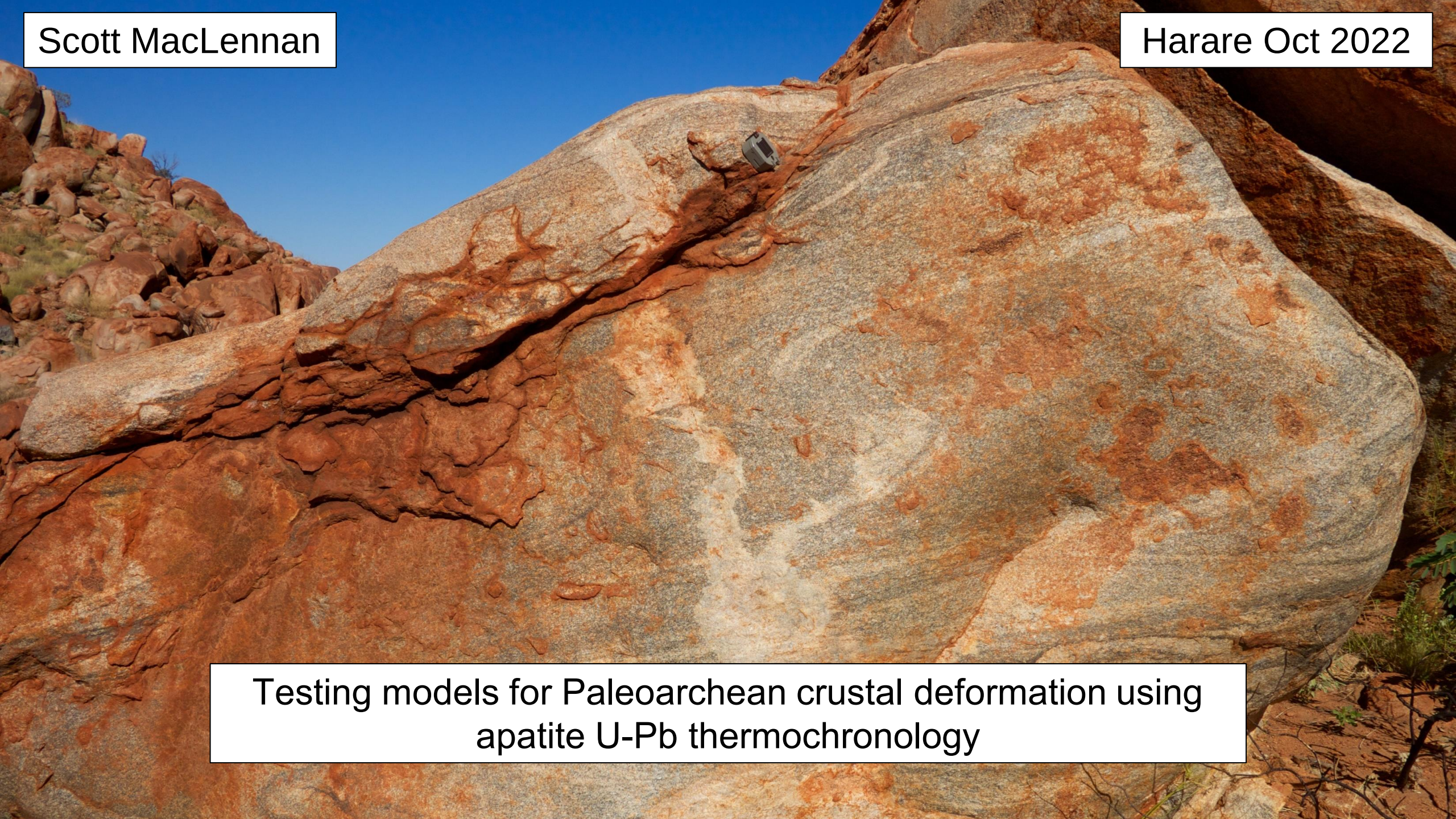


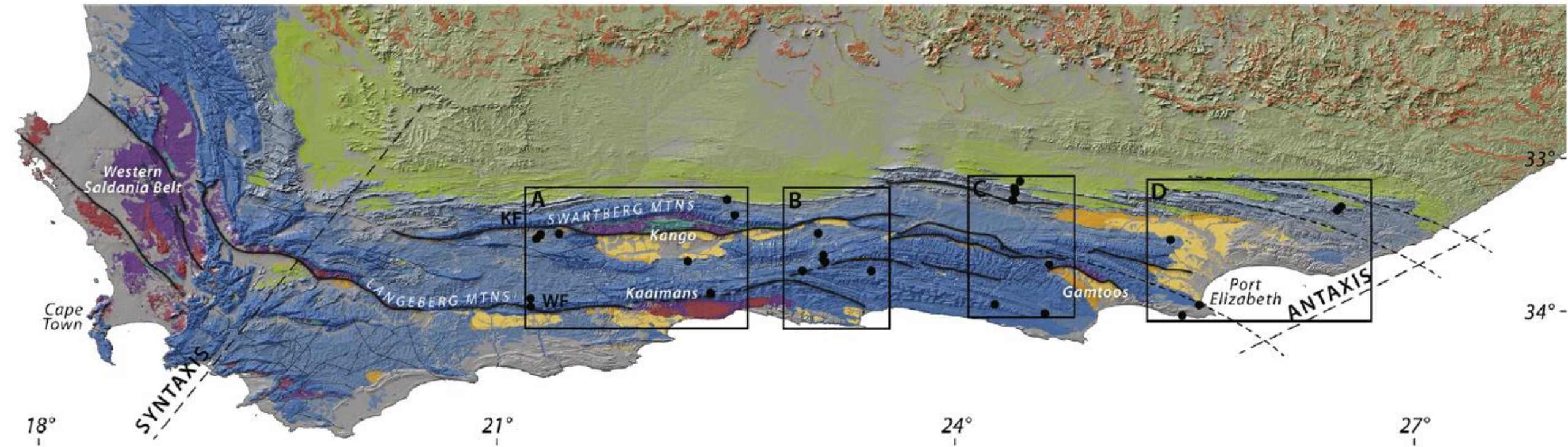
Scott MacLennan

Harare Oct 2022

Testing models for Paleoproterozoic crustal deformation using
apatite U-Pb thermochronology

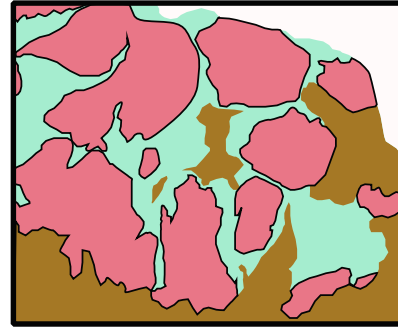


Phanerozoic rigid plate interactions

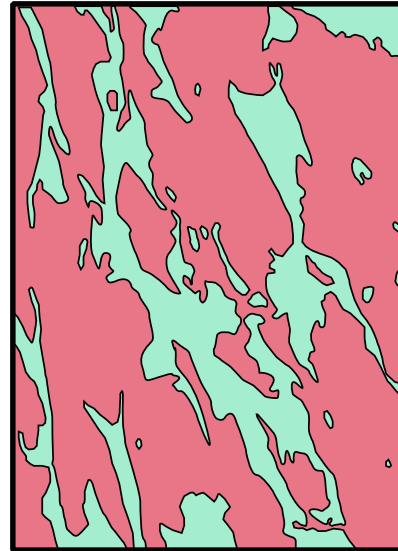


Archean transition to plate tectonics?

Pilbara craton
3.5-3.0 Ga

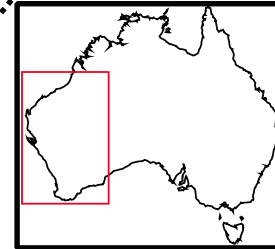
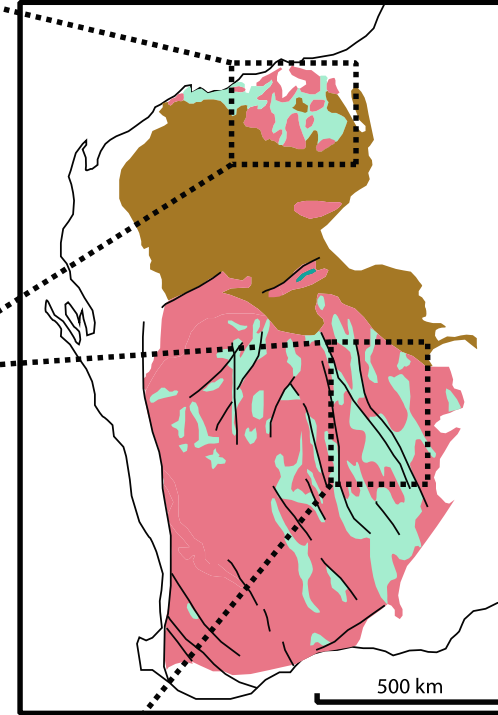


Yilgarn Craton
< 3 Ga



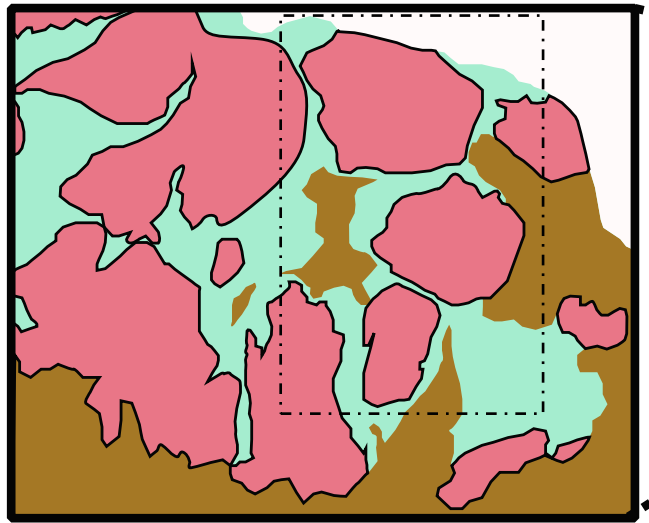
Supracrustals
Granite-Gneiss
Neoarchean Cover

