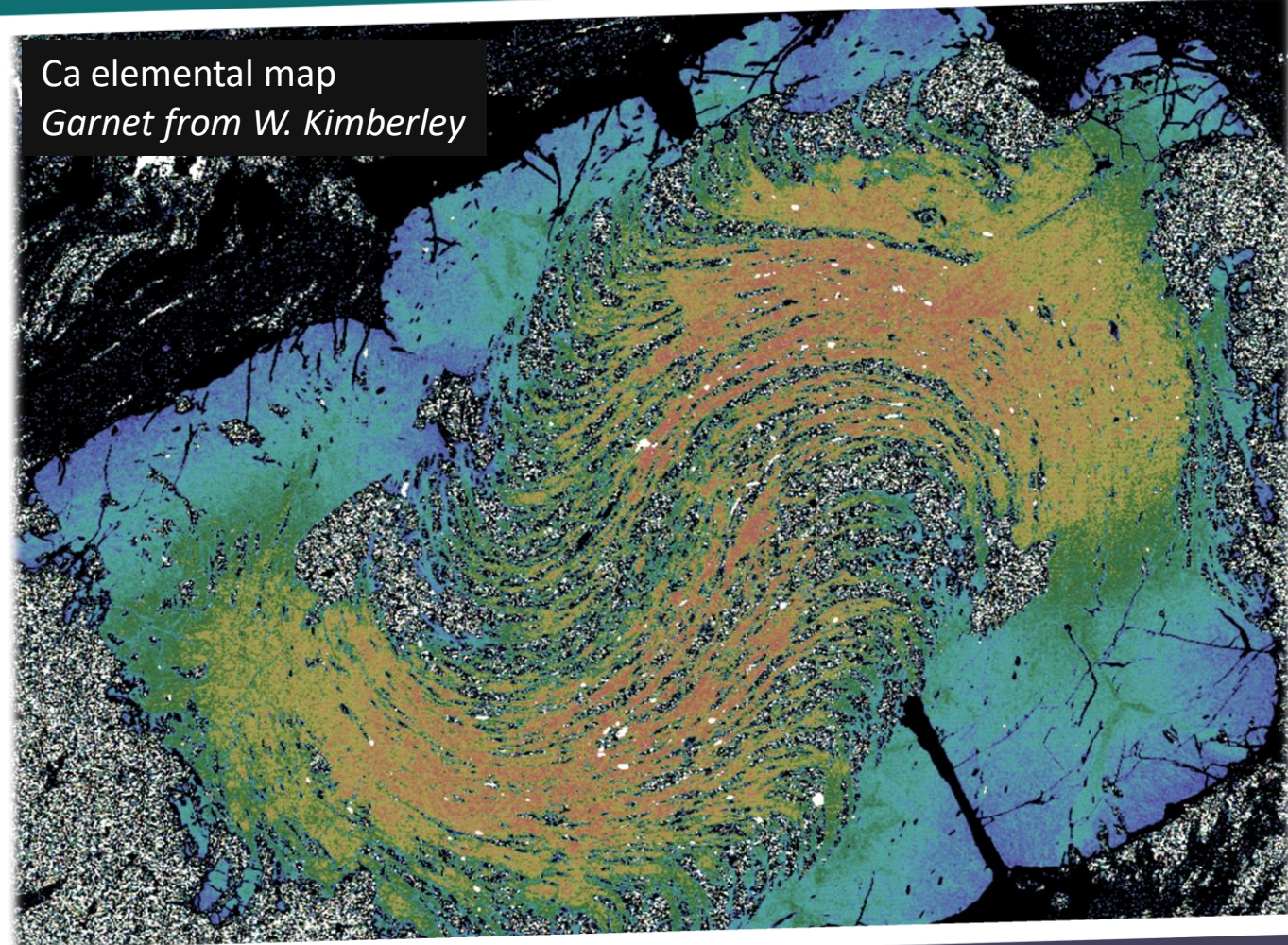




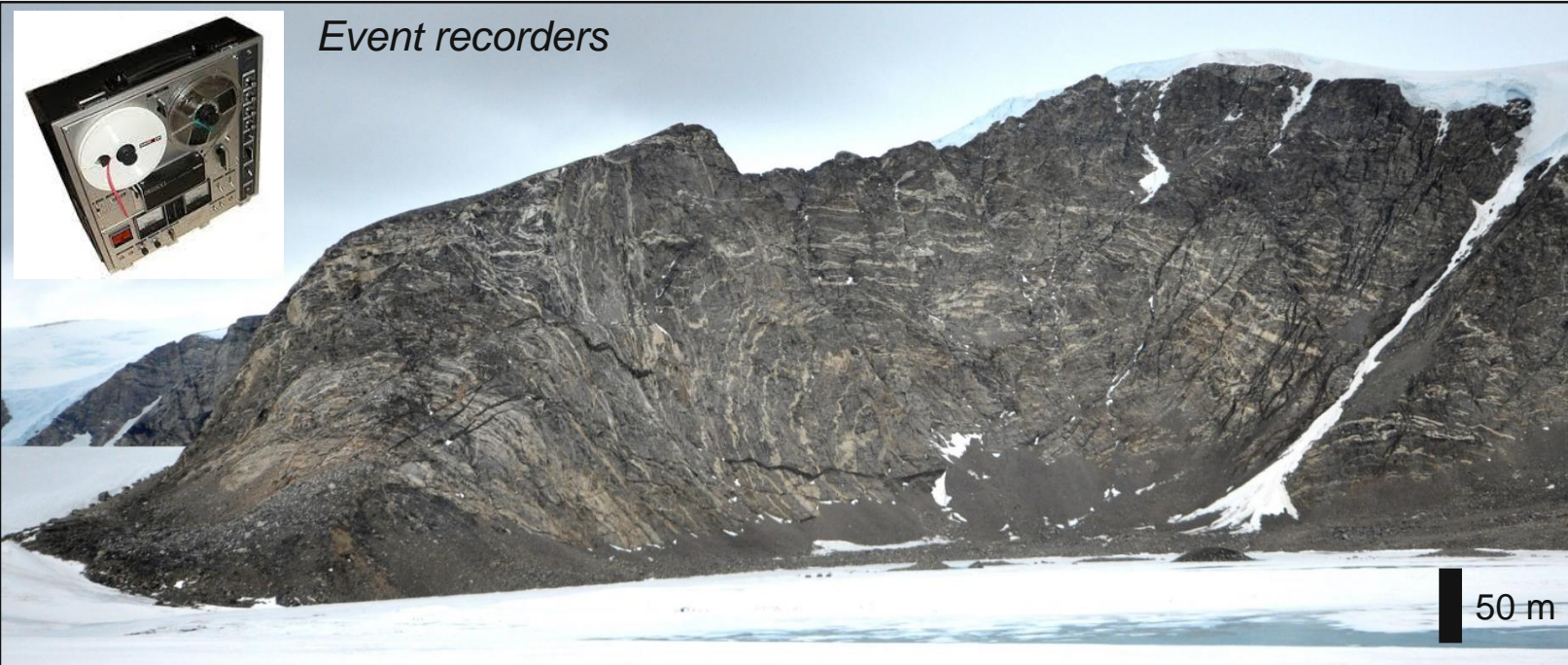
# New directions in metamorphic studies at GSWA

