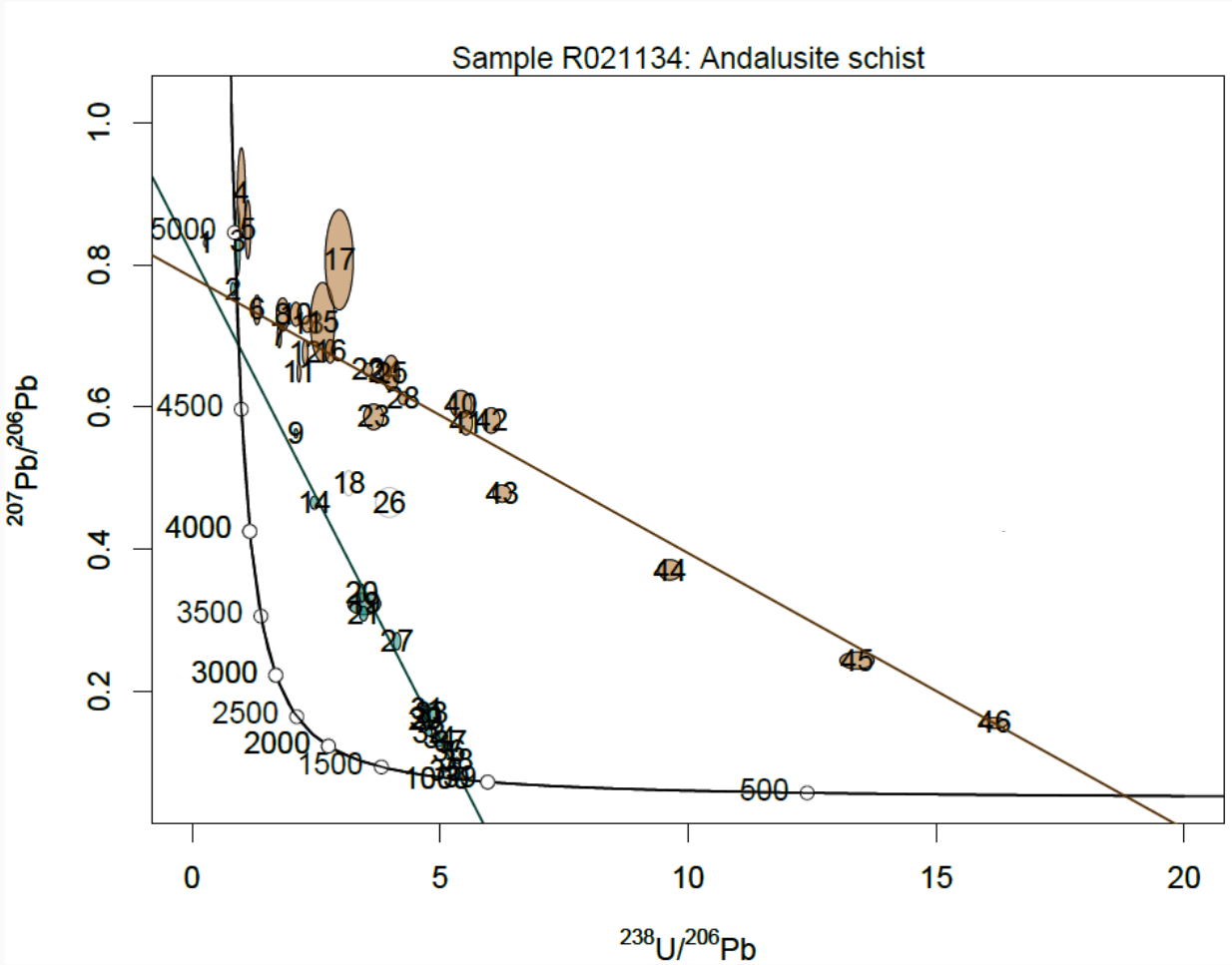
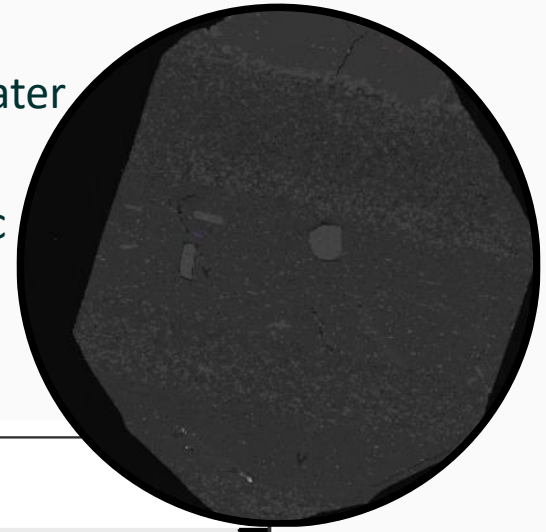
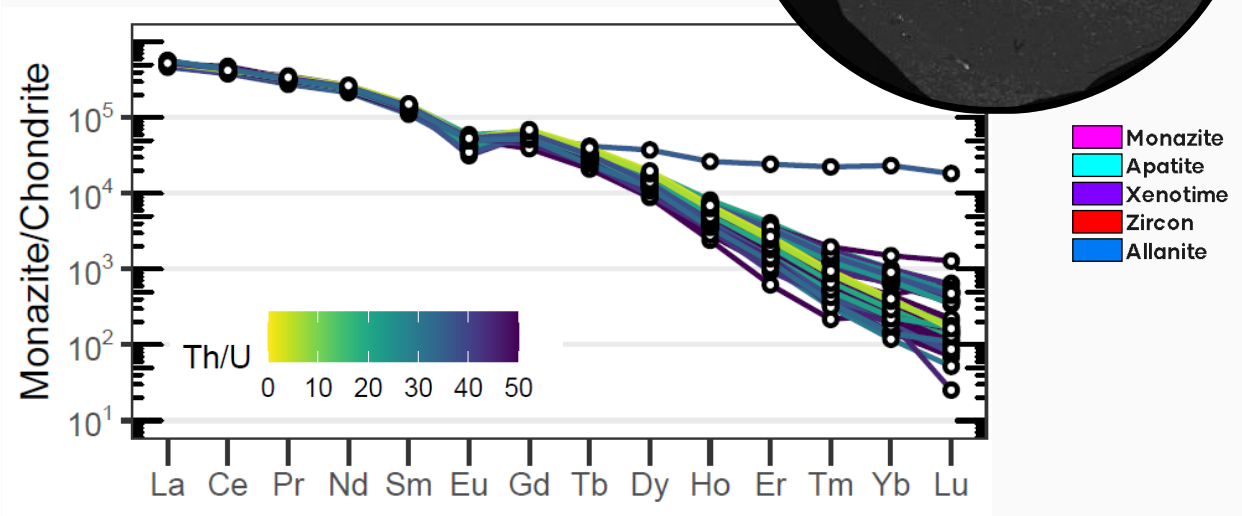
New data from Andalusite schist near Strickland Prospect Rocky Cape Element