100km

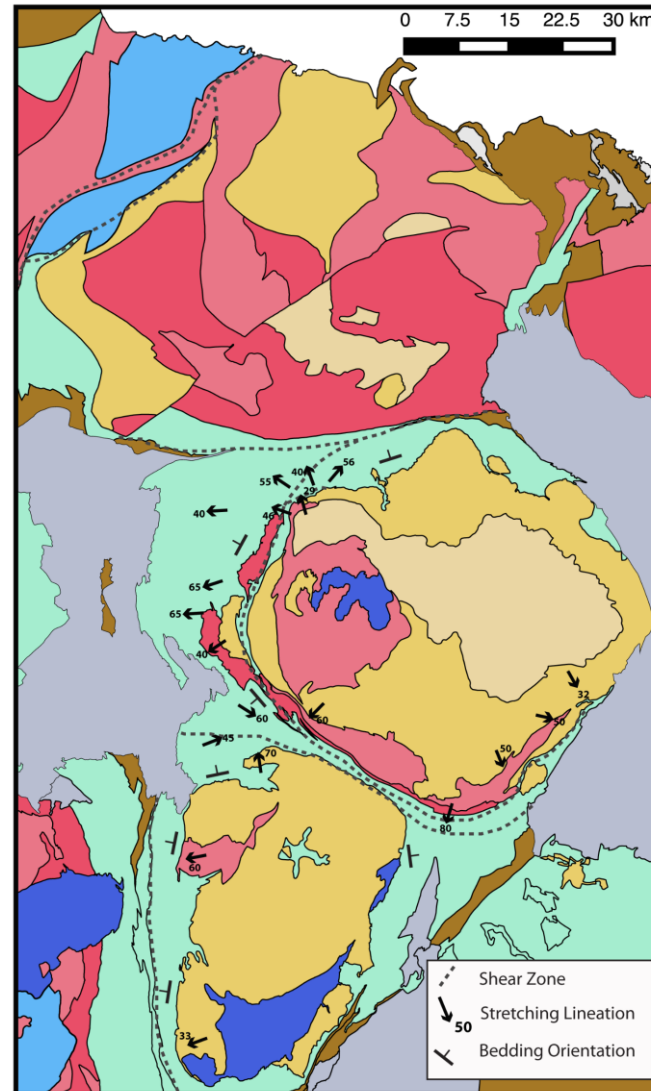


Modified after Zegers (2004)

Eastern Pilbara craton



- Supracrustals
- Granite-Gneiss
- Neoarchean Cover



2.8 to 2.9 Ga Granitoids

Split rock Supersuite

Sisters Supersuite

2.7 - 3.1 Sediments/Volcanics

Fortescue group

De Grey Supergroup

West Pilbara supracrustals

3.2 to 3.5 Ga Supracrustal rocks

Eastern Pilbara supracrustals

3.2 - 3.3 Ga Granitoids

Emu Pool Supersuite

Cleland Supersuite

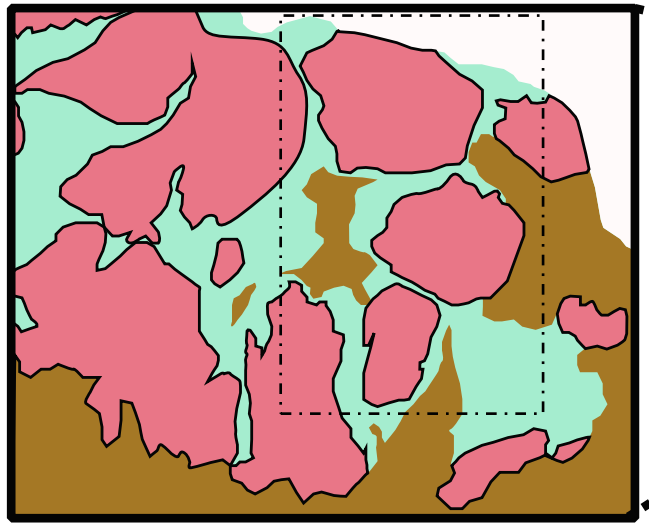
3.4 - 3.5 Ga Granite Gneiss

Callina Supersuite

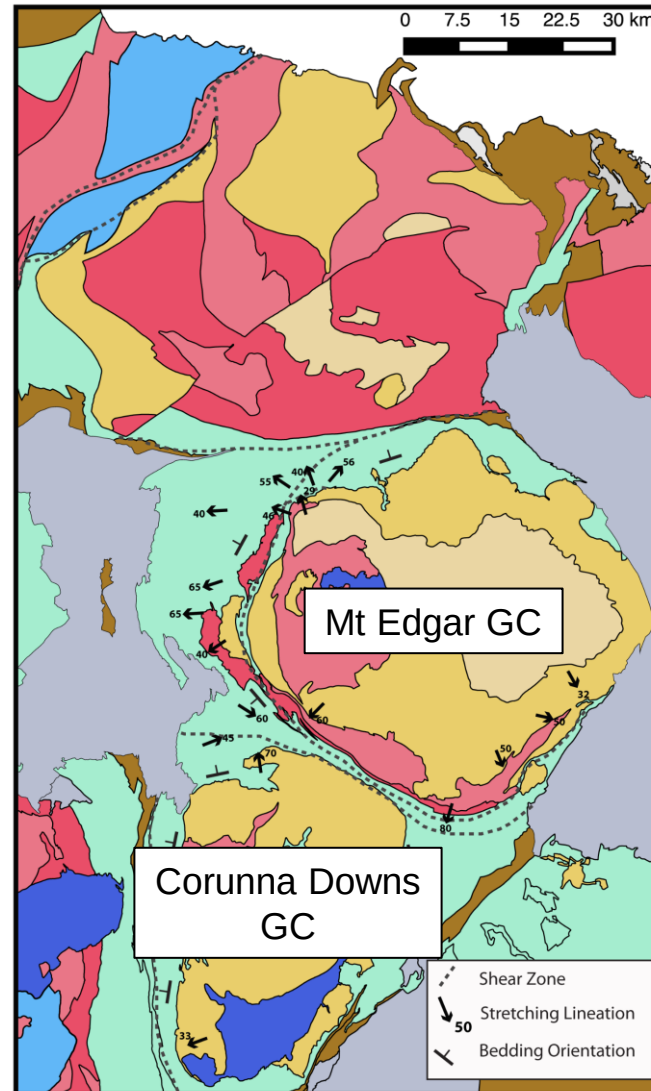
Tambina Supersuite

Field Data from Van Kranendonk et al., (2004)

Eastern Pilbara craton



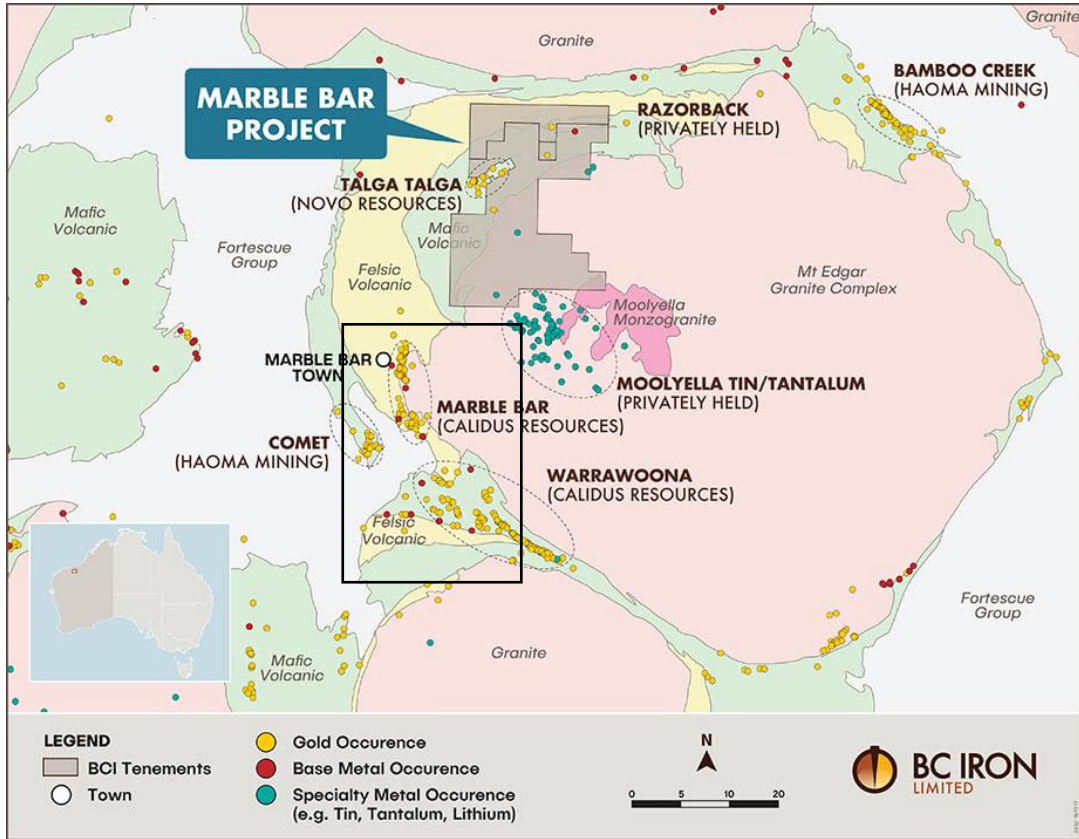
- Supracrustals
- Granite-Gneiss
- Neoarchean Cover



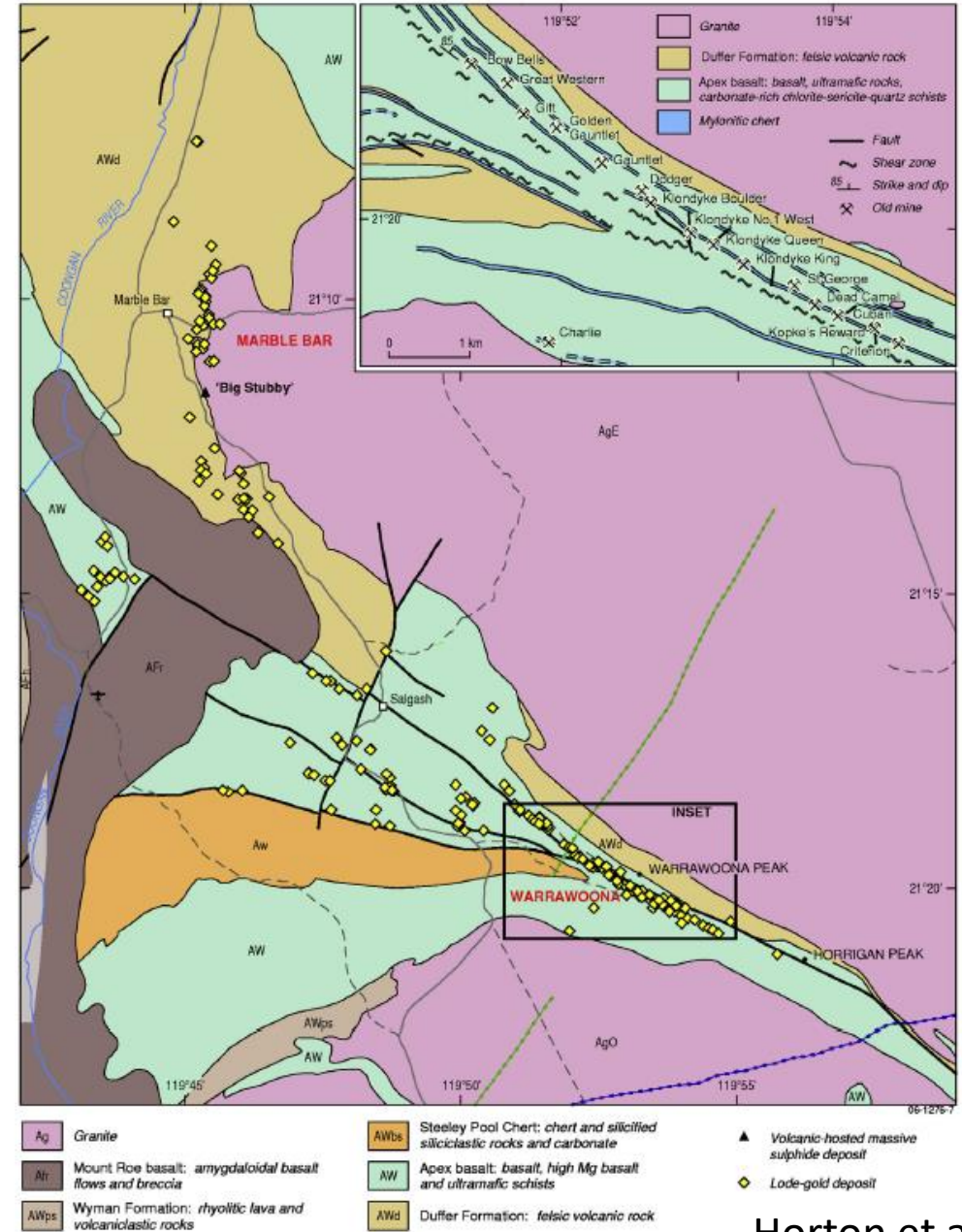
- 2.8 to 2.9 Ga Granitoids**
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- 3.4 - 3.5 Ga Granite Gneiss**
 - Callina Supersuite
 - Tambina Supersuite