Presented by  
**Fawna Korhonen**

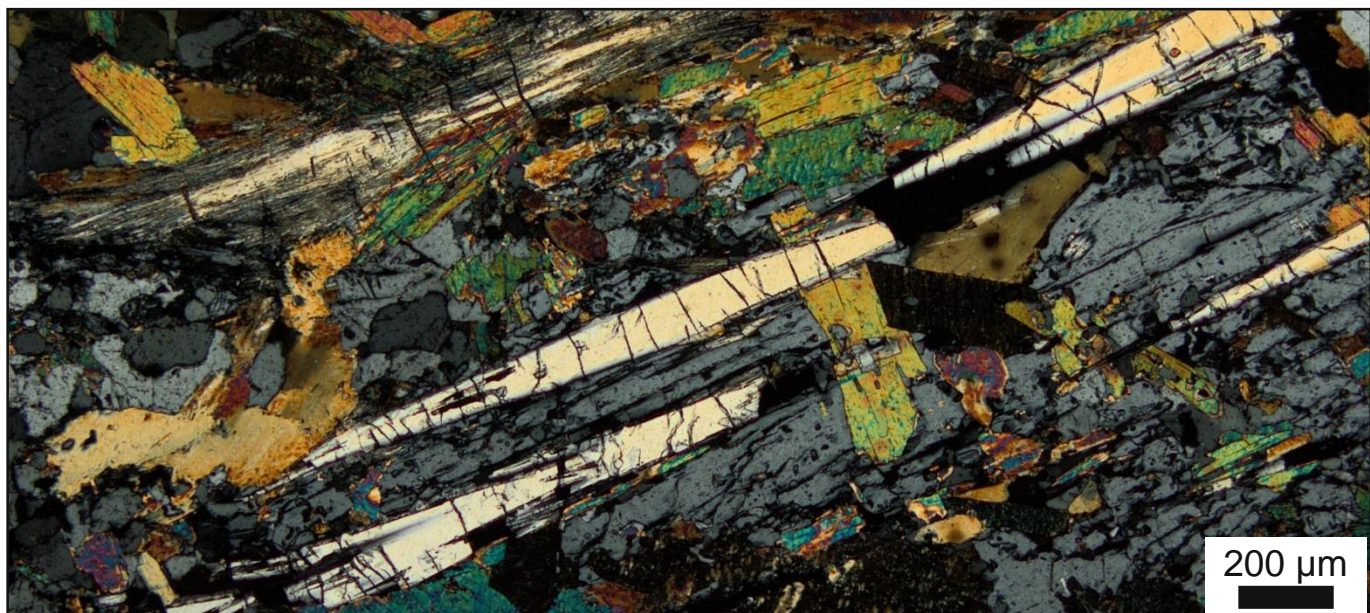


# Introduction – Why should we care about metamorphic rocks?

Event recorders



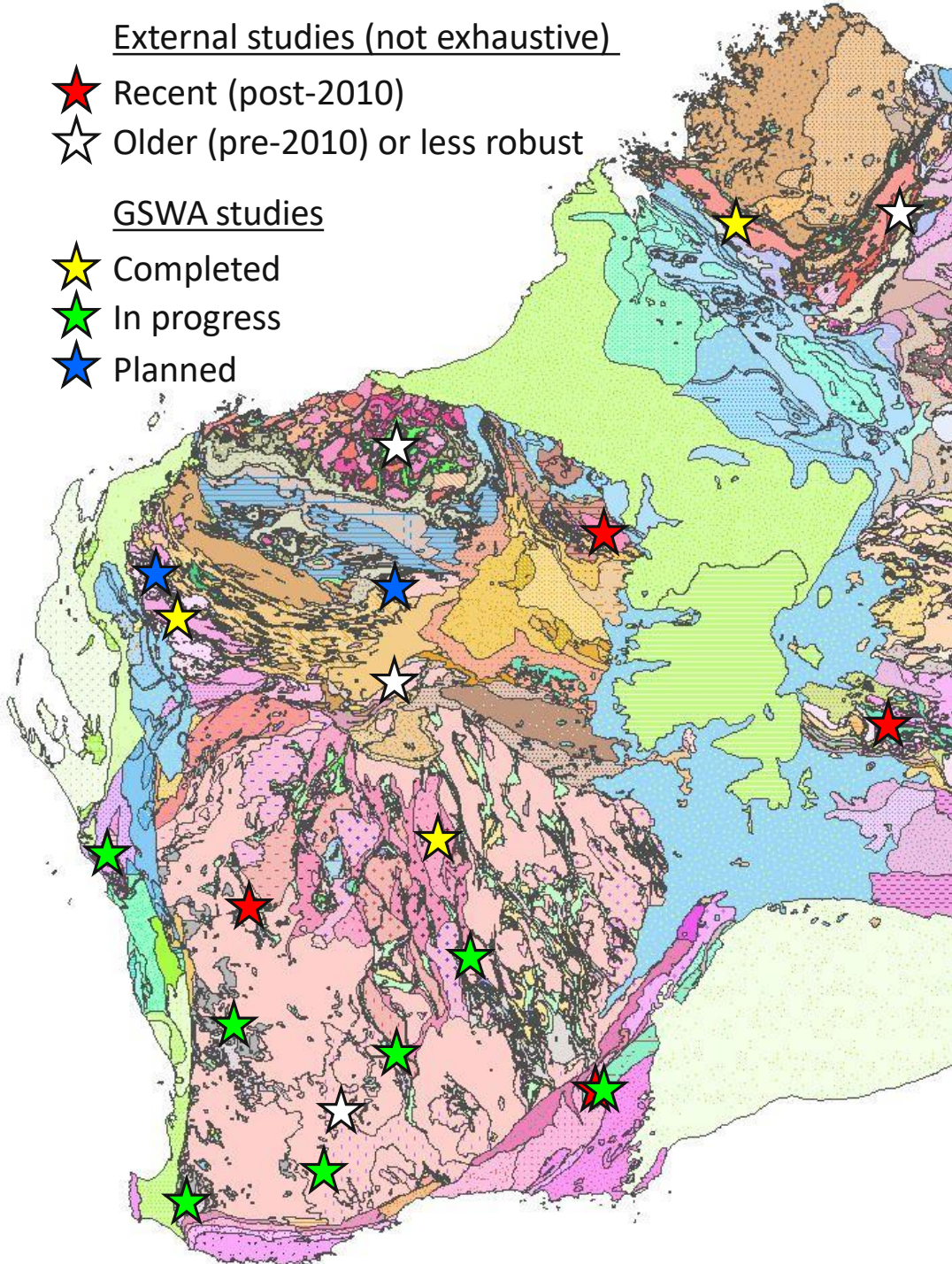
- Record the pressure ( $P$ )–temperature ( $T$ )–time ( $t$ )–deformation–fluid evolution on many scales
- Crustal response to broader tectonothermal processes
- Assemblage may record a composite history
- New techniques to interrogate the rock record



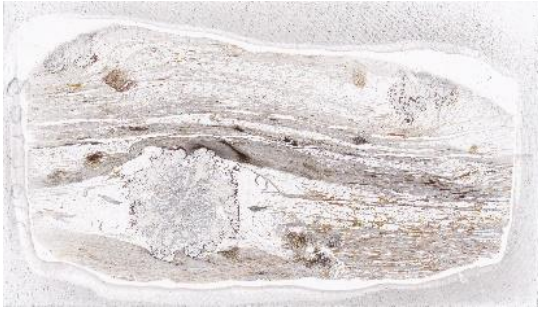
## New directions in metamorphic studies at GSWA