- Metamorphic age of c. 1090 Ma
- Resetting of some grains during later deformation and metamorphism
- High Th/U indicates metamorphic growth





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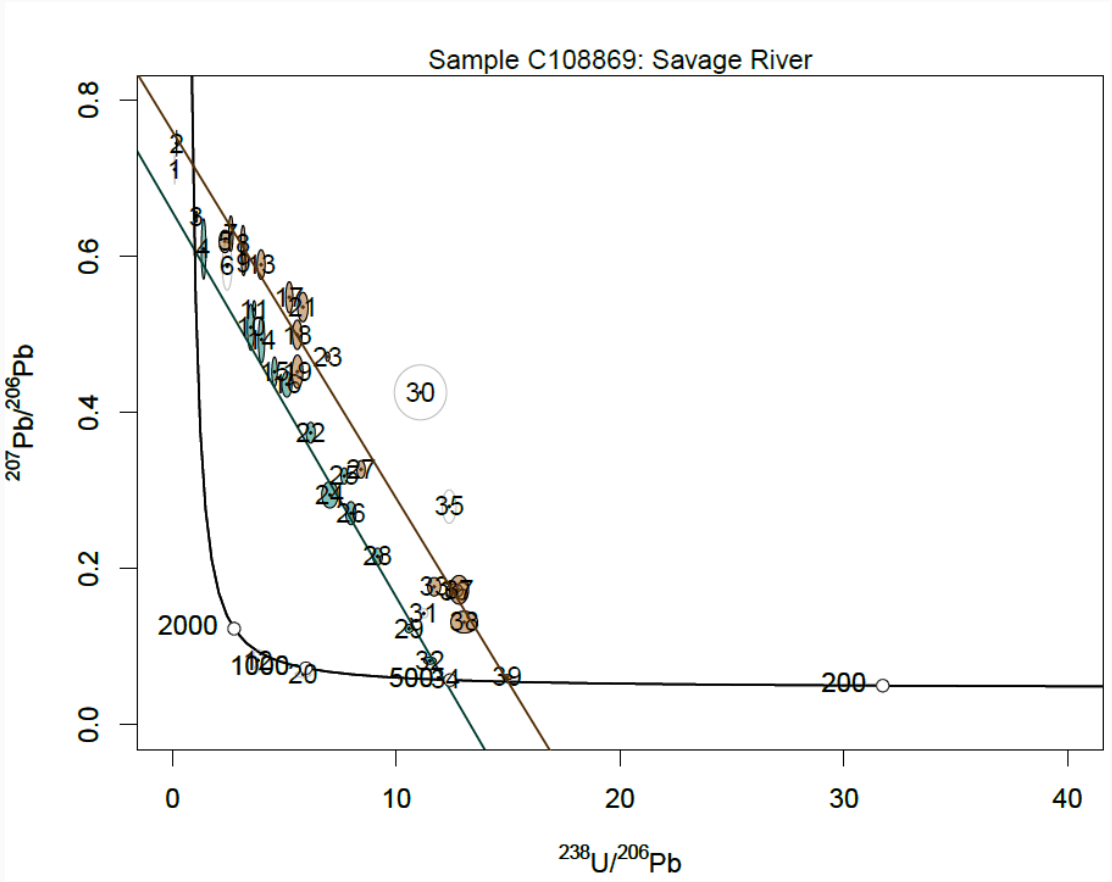
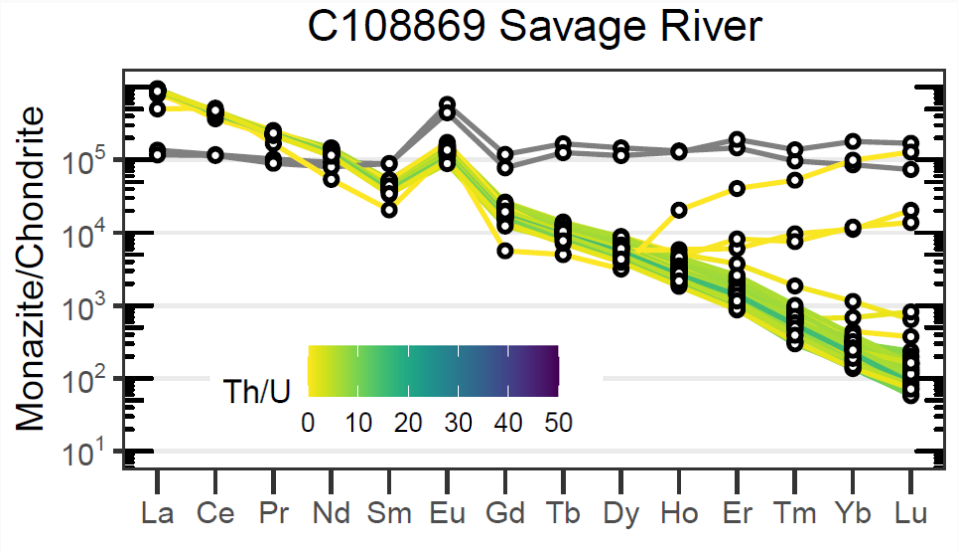
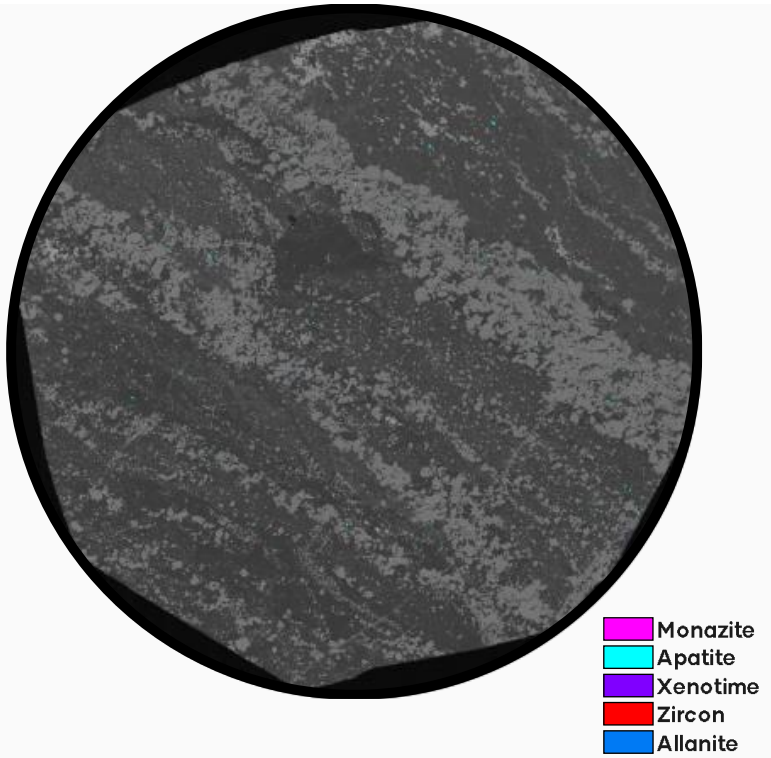
Savage River new monazite U-Pb data