Field Data from Van Kranendonk et al., (2004)

Implications for mineralization histories

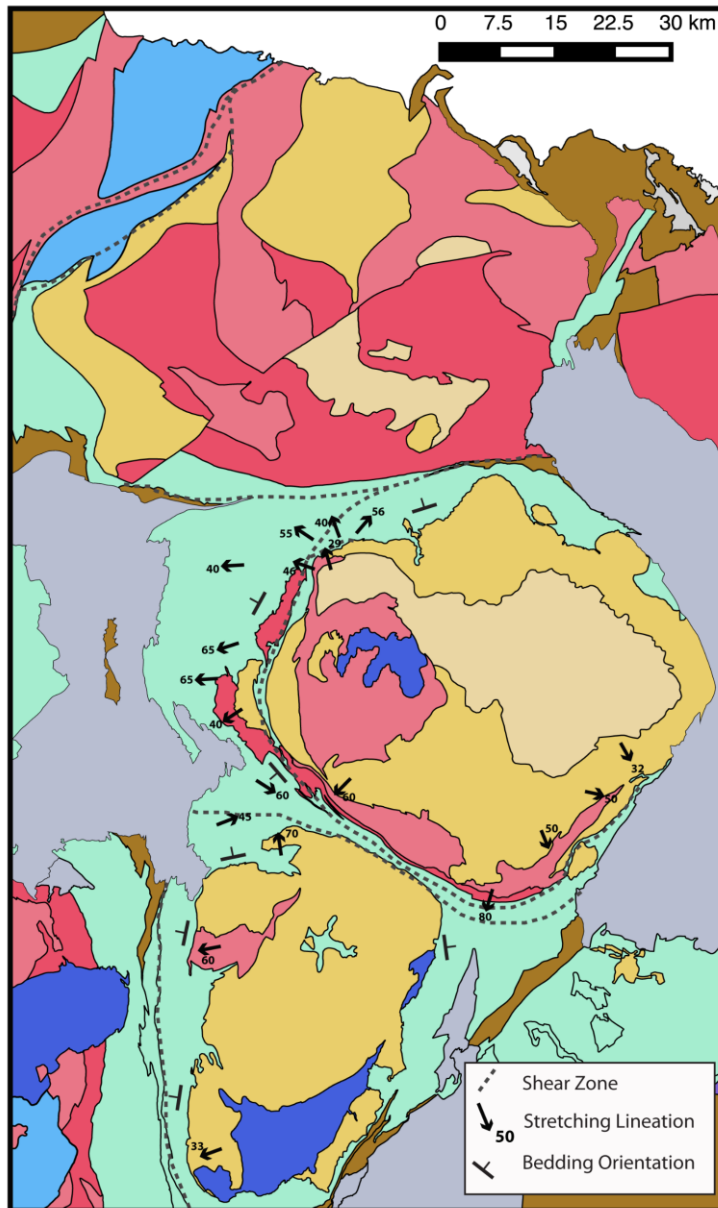


BCI minerals limited



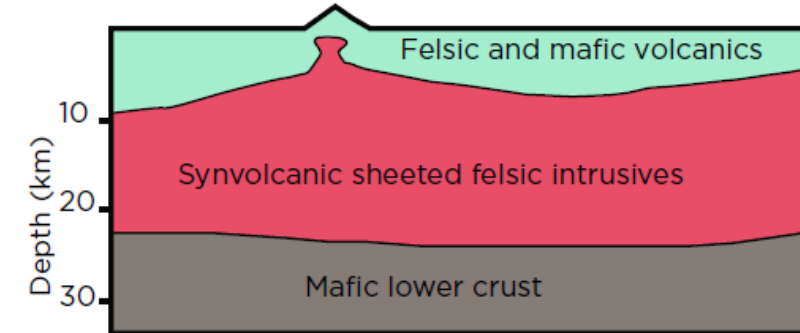
Horton et al., (2019)

Partial convective overturn model

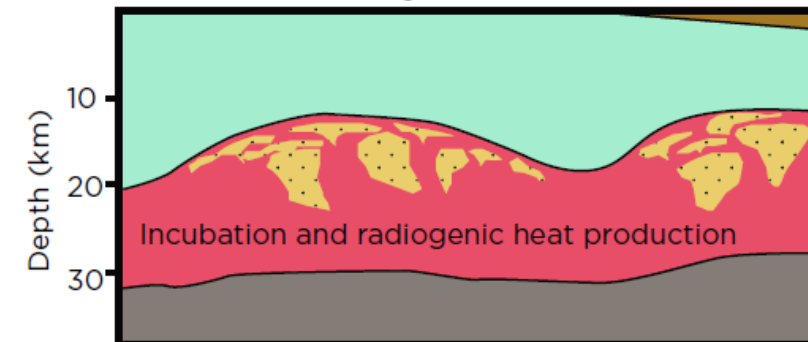


GSWA

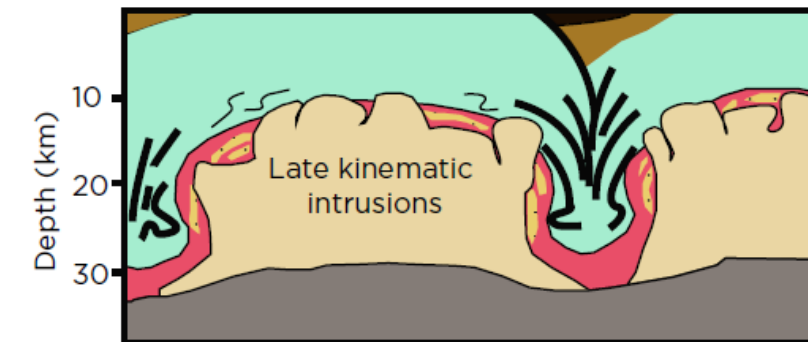
A: 3470 to 3430 Ma Felsic and mafic Magmatism



B: 3325 to 3310 Ma Syndeformational Volcanism

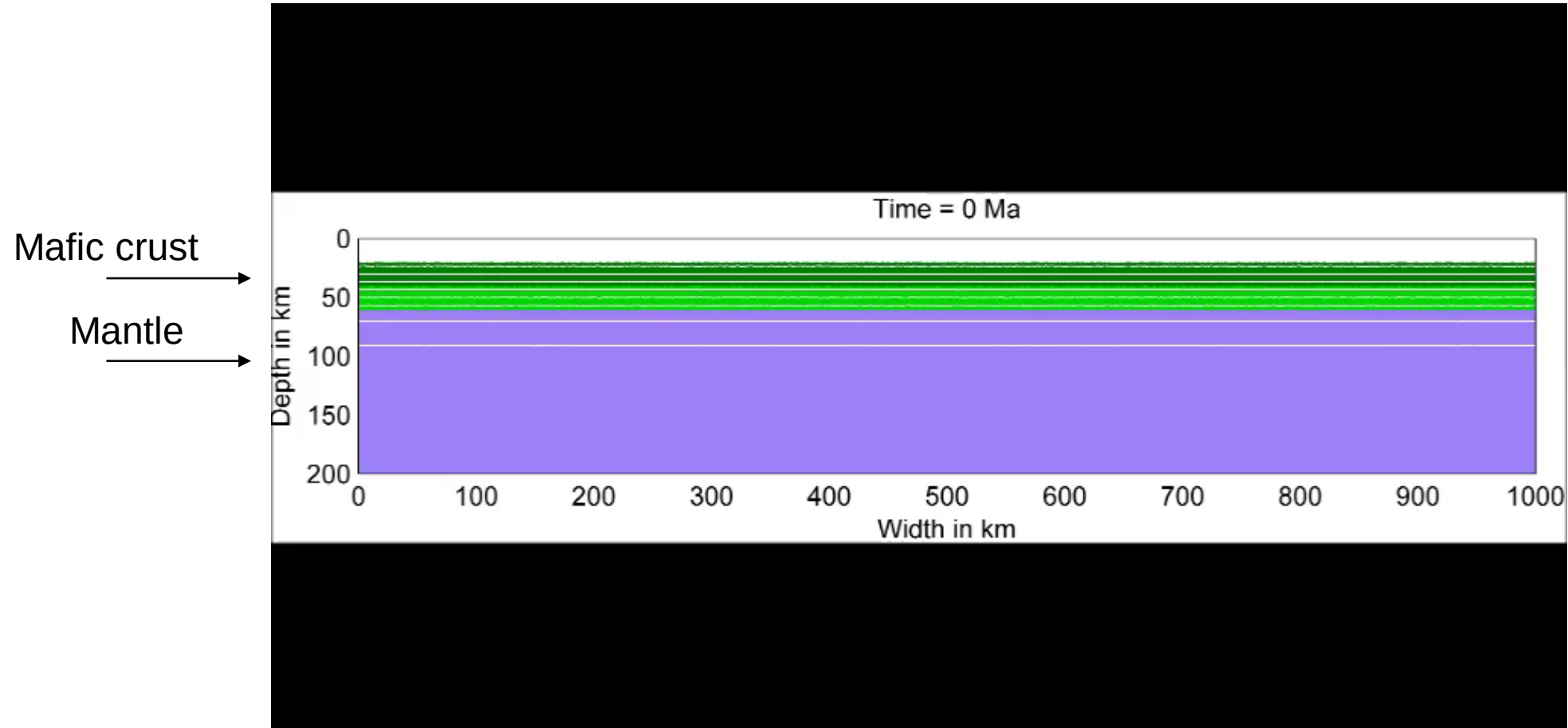


C: 3310 to 3240 Ma Partial Convective Overturn



Van Kranendonk et al., (2004)

Thermomechanical models- We need to test them!