### Metamorphic data points → State Metamorphic Map

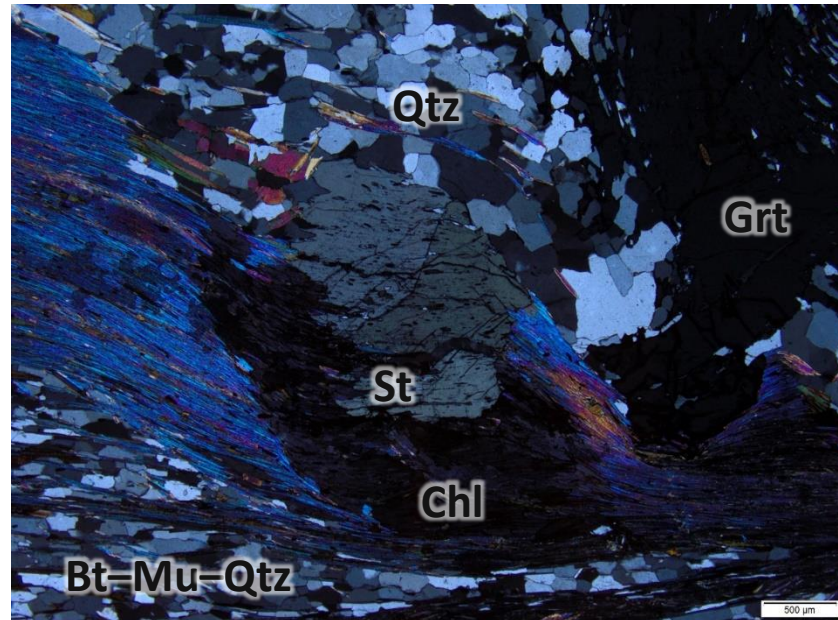
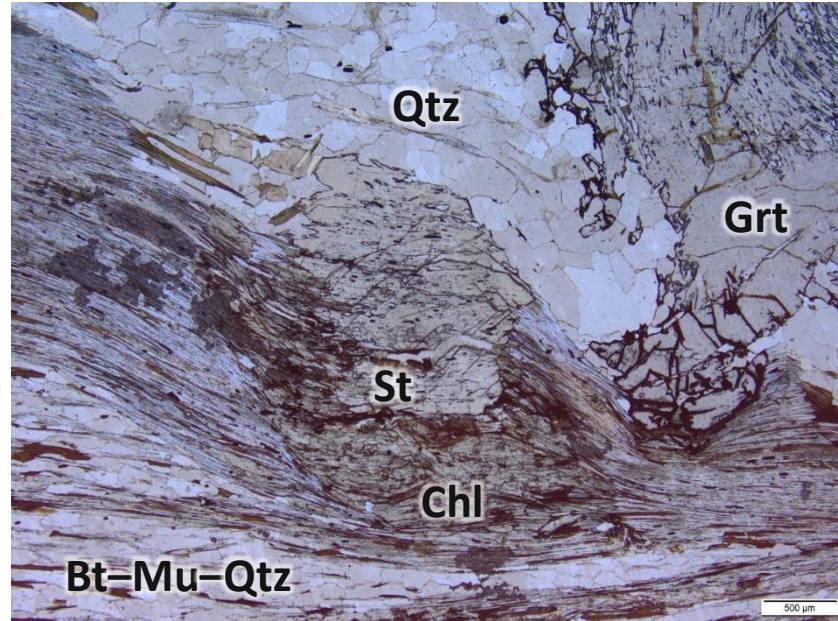
- GOLDEN SPIKES of robust metamorphic data across the State
- Retrieval of robust and standardized  $P-T-t$  data
  - Thermobarometry, mineral chemistry, in situ geochronology
  - Integrated with mineralization studies
  - Utilizing state-of-the-art techniques
  - From field to microanalytical scale
- Data capture and query: Geochronology and Mineral Chemistry database (*in development*)



# Pressure ( $P$ )–temperature ( $T$ ) estimates: example



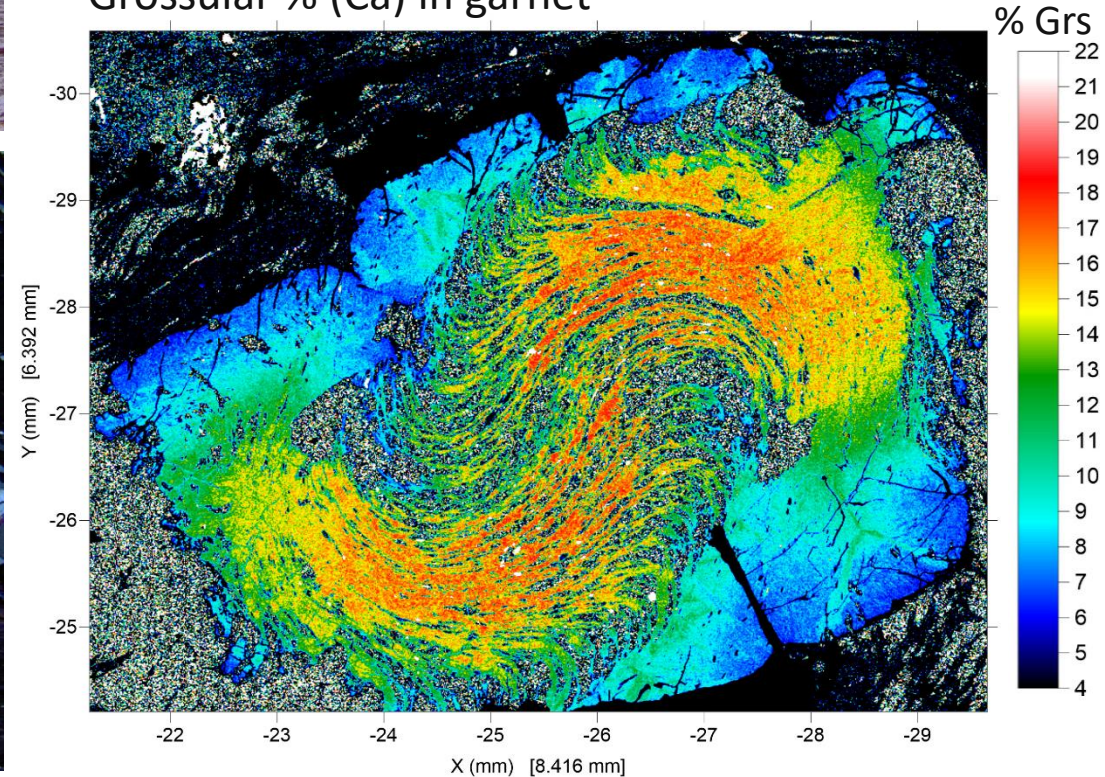
garnet–staurolite schist,  
West Kimberley