- Two ages: c. 510 Ma and c. 415 Ma
- Positive Eu anomalies indicate that the monazites formed during albite alteration

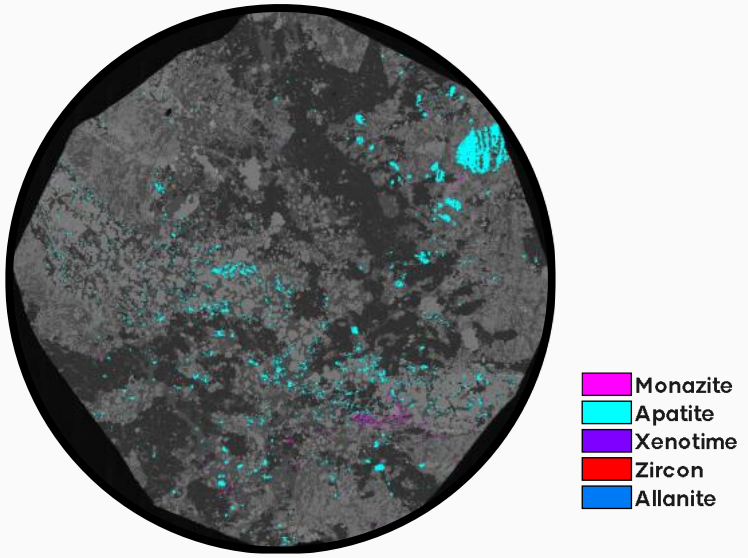


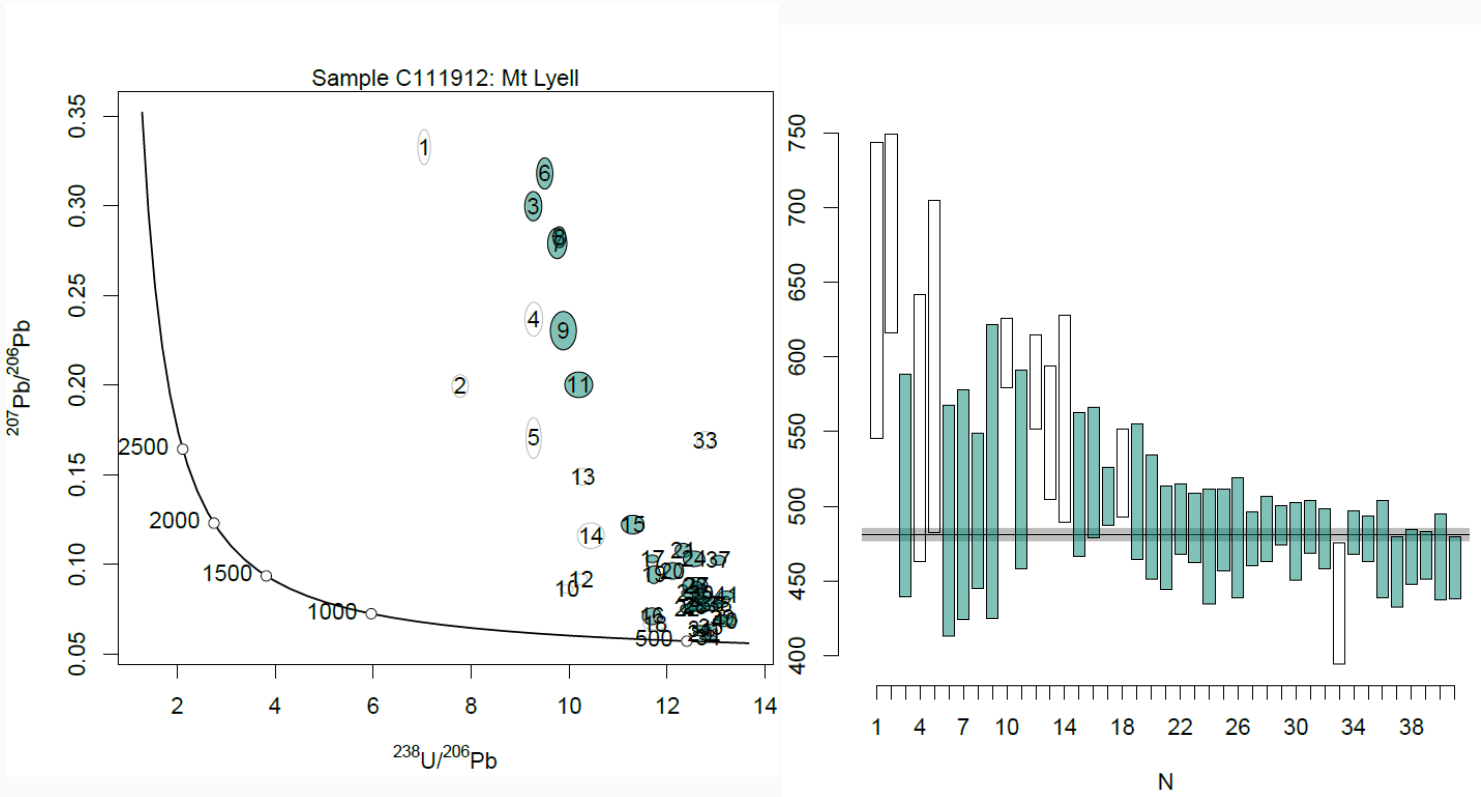


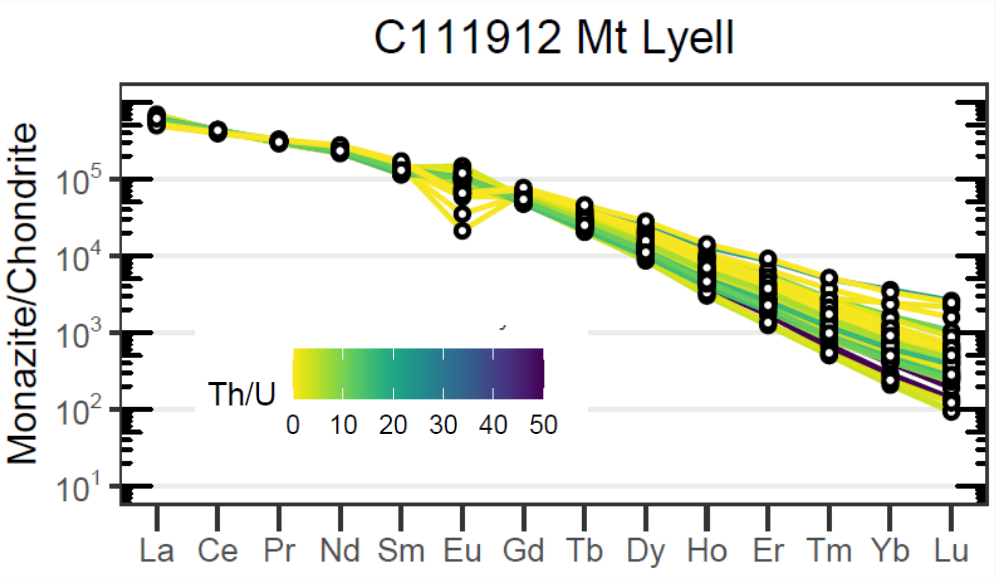


Dundas Tectonic Element – Mt Lyell

- New monazite age c. 480 Ma
- Lots of apatite in this sample, which will be dated using Lu-Hf apatite and U-Pb apatite