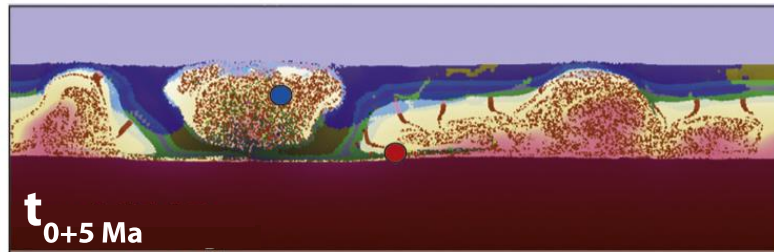
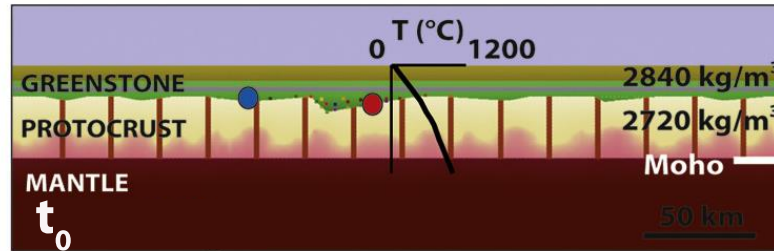


Sizova et al., (2015)

Thermomechanical models- We need to test them!

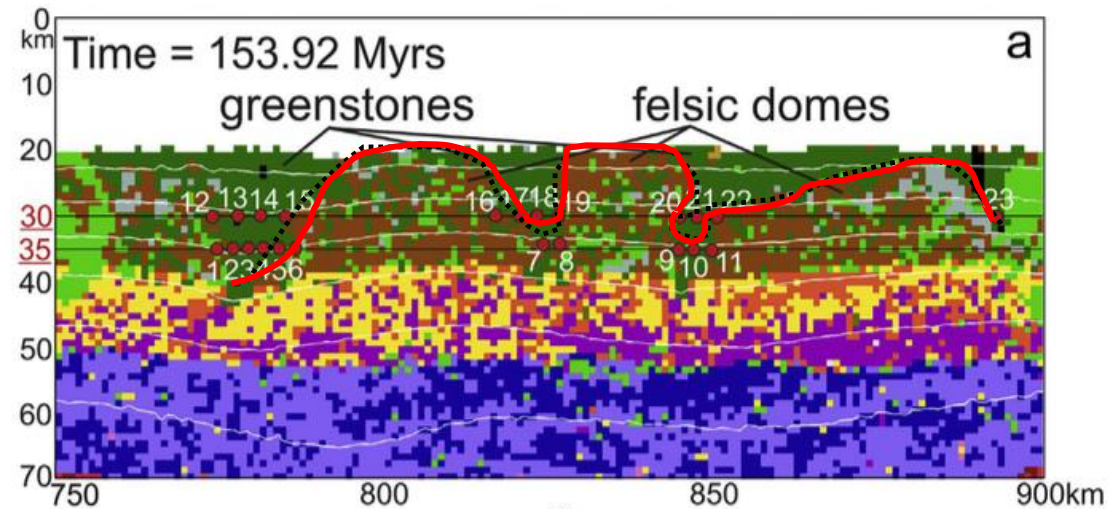
François et al., (2014)

$\Delta t = \sim 5 \text{ Ma}$

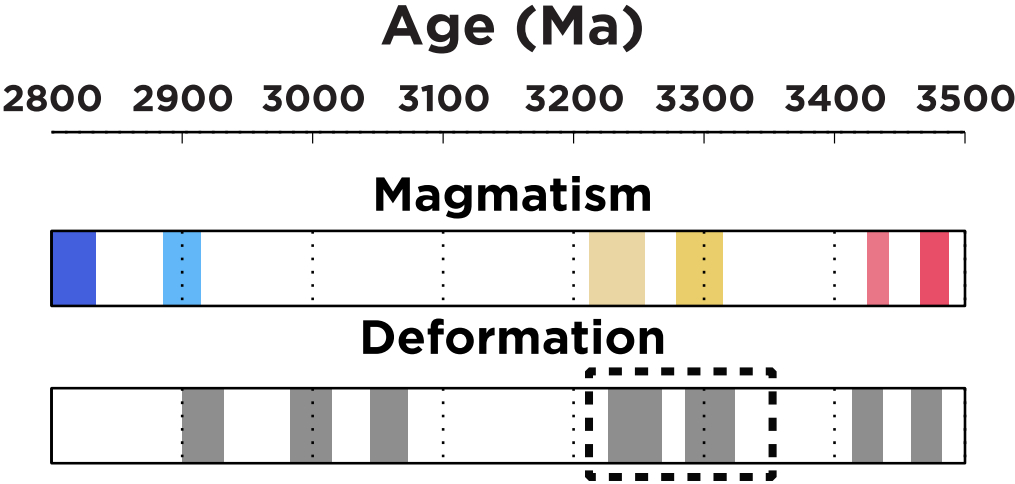


Sizova et al., (2015)

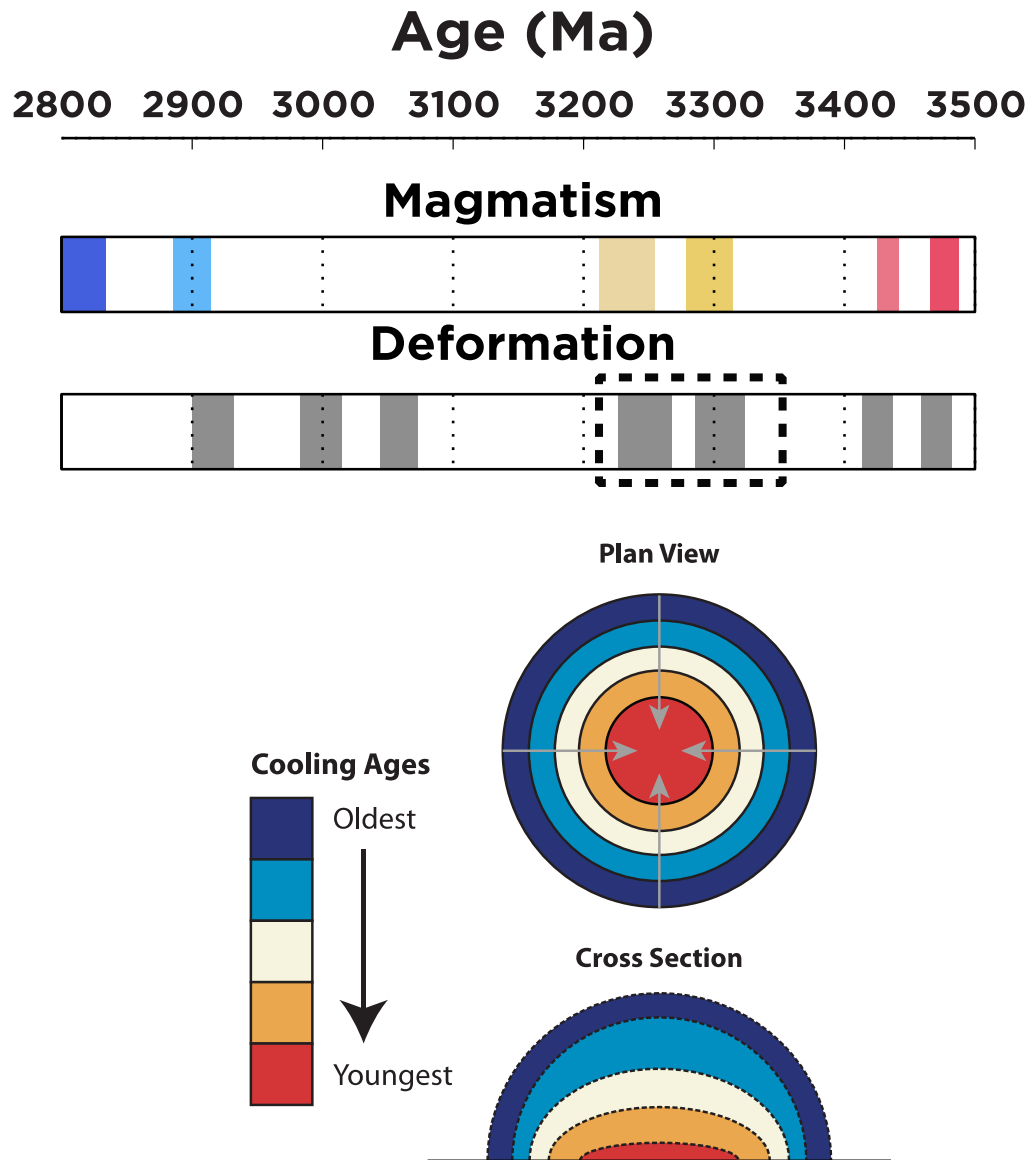
$\Delta t = \sim 150 \text{ Ma}$



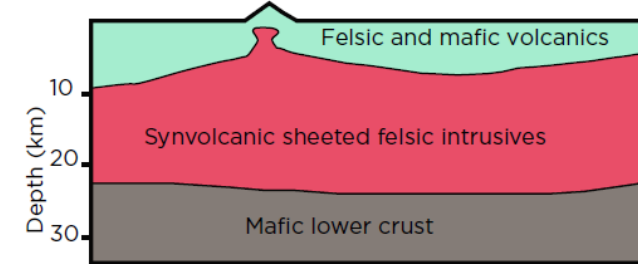
Thermal history predictions from different models



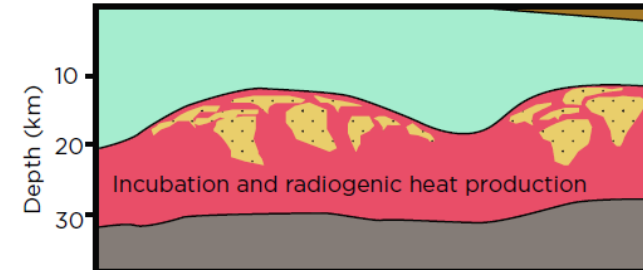
Thermal history predictions from different models



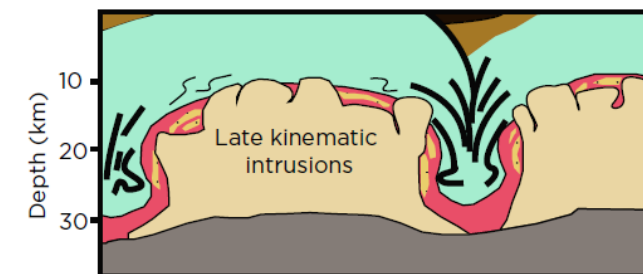
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C: 3310 to 3240 Ma Partial Convective Overturn