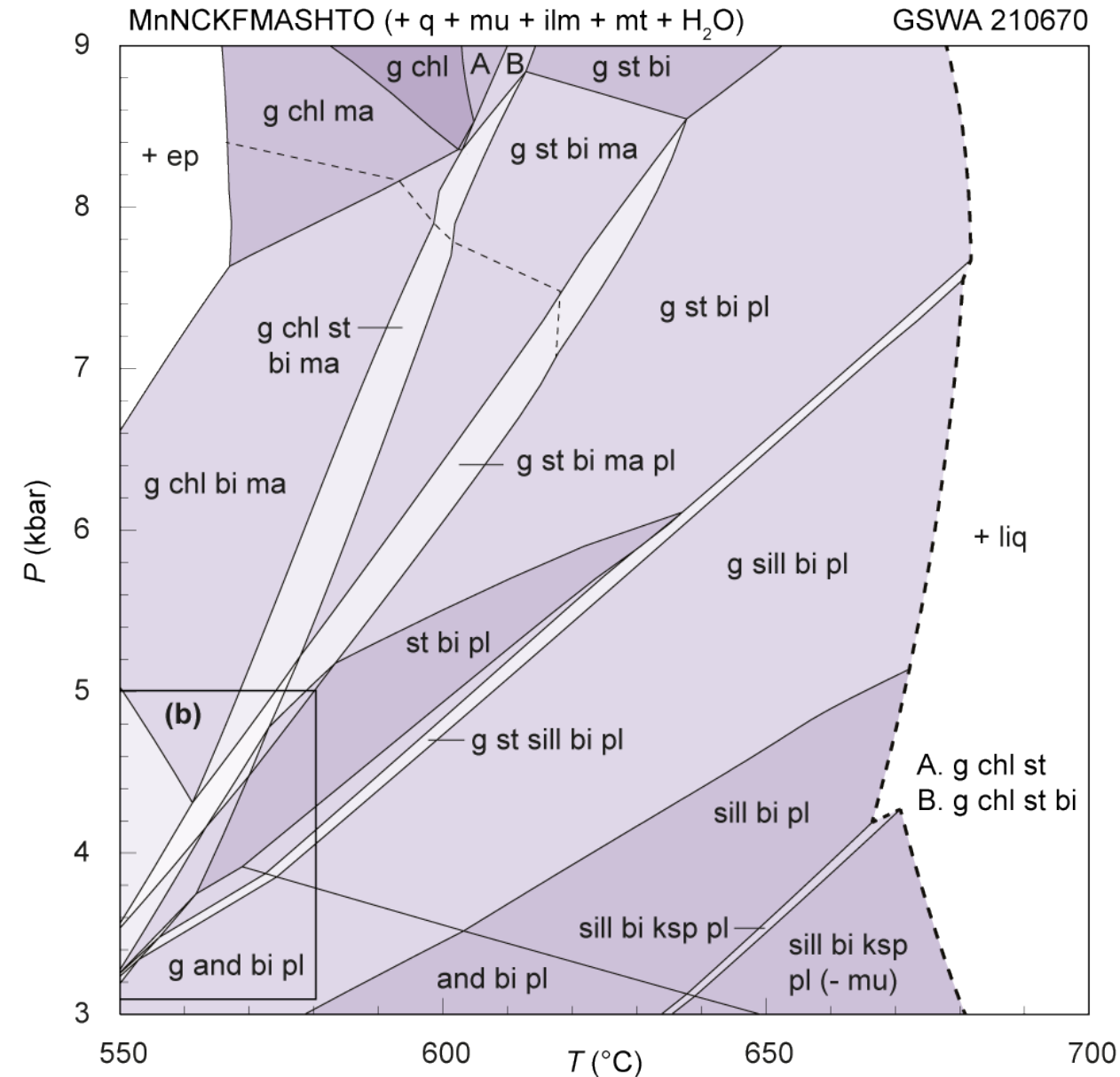
## Petrography and mineral chemistry

1. Garnet (cores + Qtz–Ilm–Mu–Chl)
2. Garnet (rims) + Staurolite (Qtz–Ilm–Bt)
3. Foliation: Chl–Bt–Mu–Qtz

## Grossular % (Ca) in garnet

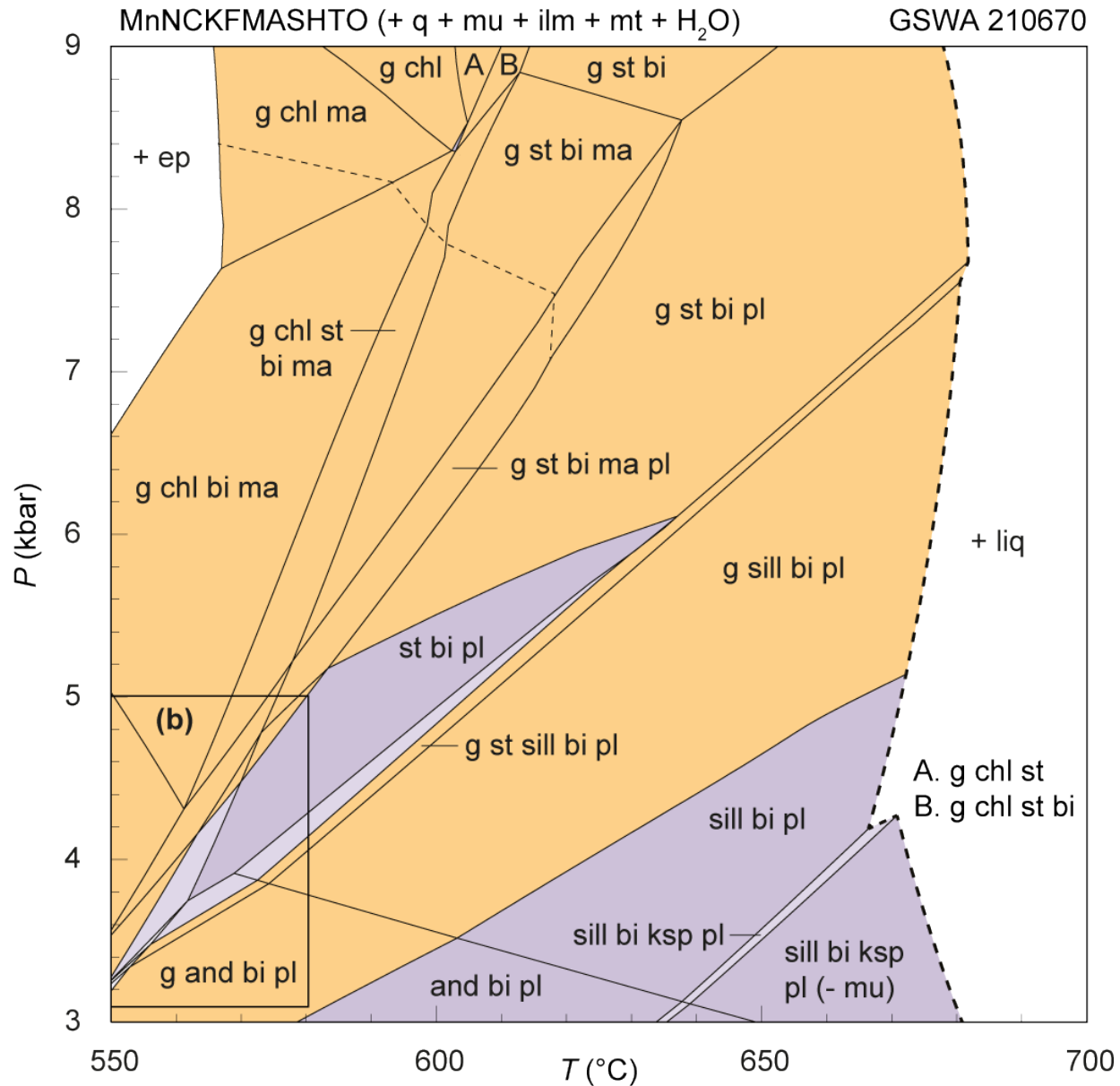


# Pressure ( $P$ )–temperature ( $T$ ) estimates: isochemical