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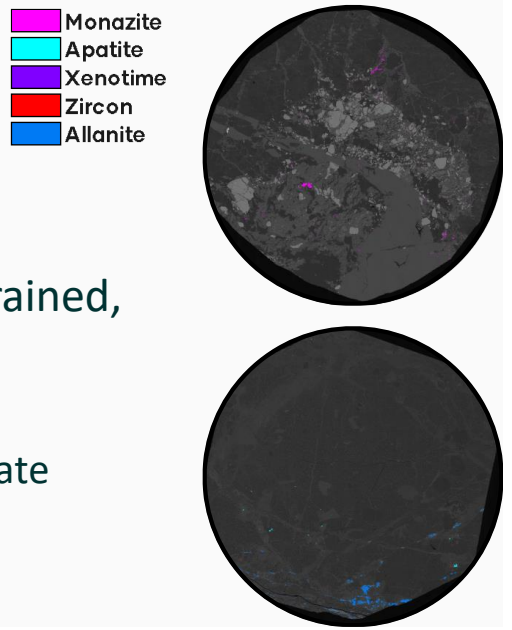
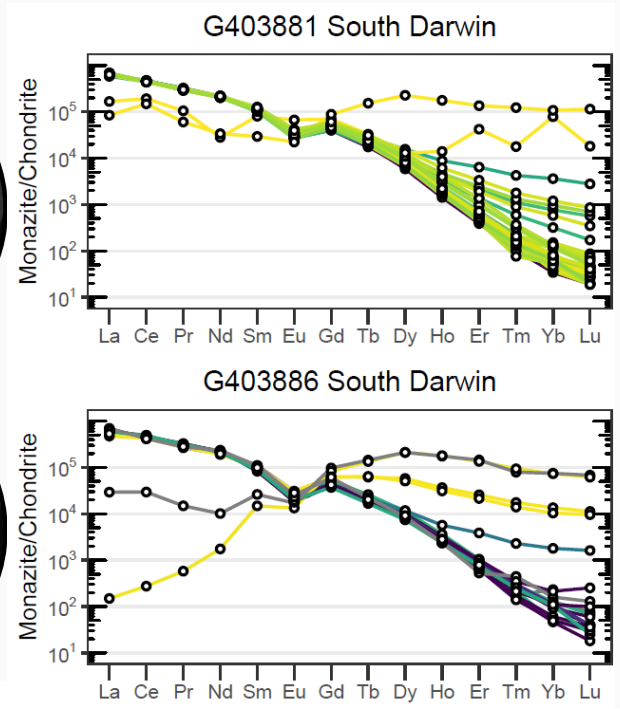
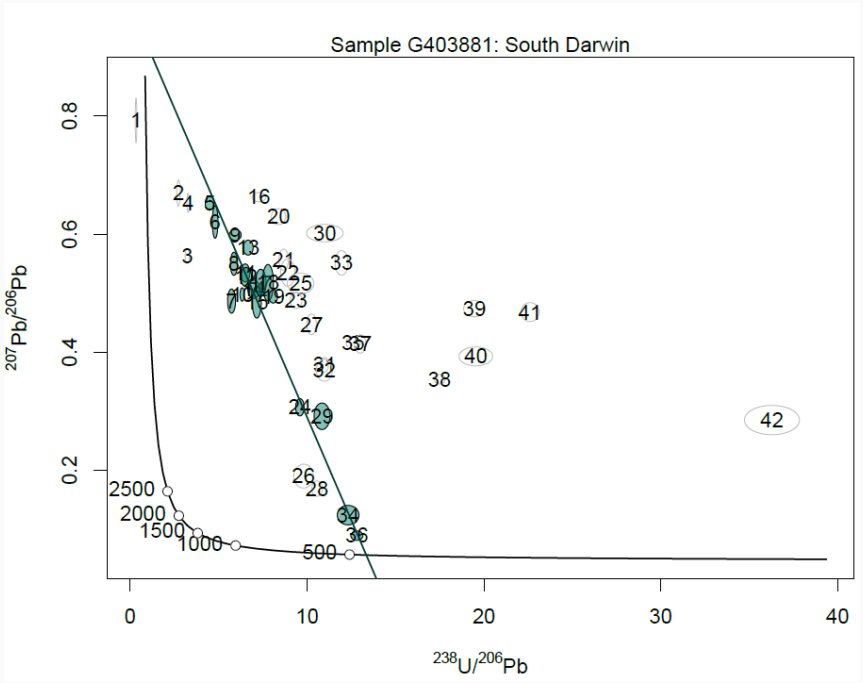
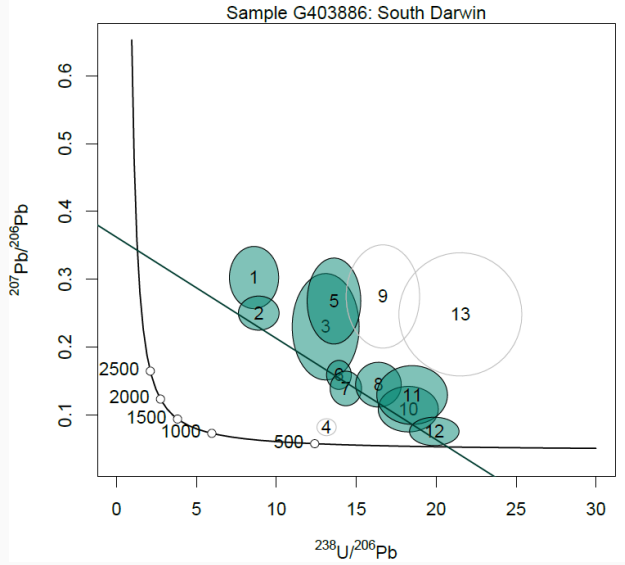
Dundas Tectonic Element – South Darwin 2 samples

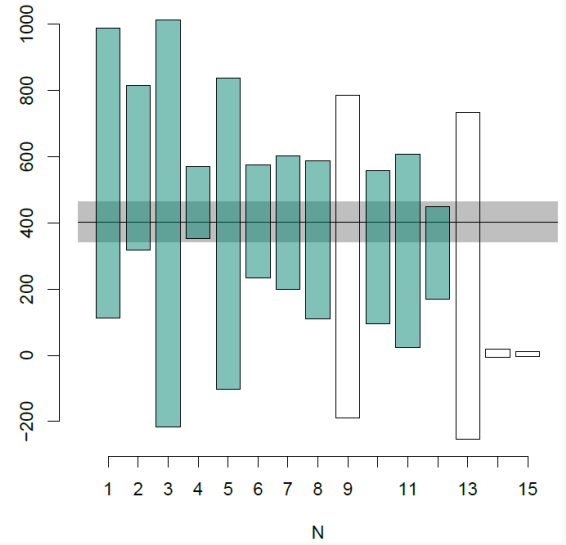
- G403881 –
  - Intercept age of c. 465 Ma
- G403886 – monazite very small and results are not well constrained, likely mixing signals with other minerals
  - Likely follow up with SHRIMP on small grains
  - Sample has lot of large allanite crystals that we can attempt to date
  - Also contains apatite and zircon