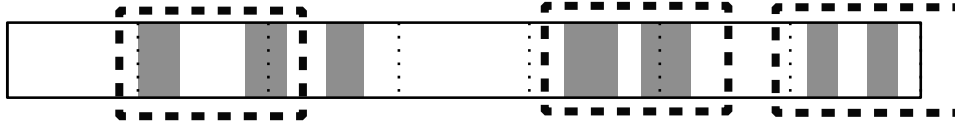
Thermal history predictions from different models

Age (Ma)
2800 2900 3000 3100 3200 3300 3400 3500

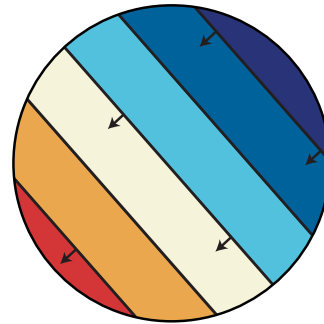
Magmatism



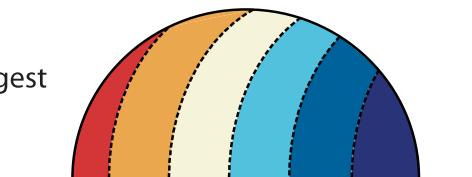
Deformation



Plan View



Cross Section

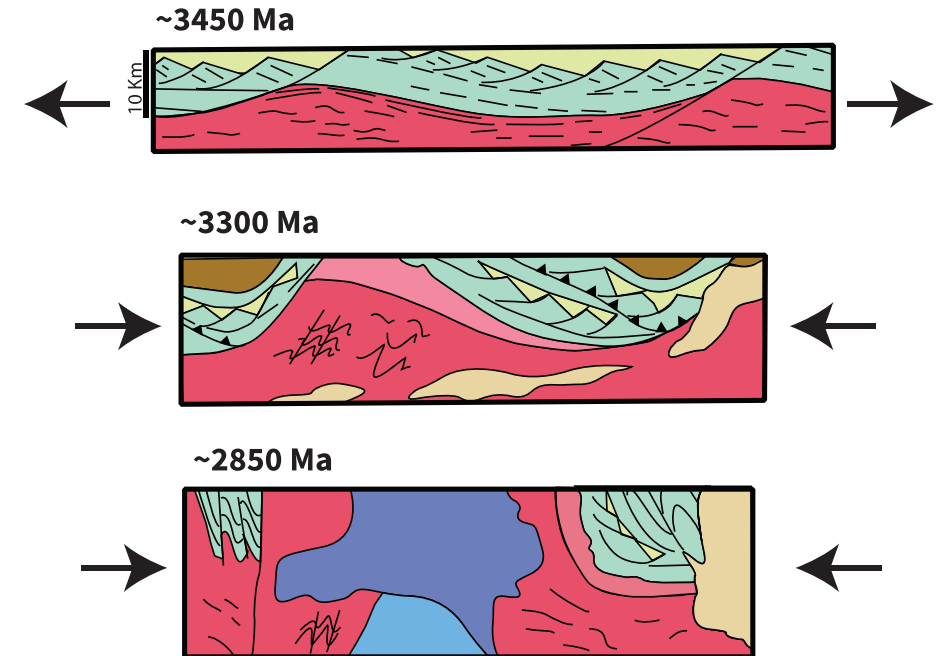


Cooling Ages



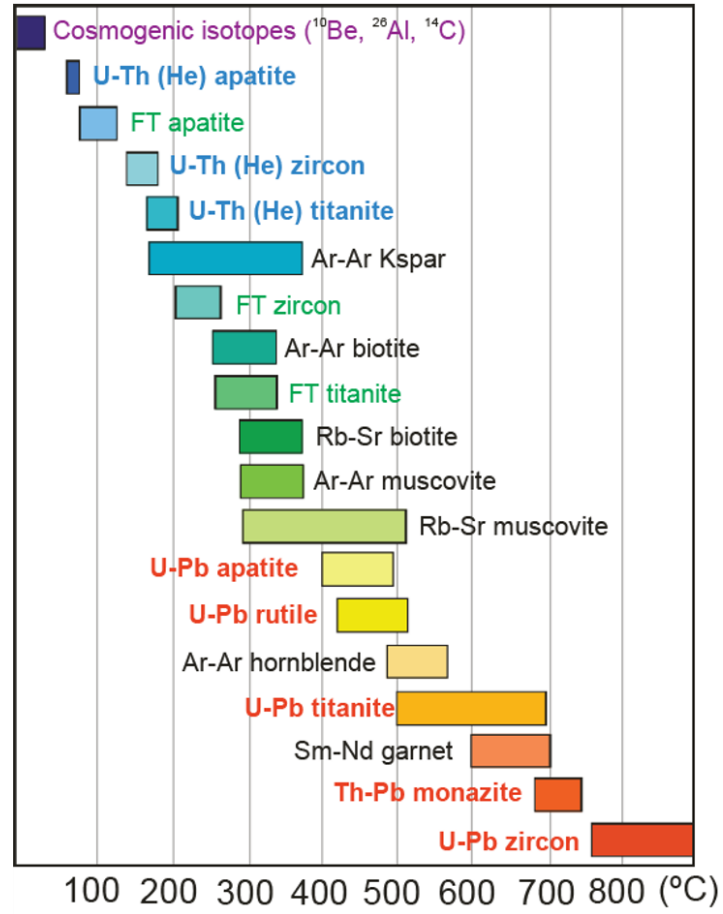
Oldest

Youngest



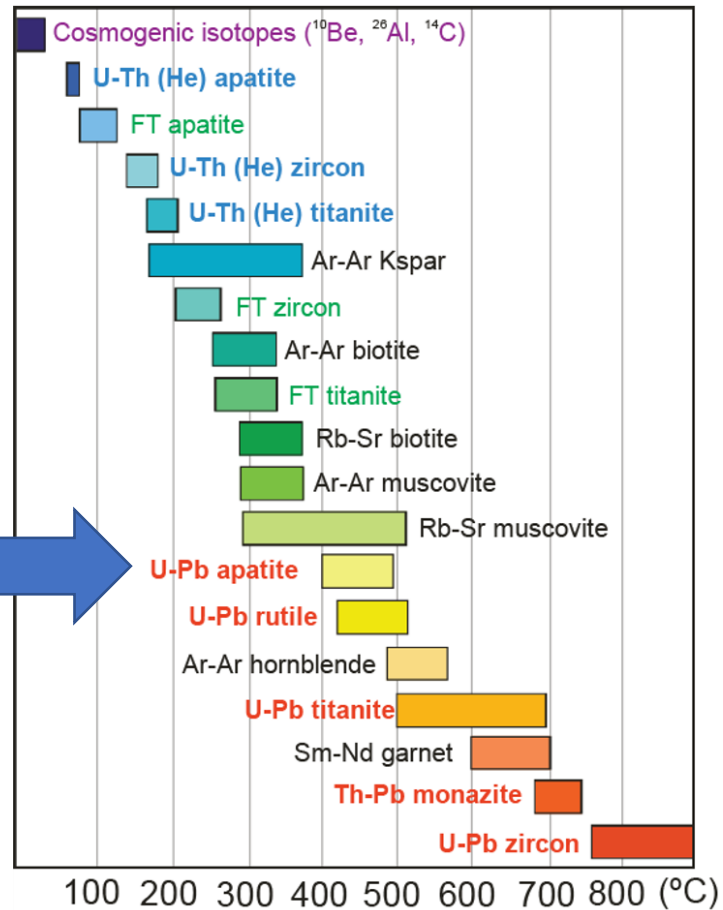
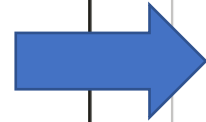
Zegers et al., (2001)