phase diagrams



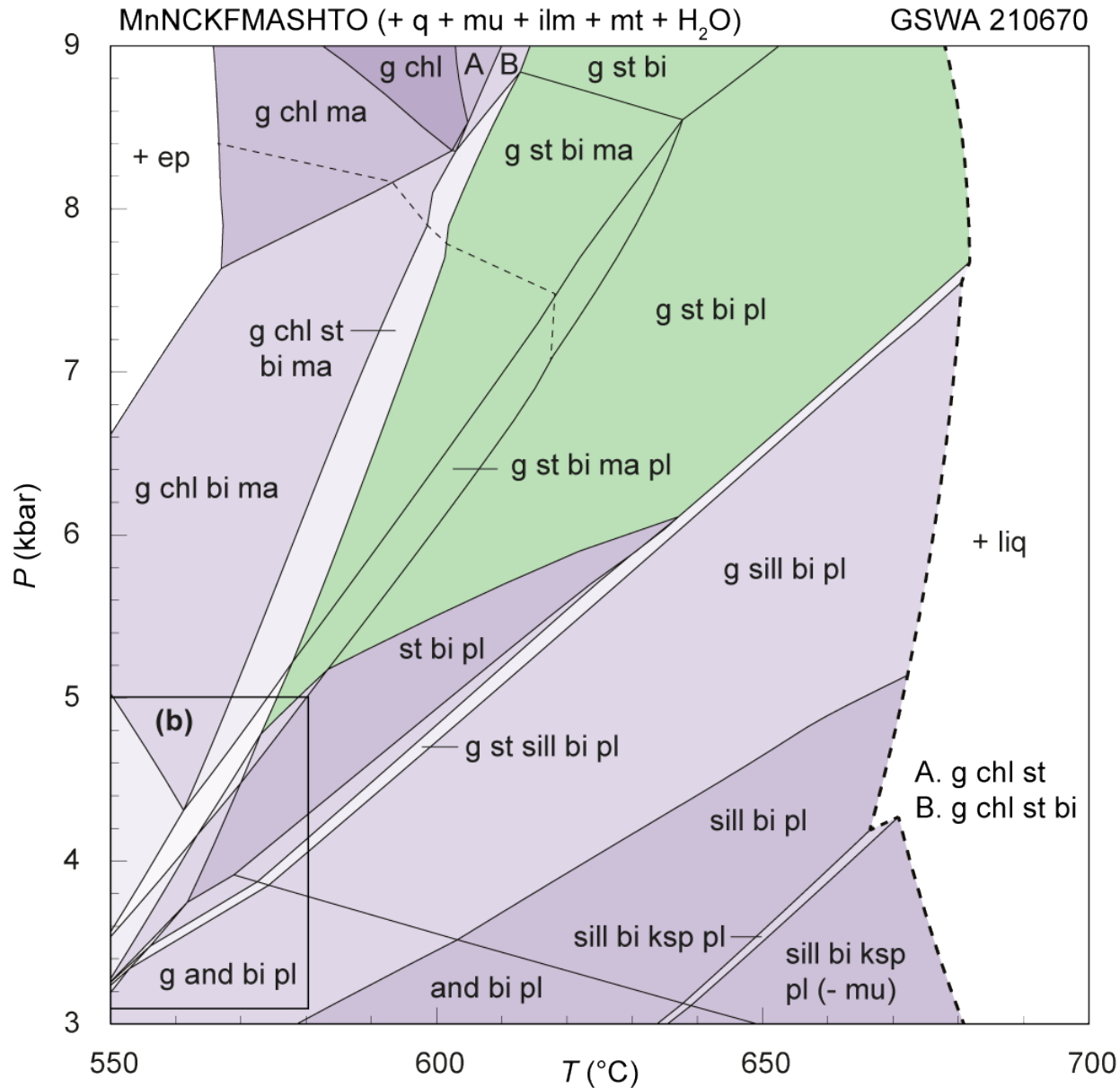
- Constructed for specific bulk composition
- Chemical system closely approximates nature
- Minerals and fluids
- Observe changes in model assemblages with  $P$ – $T$ –composition ( $X$ )

# Pressure ( $P$ )–temperature ( $T$ ) estimates: isochemical phase diagrams



1. Garnet (cores) + Qtz–Ilm–Mu–Chl