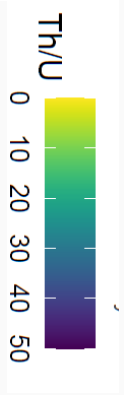












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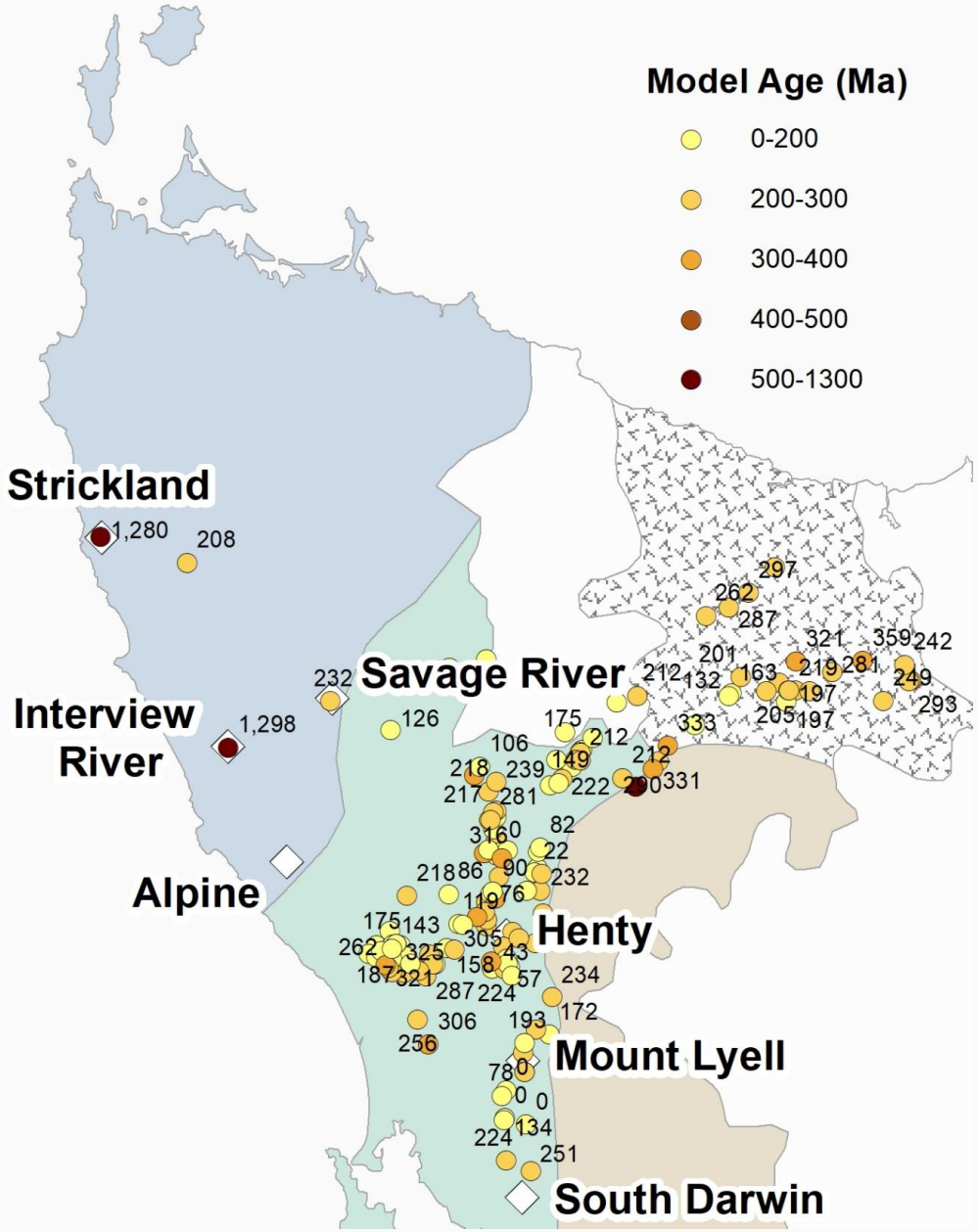
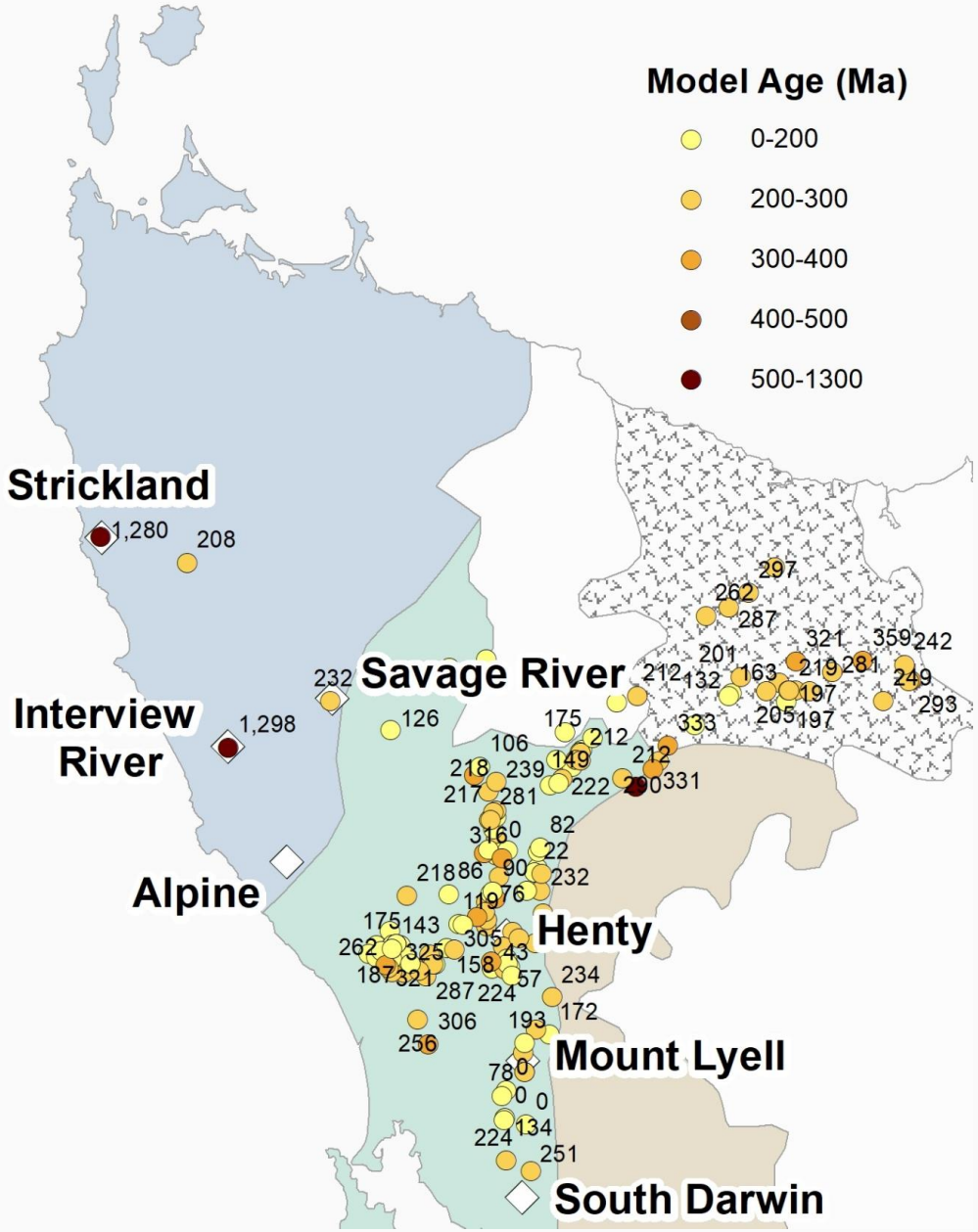
Future work – current dataset