Apatite Thermochronology



Apatite Thermochronology

Quartz and plagioclase
ductile- temporal
constraint on deformation

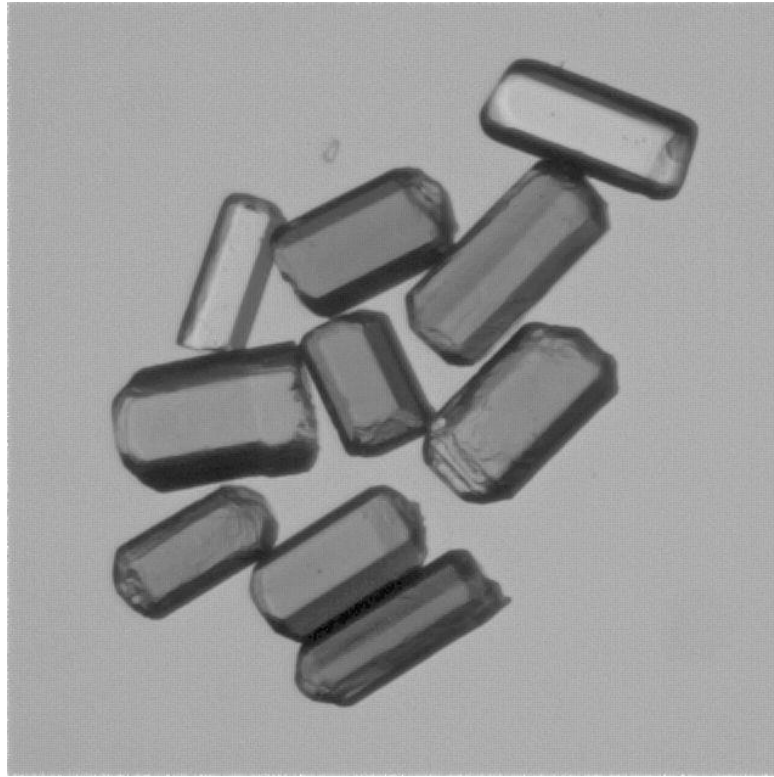


Mid crustal temperatures

U-Pb apatite thermochronology



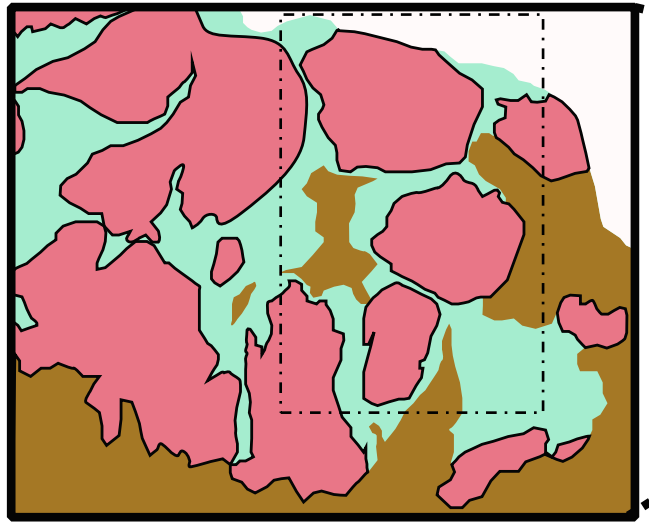
U-Pb apatite thermochronology



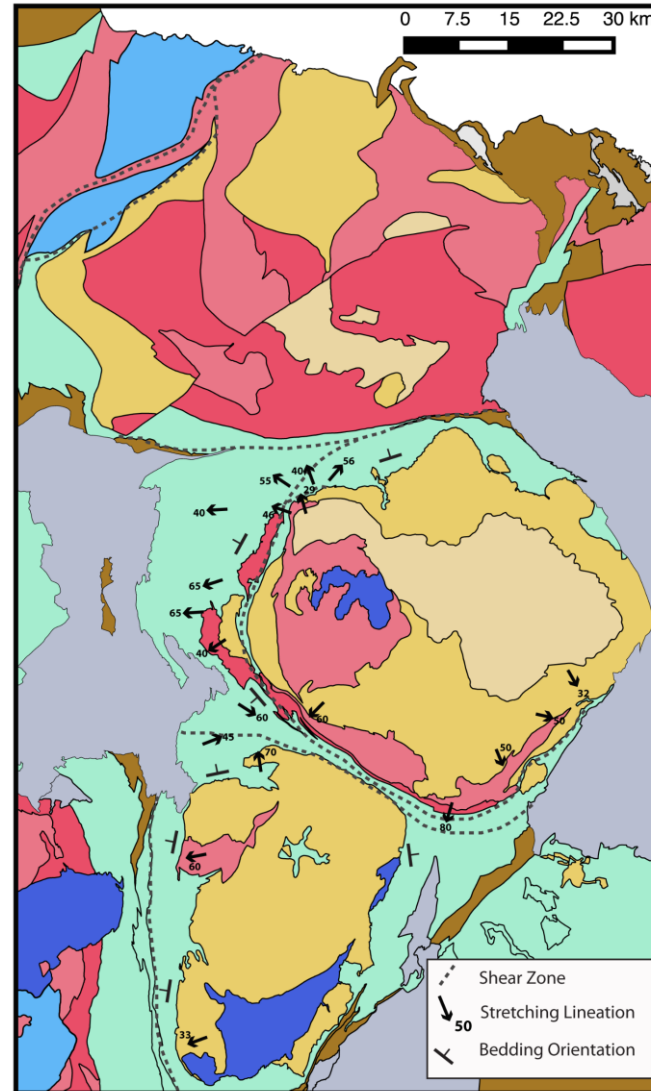
apparentdip.wordpress.com



Eastern Pilbara craton



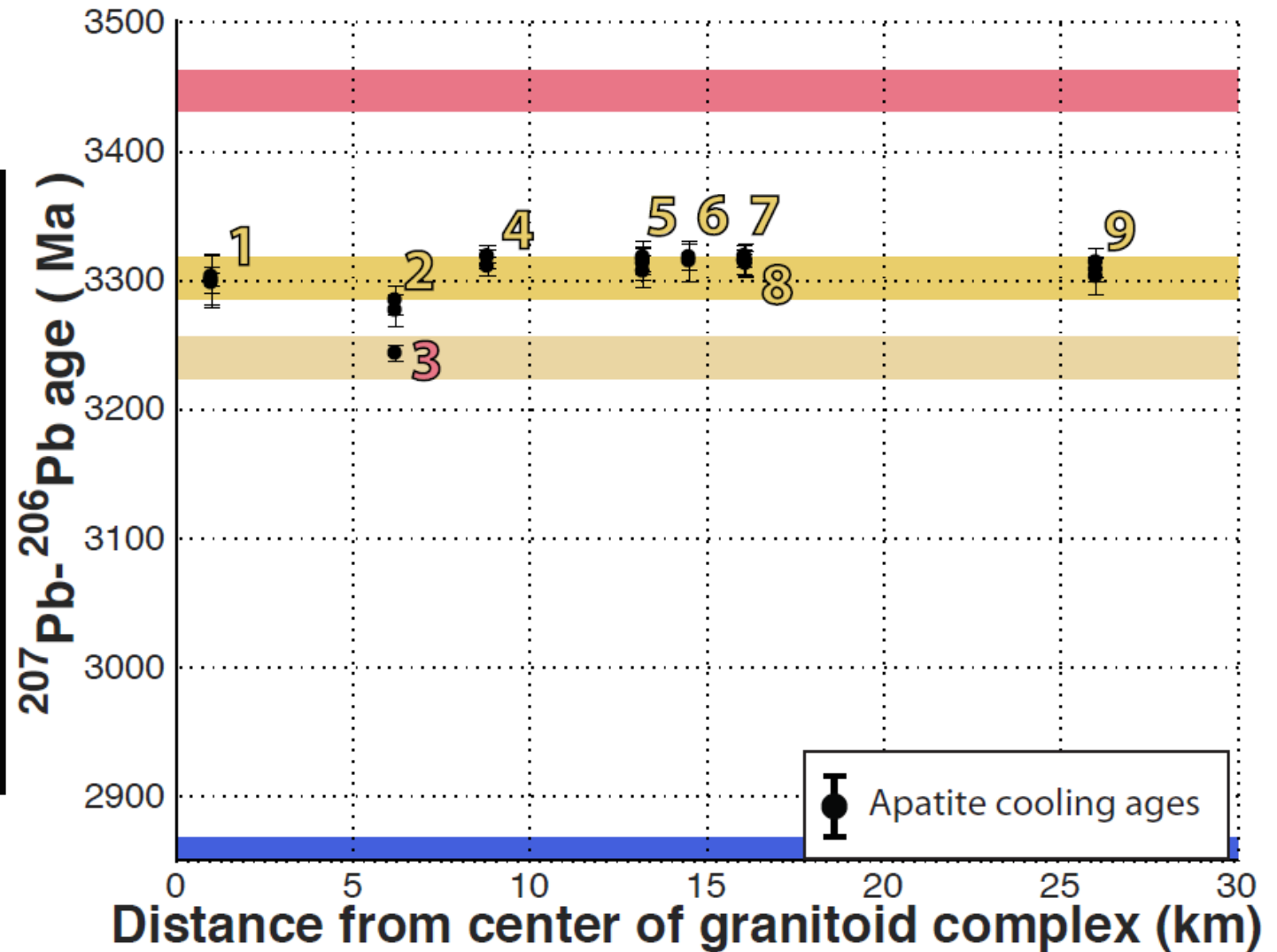
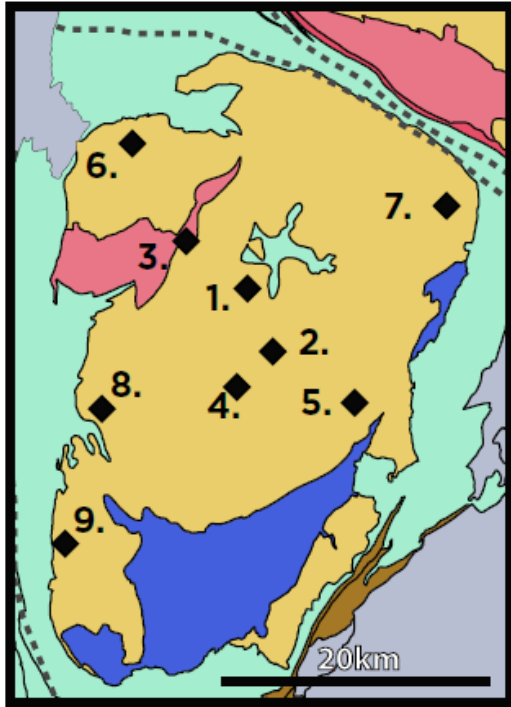
- Supracrustals
- Granite-Gneiss
- Neoarchean Cover



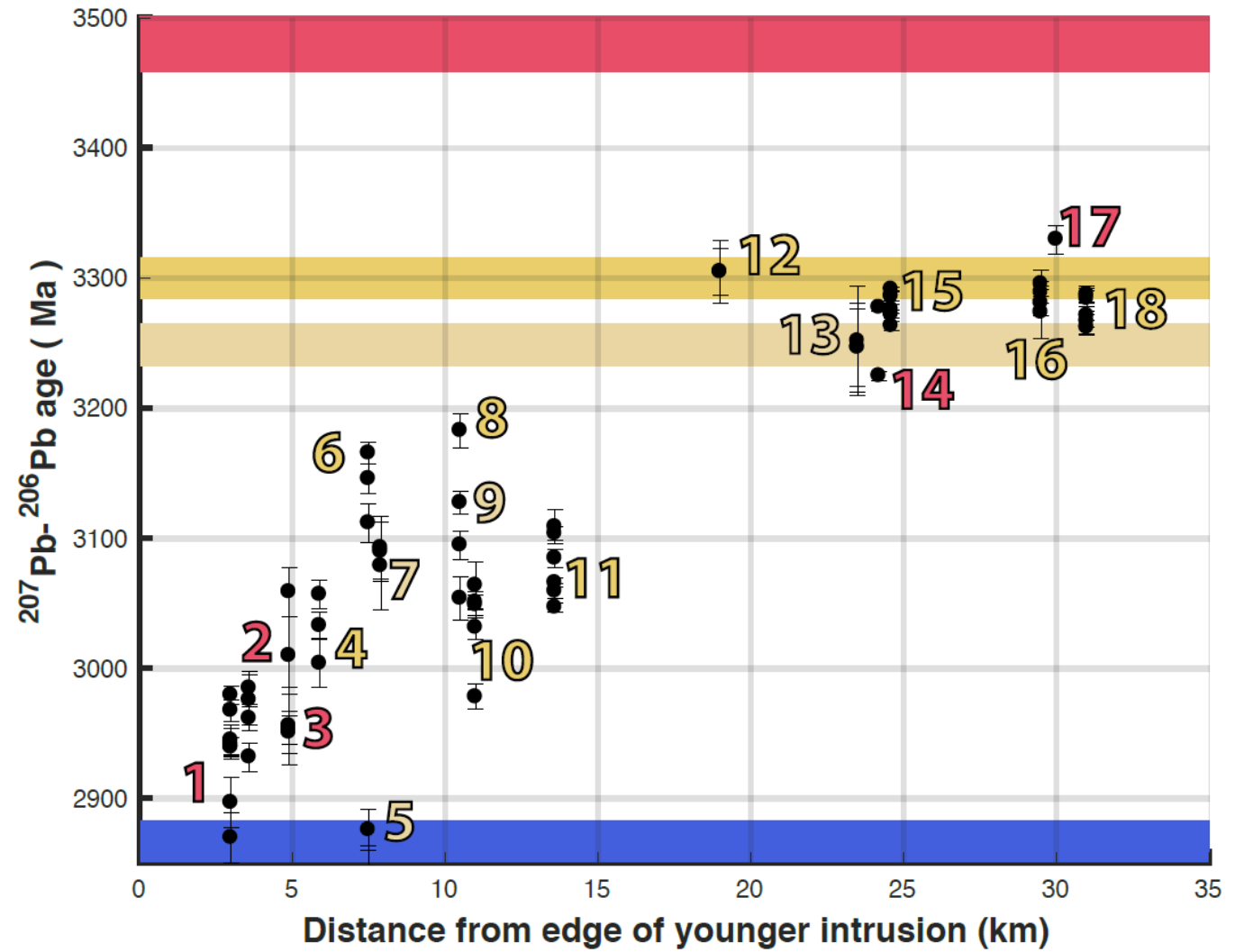
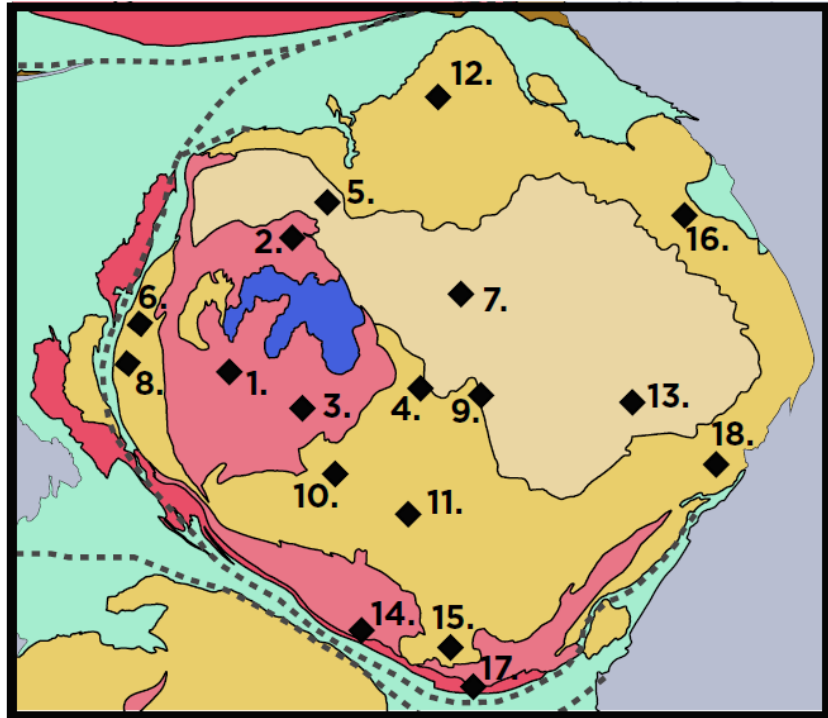
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Field Data from Van Kranendonk et al., (2004)