2. Garnet (rims) + Staurolite (Qtz–Ilm–Bt)
3. Foliation: Chl–Bt–Mu–Qtz

# Pressure ( $P$ )–temperature ( $T$ ) estimates: isochemical phase diagrams

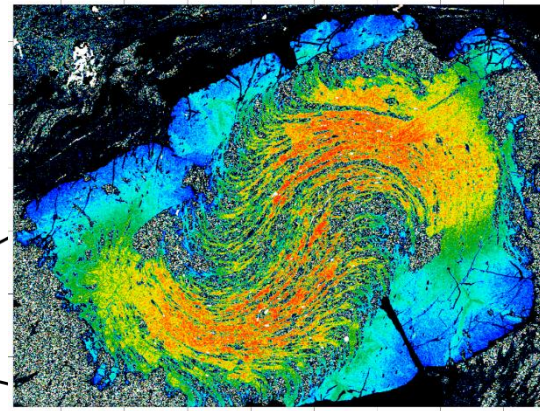
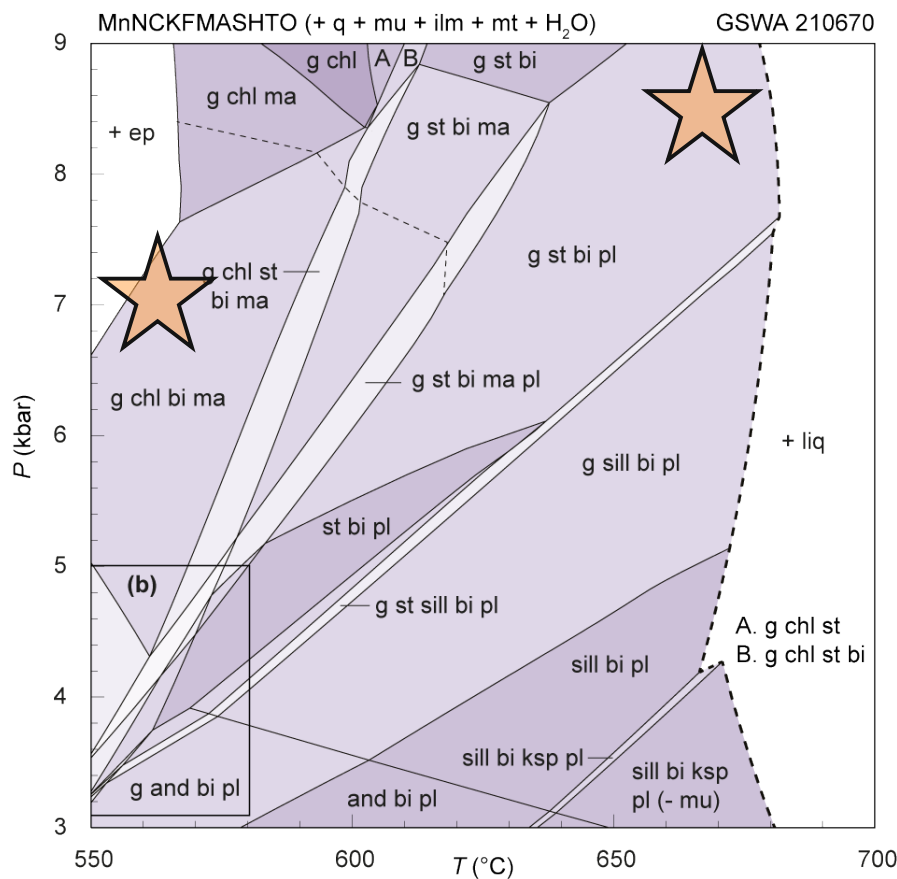
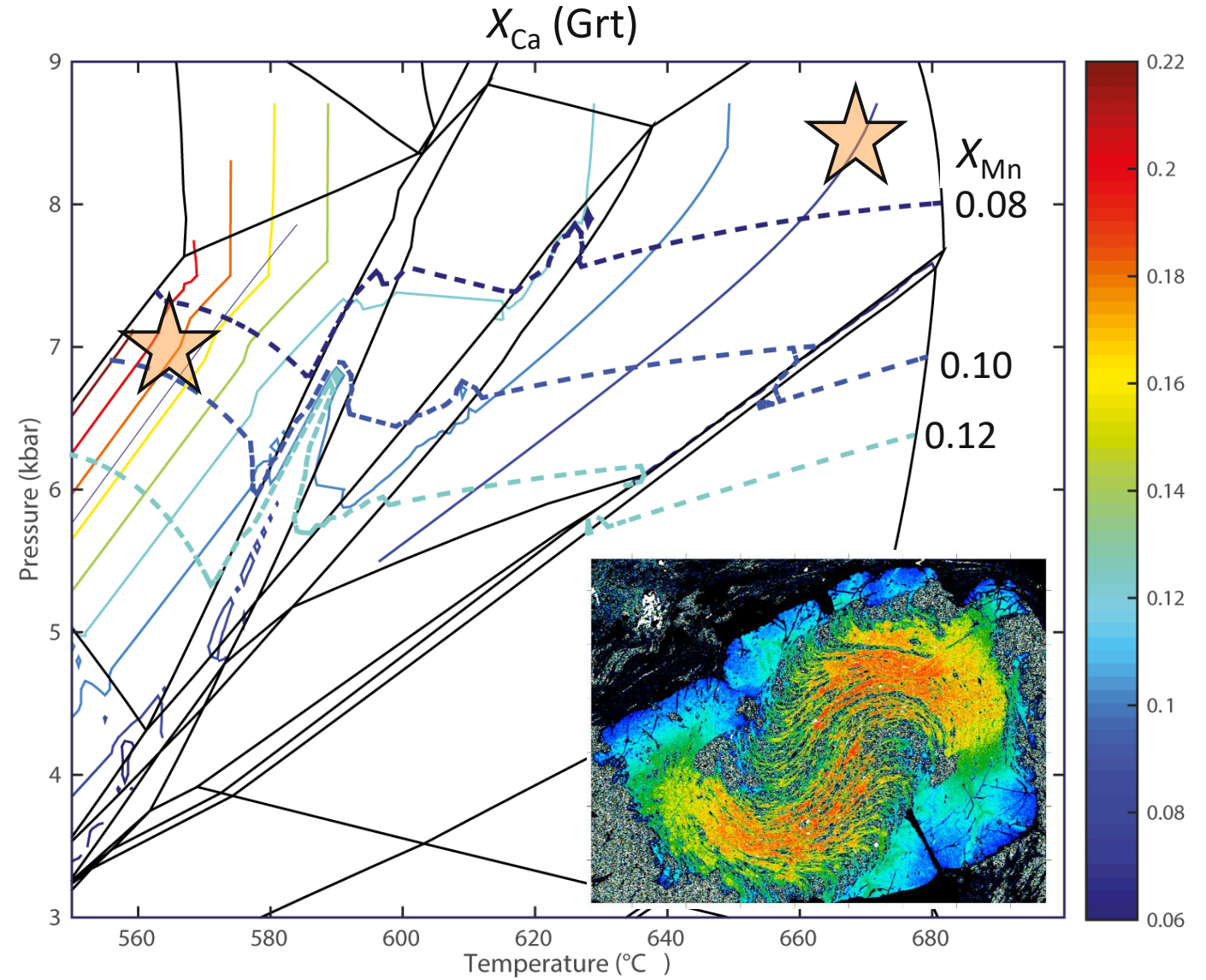