- Better refine/process current data
- Understand what the trace element signatures mean for monazite growth in these deposits
- Analyse additional samples from other parts of the deposit to understand mineral paragenesis



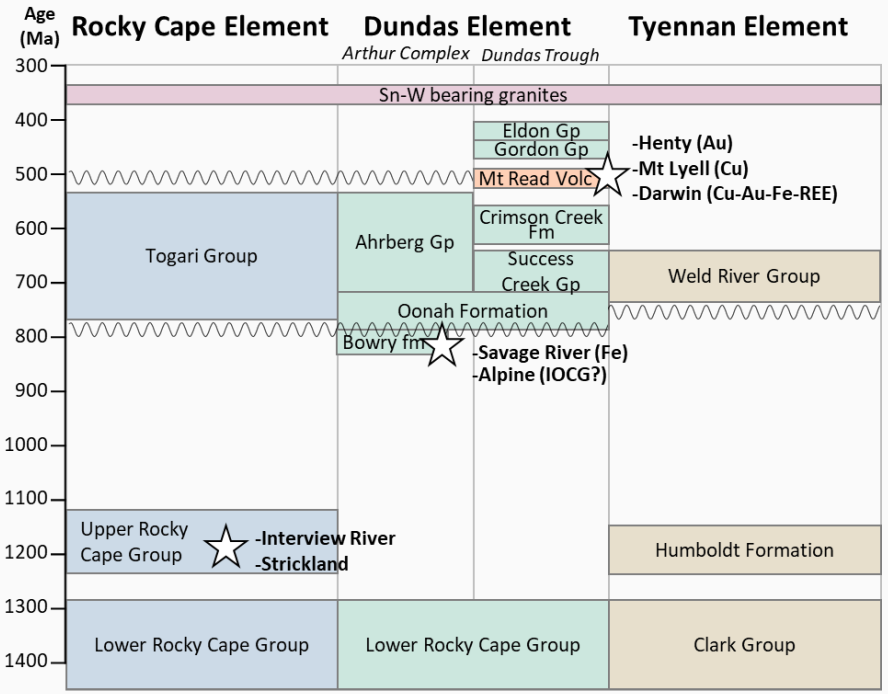
Future work – other deposits

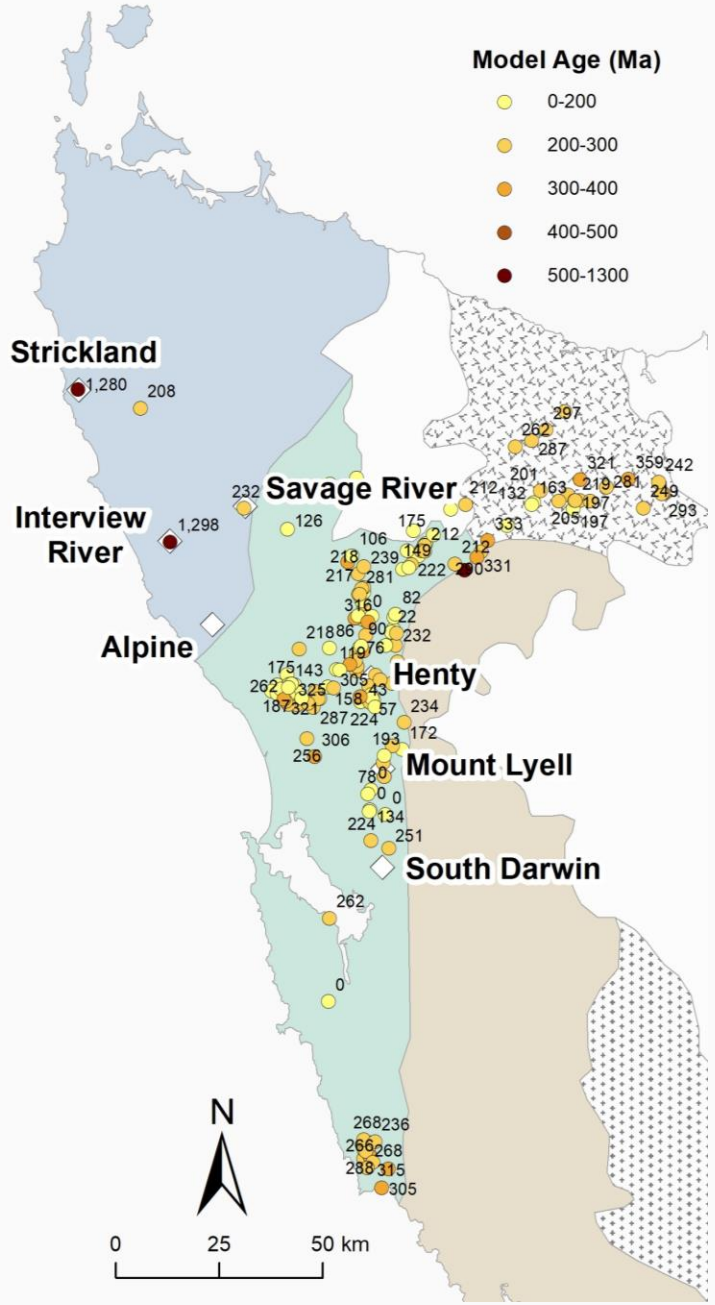
- Interview River & Strickland (Rocky Cape Group)
  - Look at broader potential for sedimentary Cu mineralisation in this region
  - Field access is challenging, need to collect samples
- Henty
- Alpine