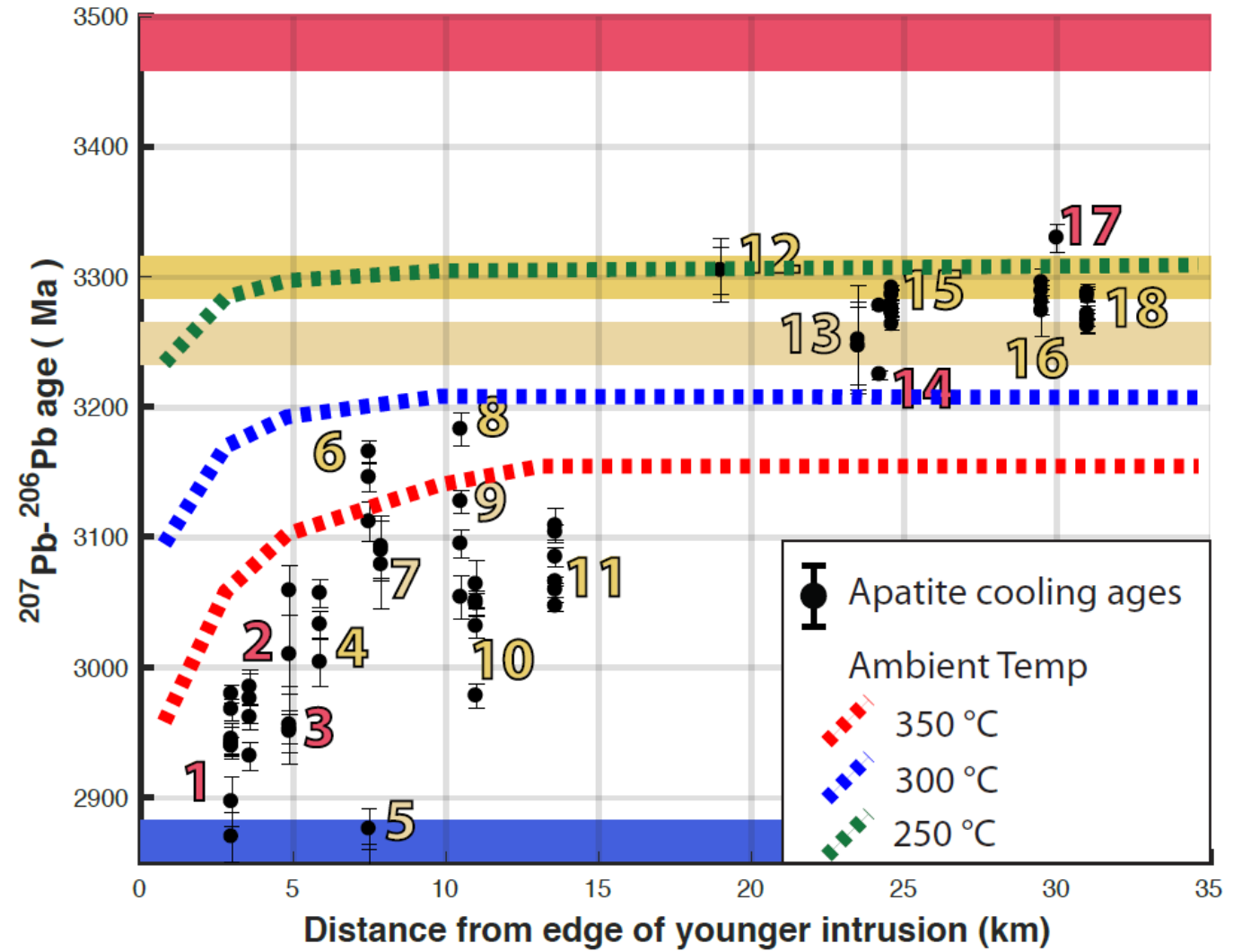
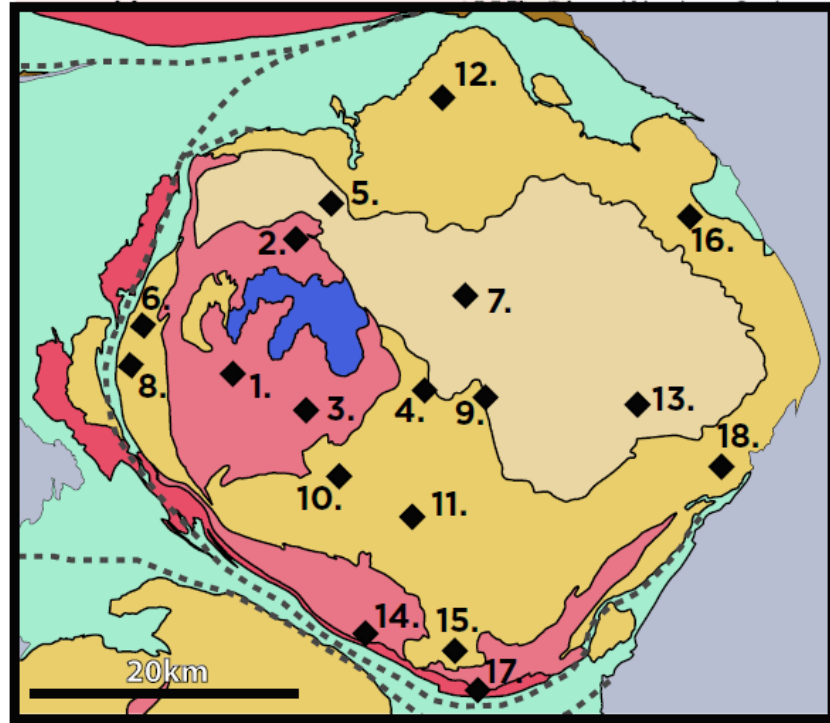
U-Pb apatite ages from the Corunna Downs granitoid complex