1. Garnet (cores) + Qtz–Ilm–Mu–Chl
2. Garnet (rims) + Staurolite (Qtz–Ilm–Bt)
3. Foliation: Chl–Bt–Mu–Qtz

# Pressure ( $P$ )–temperature ( $T$ ) estimates: isochemical phase diagrams

1. Garnet (cores) + Qtz–Ilm–Mu–Chl
2. Garnet (rims) + Staurolite (Qtz–Ilm–Bt)
3. Foliation: Chl–Bt–Mu–Qtz

Garnet cores:  $X_{Ca} = 0.18$ ,  $X_{Mn} = 0.09$   
 Garnet rims:  $X_{Ca} = 0.08$ ,  $X_{Mn} > 0.08$

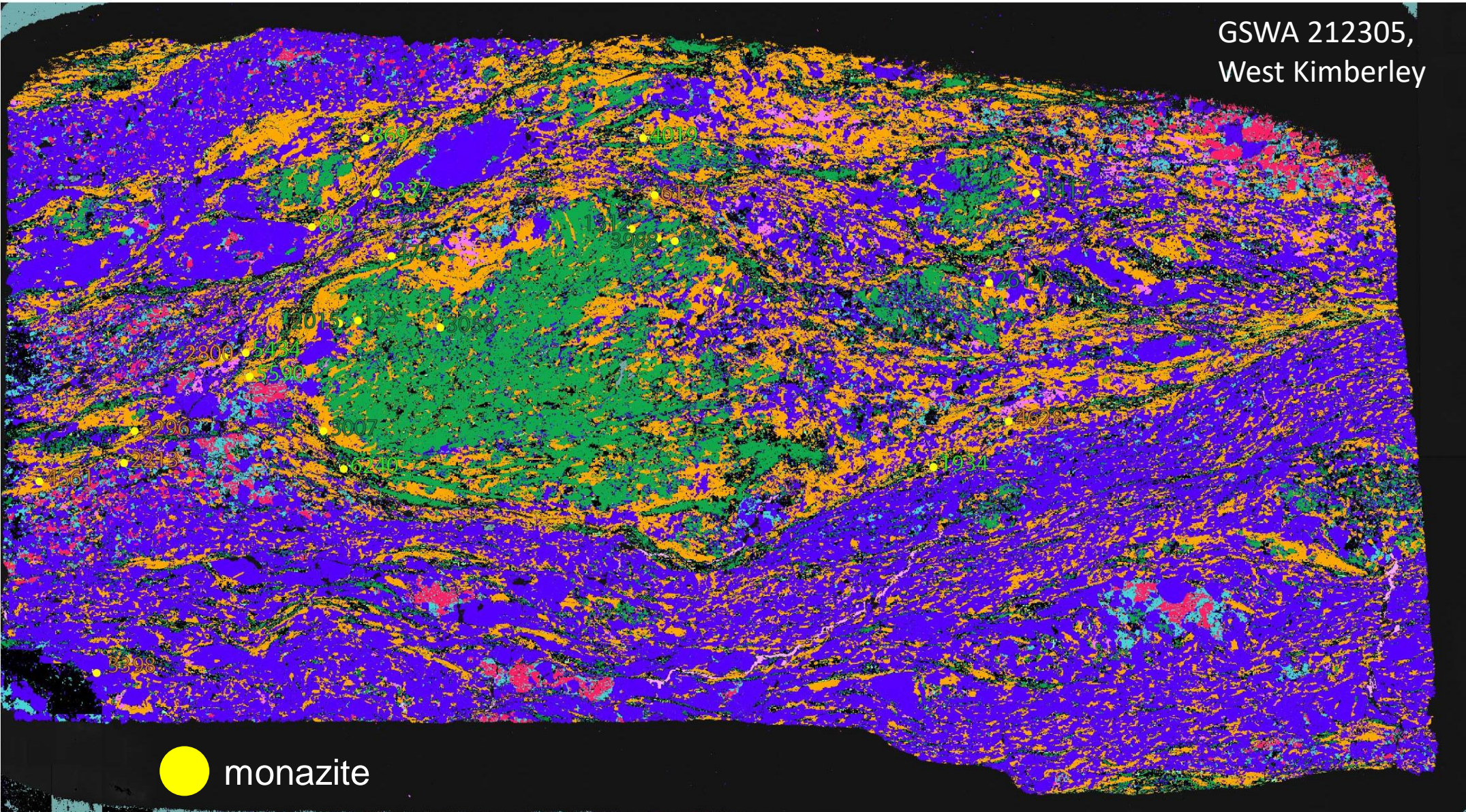




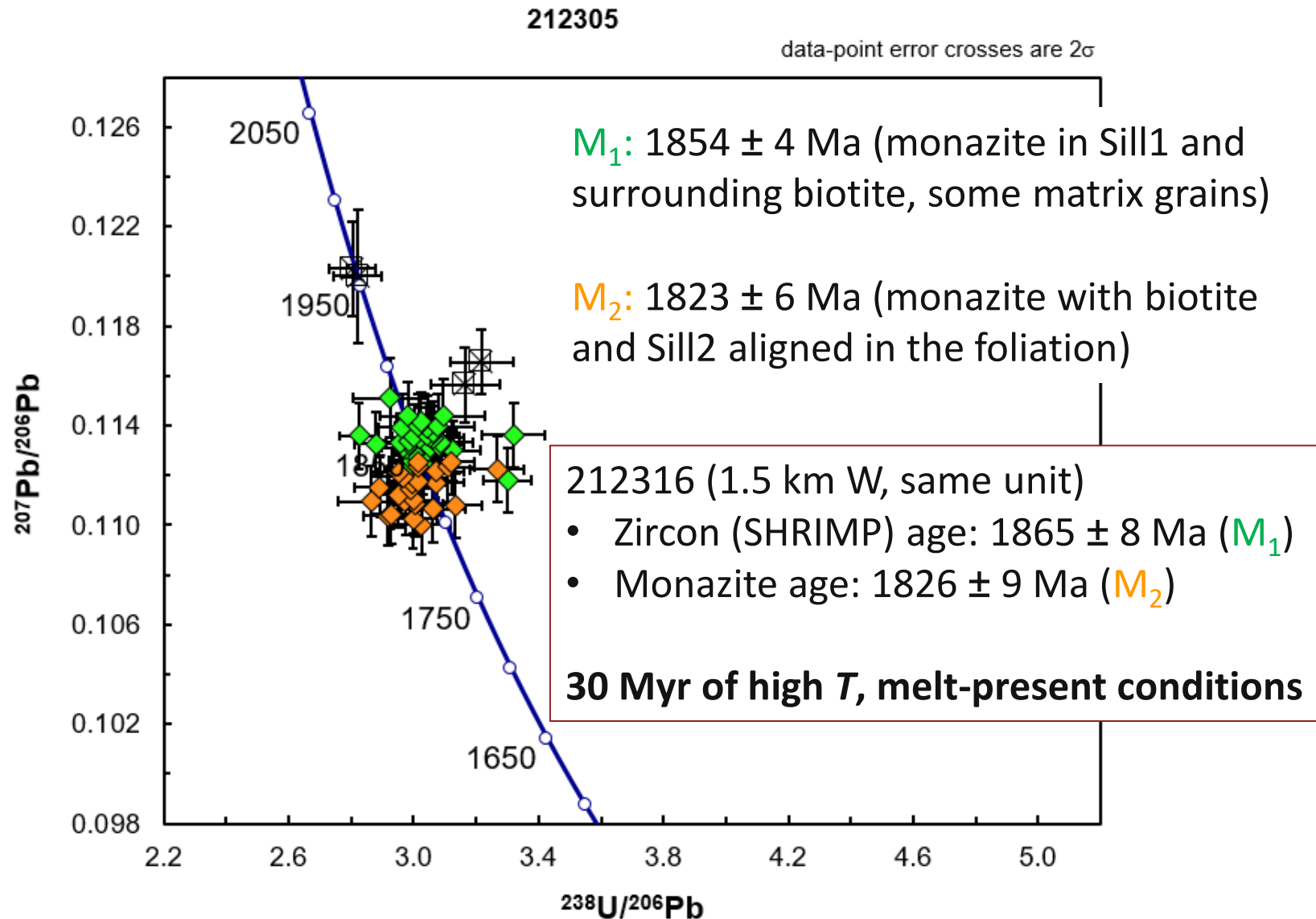
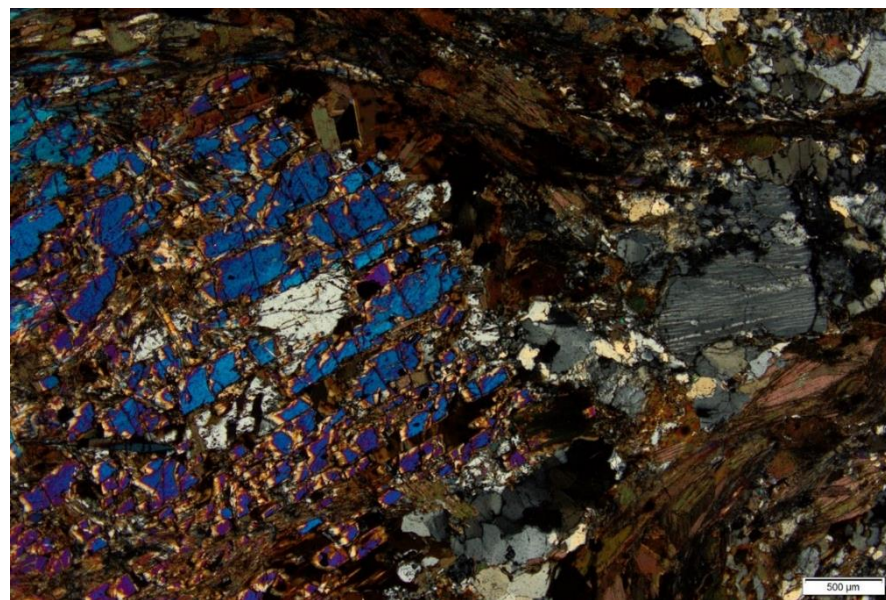
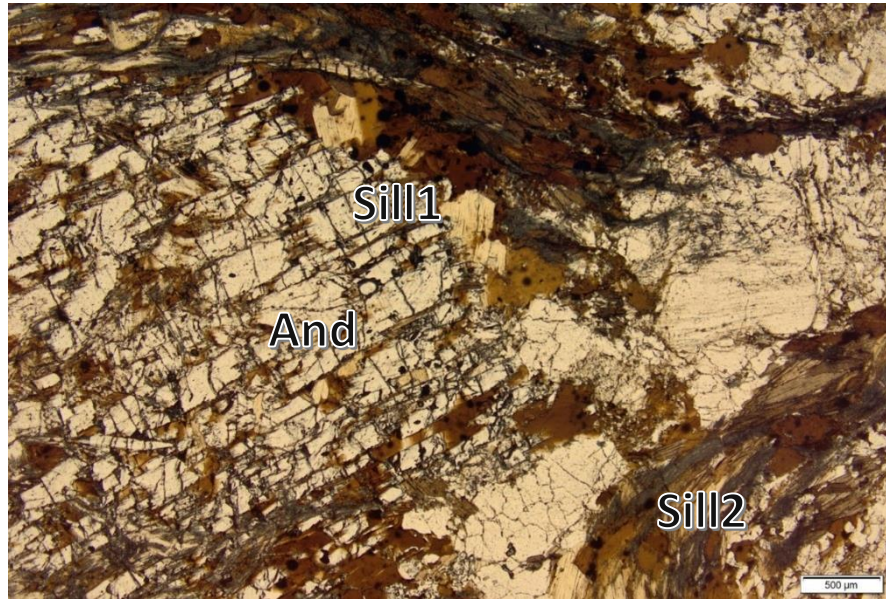
# In situ geochronology: monazite