Alpine Deposit – IOCG?

- New project led by Jeff Steadman to look at IOCG deposits in Australia
- Alpine deposit chosen as a Tasmanian example of a potential IOCG system
- Along strike from Savage River – hosted by the Neoproterozoic Bowry Formation? Need more age constraints on host rocks and mineralisation
- 16 samples currently being processed, with new data expected in early 2023





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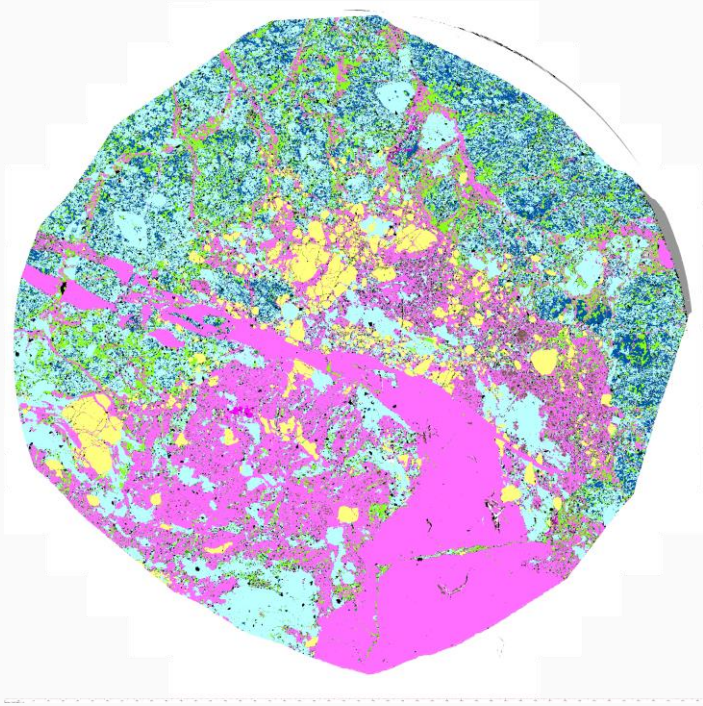
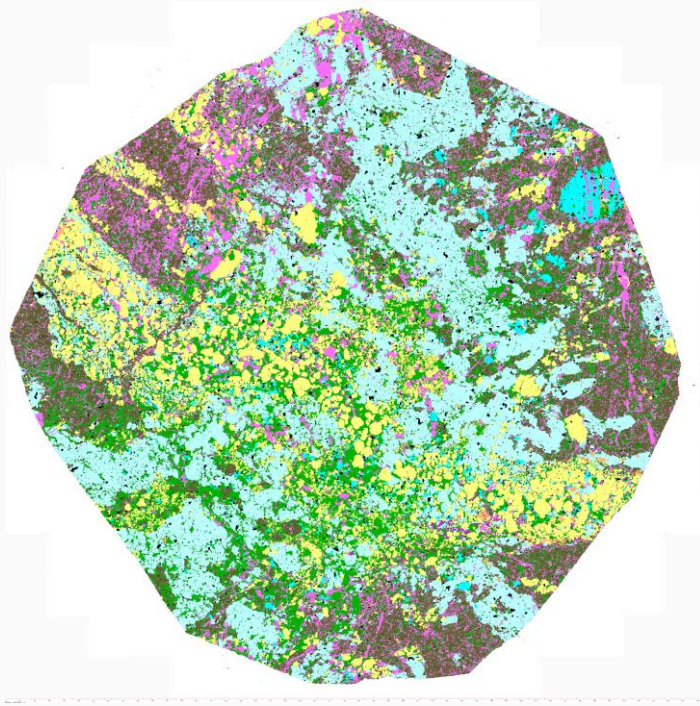
Future work – other analytical techniques

- Dating other minerals at UTAS:
  - Apatite U-Pb
  - Zircon U-Pb
  - Allanite U-Pb
  - Titanite U-Pb
  - Xenotime U-Pb
  - Garnet Lu-Hf (?)
  - Calcite (?)





- Use SHRIMP instrumentation at Geoscience Australia for monazite and xenotime U-Pb, which allows smaller grain sizes to be analysed and better common Pb corrections.

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Summary

- New two-year project funded by Geoscience Australia to collect new geochronology data from deposits and prospects in western Tasmania
- Can use a range of novel geochronology/thermochronology techniques at UTAS
- Collaboration with the IOCG^3 project led by Jeff Steadman to look at the Alpine deposit
- Focus on the Rocky Cape Element to better constrain the mineral potential in Proterozoic rocks in western Tasmania

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