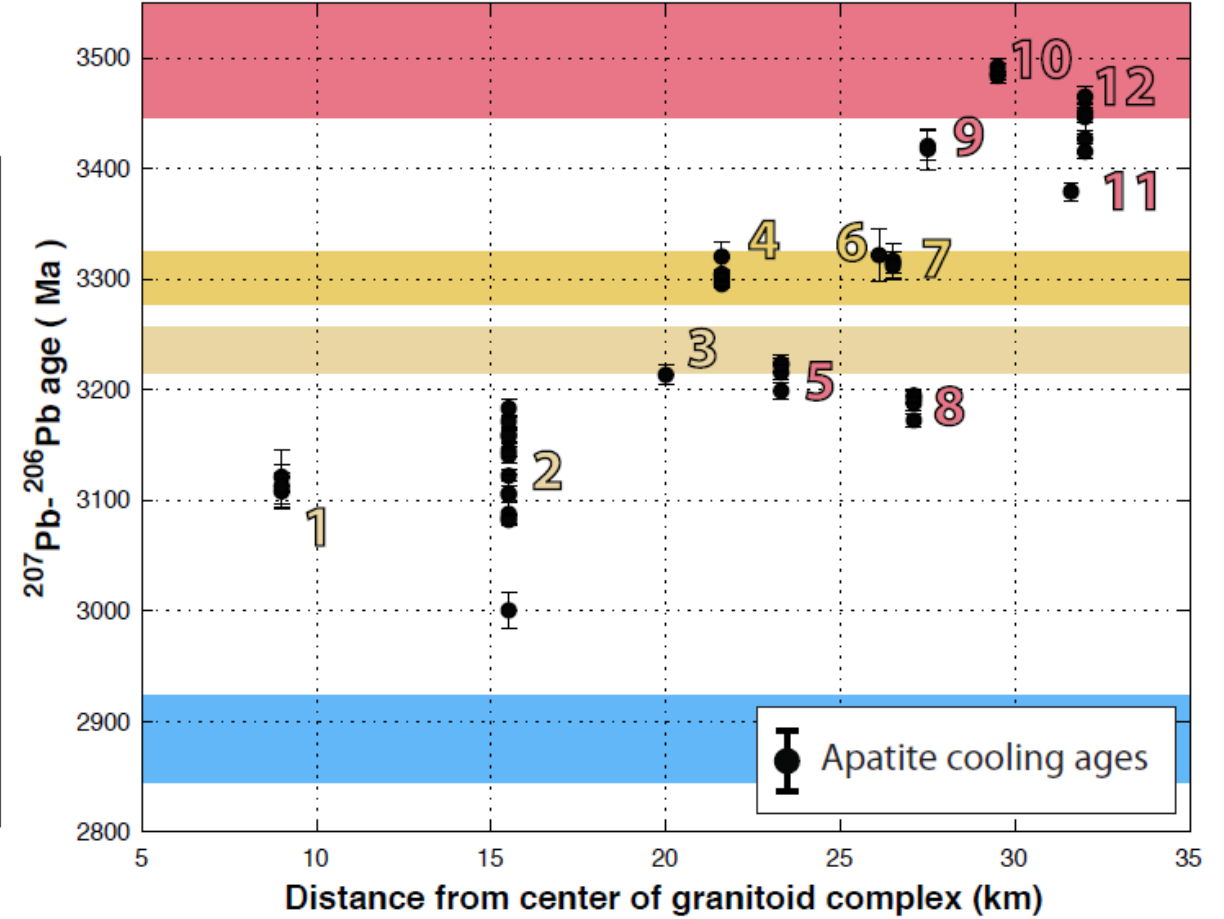
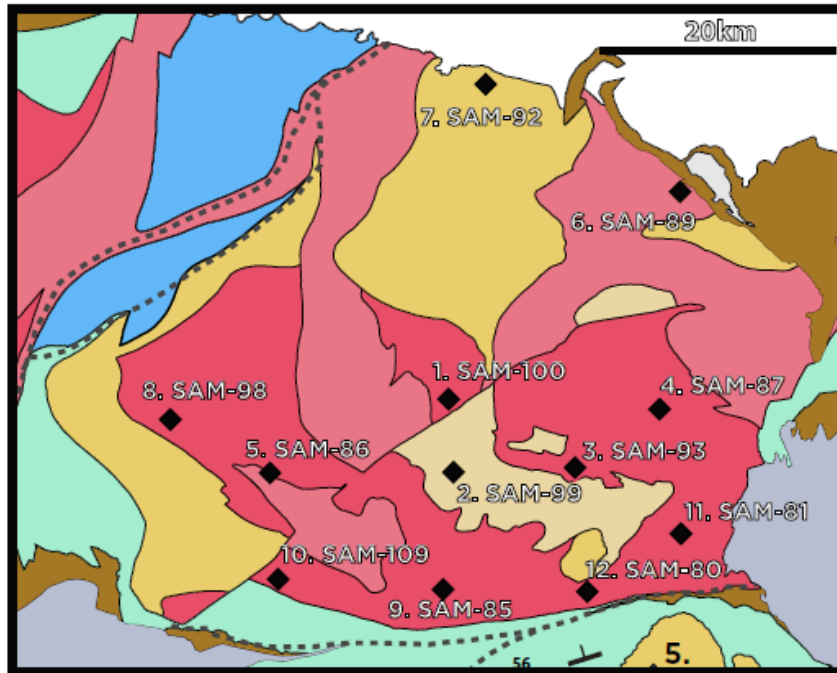
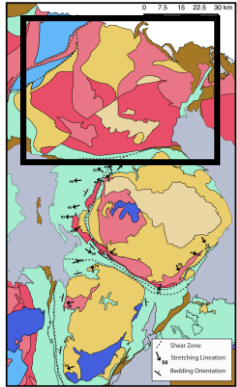
U-Pb apatite ages from the Mt Edgar granitoid complex



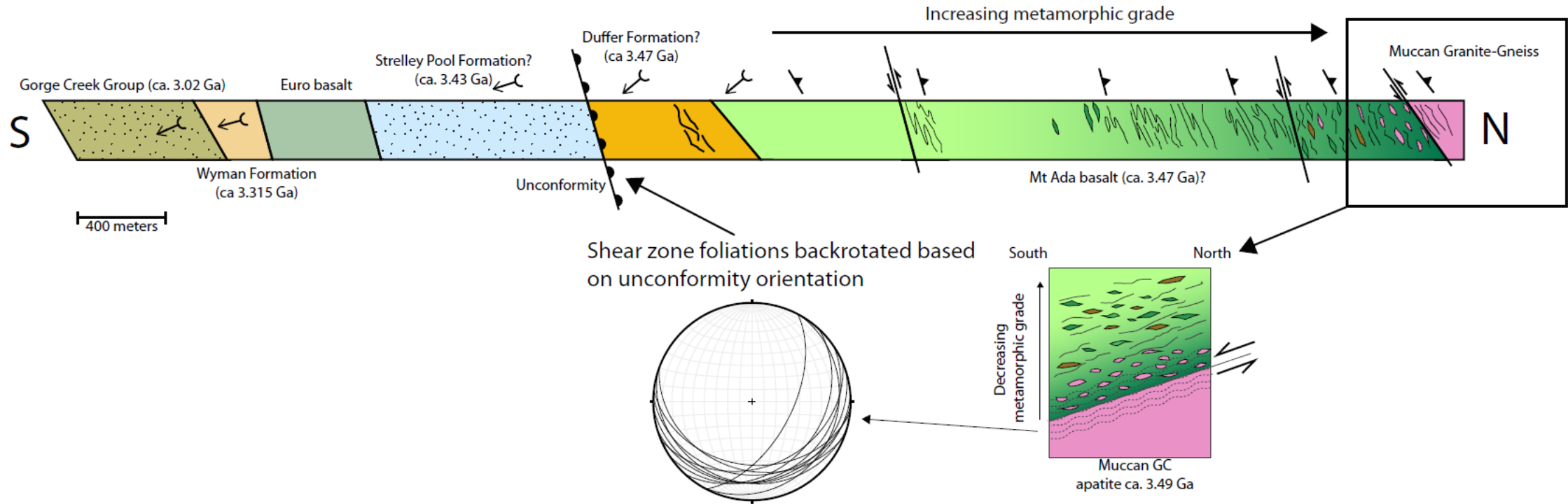
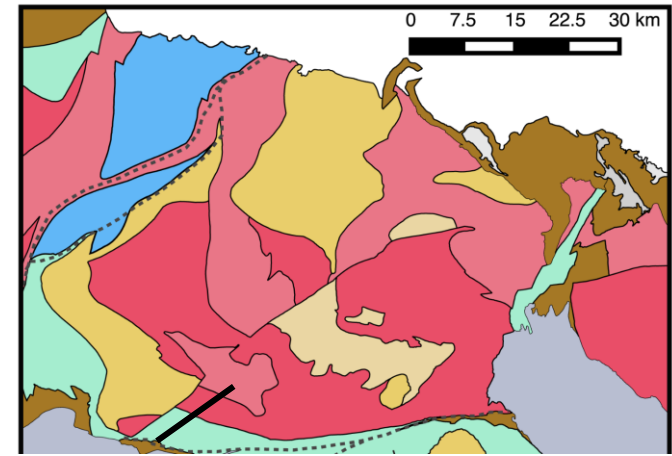
U-Pb apatite ages from the Mt Edgar granitoid complex



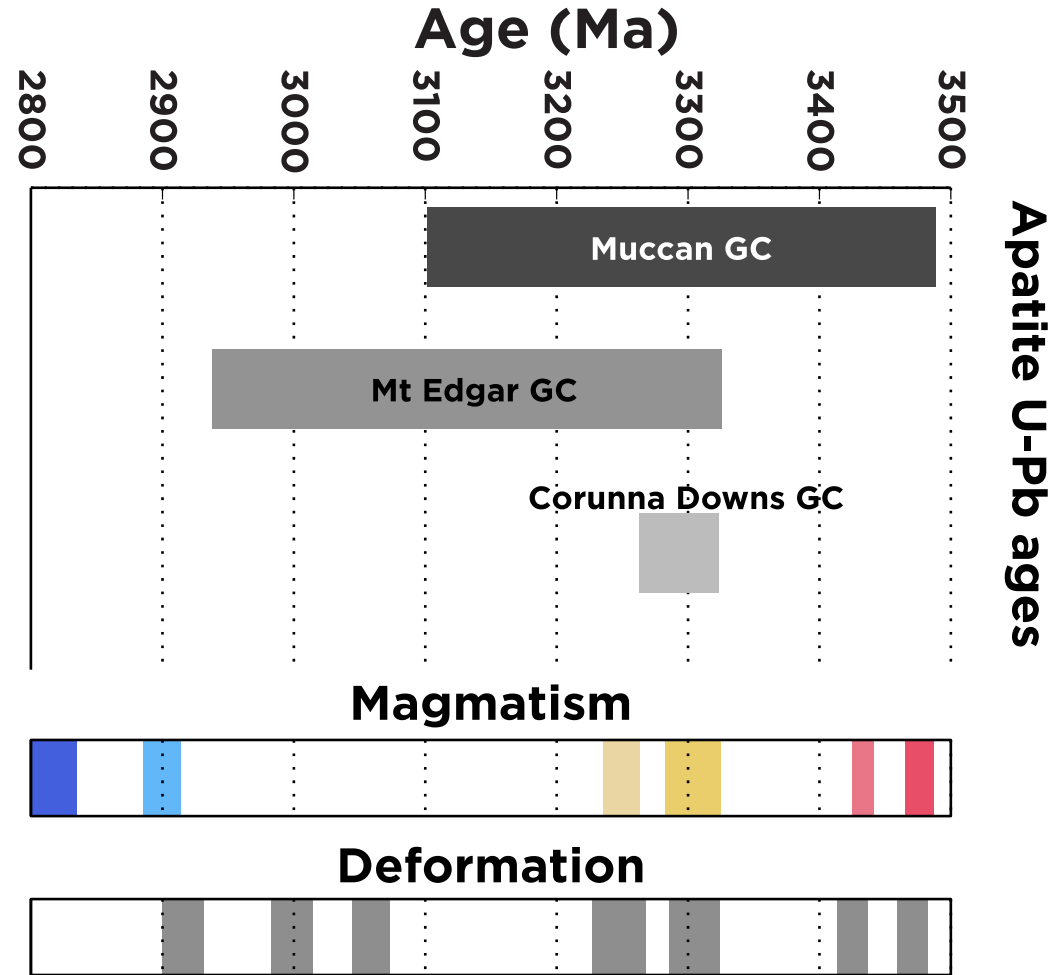
Muccan granitoid complex



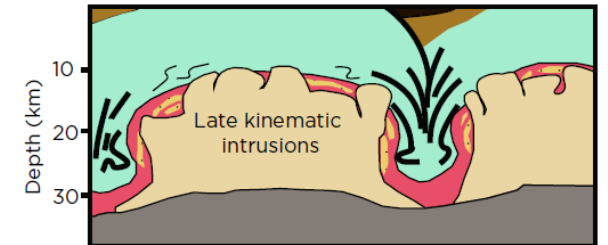
Muccan granitoid complex- Southern Margin



Thermal and deformation history constraints



C: 3310 to 3240 Ma Partial Convective Overturn



Late compressional overprint?