The hunt for monazite:  
TESCAN integrated mineral analyser (TIMA) scan

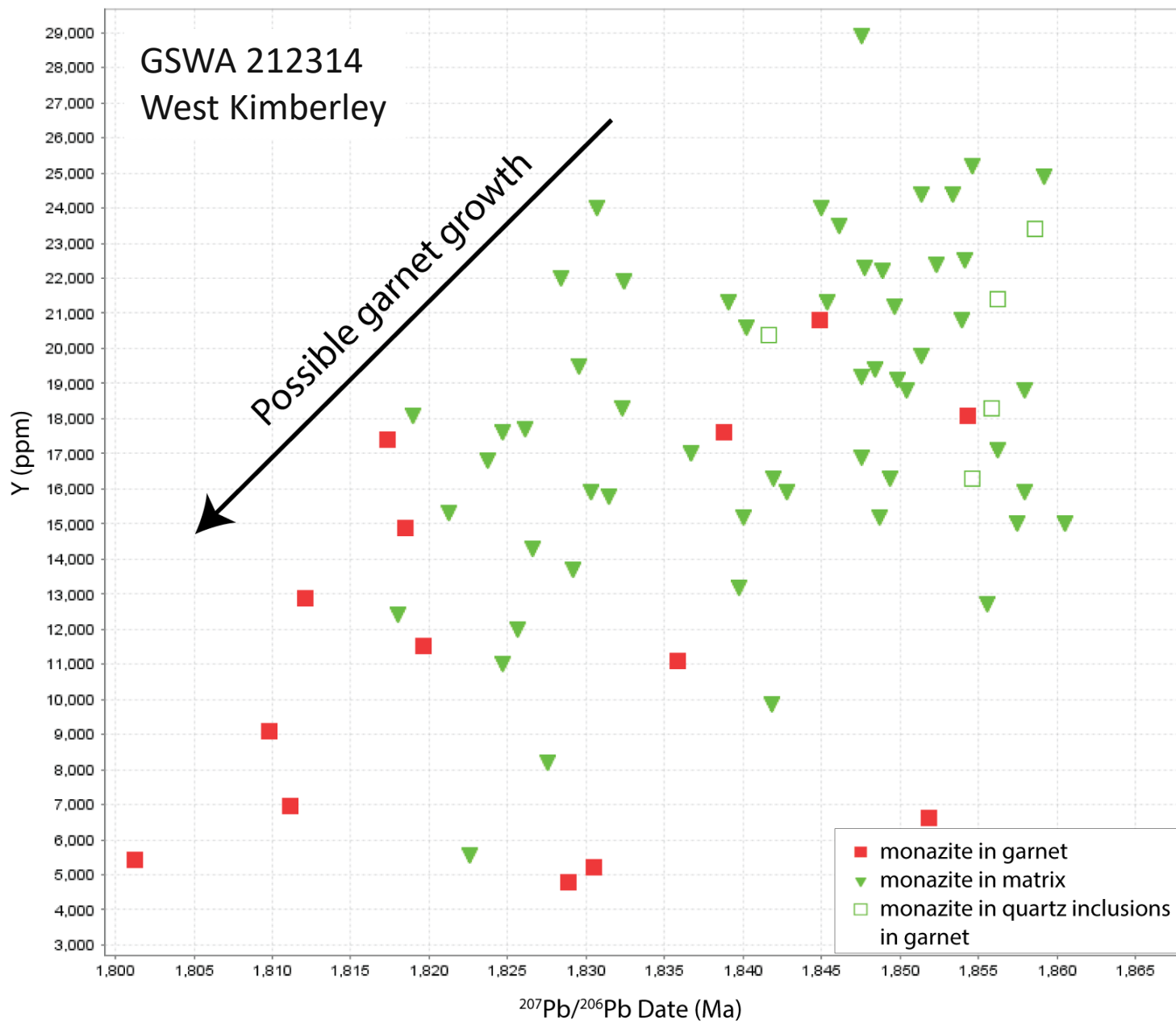
GSWA 212305,  
West Kimberley



# In situ geochronology: monazite (laser ablation split stream)



# Monazite trace element chemistry



## Create Metamorphic History Record

Enter Sample ID

**Attributes**

Unit Code  Unit Name  Tectonic Unit

Peak Pressure 1  Peak Pressure 1 Uncertainty  Peak Temp 1  Peak Temp 1 Uncertainty  Event 1 Dated

Peak Pressure 2  Peak Pressure 2 Uncertainty  Peak Temp 2  Peak Temp 2 Uncertainty  Event 2 Dated

Retrograde Pressure  Retro Pressure 2 Uncertainty  Retrograde Temperature  Retro Temp Uncertainty  Retro Event Dated

**Location and Sampling**

Attachment 1 Caption

**Tectonic Unit** >

**Petrography** >

**Methodology and Analytical Details** >

**Results** >

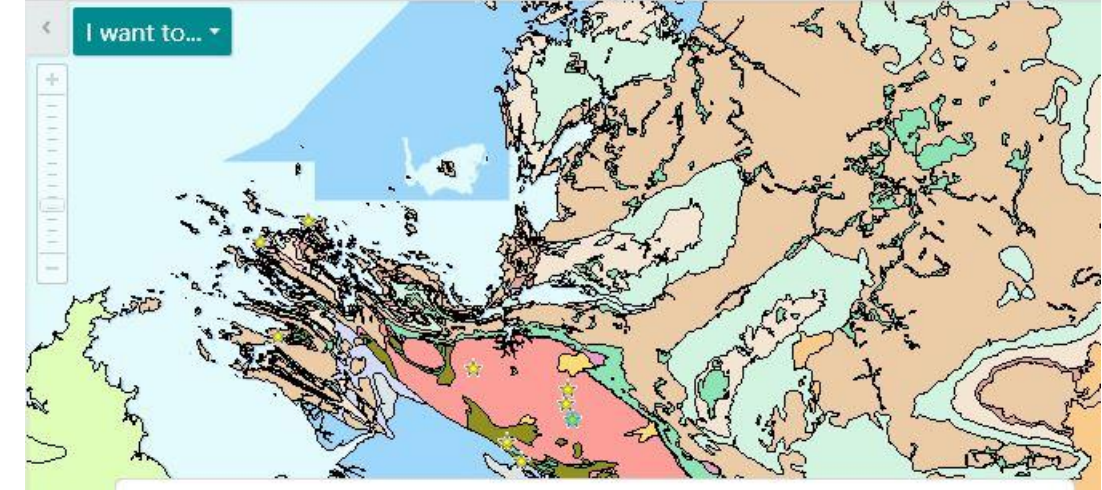
**Interpretations** >

**Uncertainties** >

**References** >

**Recommended Reference for this Publication** >

Zoom In Zoom Out



**GSWA Metamorphic History - 212305**

Zoom to Feature | Pan to Feature | Create a Report | Copy to Drawing | Add to Selected

Export Feature Attachments

Field Name	Field Value
ANALYSIS DOCUMENT	95449.1.pdf
UPB DATA	GSWA_95449.1.txt
LUHF DATA	Hf_95449_1.txt
INTRODUCTION DOCUMENT	Intro_2017.pdf
RECOMMENDED REFERENCE	Lu, Y, Wingate, MTD, Kirkland, CL and Griffin, TJ 2017, 95449: hornblende
STRATIGRAPHIC REFERENCE	Tyler, IM and Griffin, TJ 1993, Yampi, Western Australia (2nd edition): Ge
SITE ID	TJGHCO000904
ORIGINATOR NAME	Griffin T.J.

25mi 50km  Scale: 1: 2,207,873

# New directions in metamorphic studies at GSWA – *where we have been, where we are, and where we are going...*

## PAST:

- Field-based work, geophysics, geochemistry, geochronology
- Metamorphic studies not routinely done at GSWA; not standardized

## PRESENT: GOLDEN SPIKES of robust metamorphic data across the State

- Protocol developed for the construction of isochemical phase diagrams (pseudosections)
- Protocols and work flow now in place for routine and standardized mineral chemistry and in situ monazite geochronology (+ trace elements)
- Detailed field and microanalysis integrated with  $P$ – $T$ – $t$  data
- Continuing to explore and apply new techniques, particularly in regards to thermobarometry (e.g. Raman barometry, trace element thermometers)

## FUTURE:

- Metamorphic History Records (linked with GeoVIEW)
- Geochronology and Mineral Chemistry database
- Metamorphic State Map (descriptive versus interpreted)

