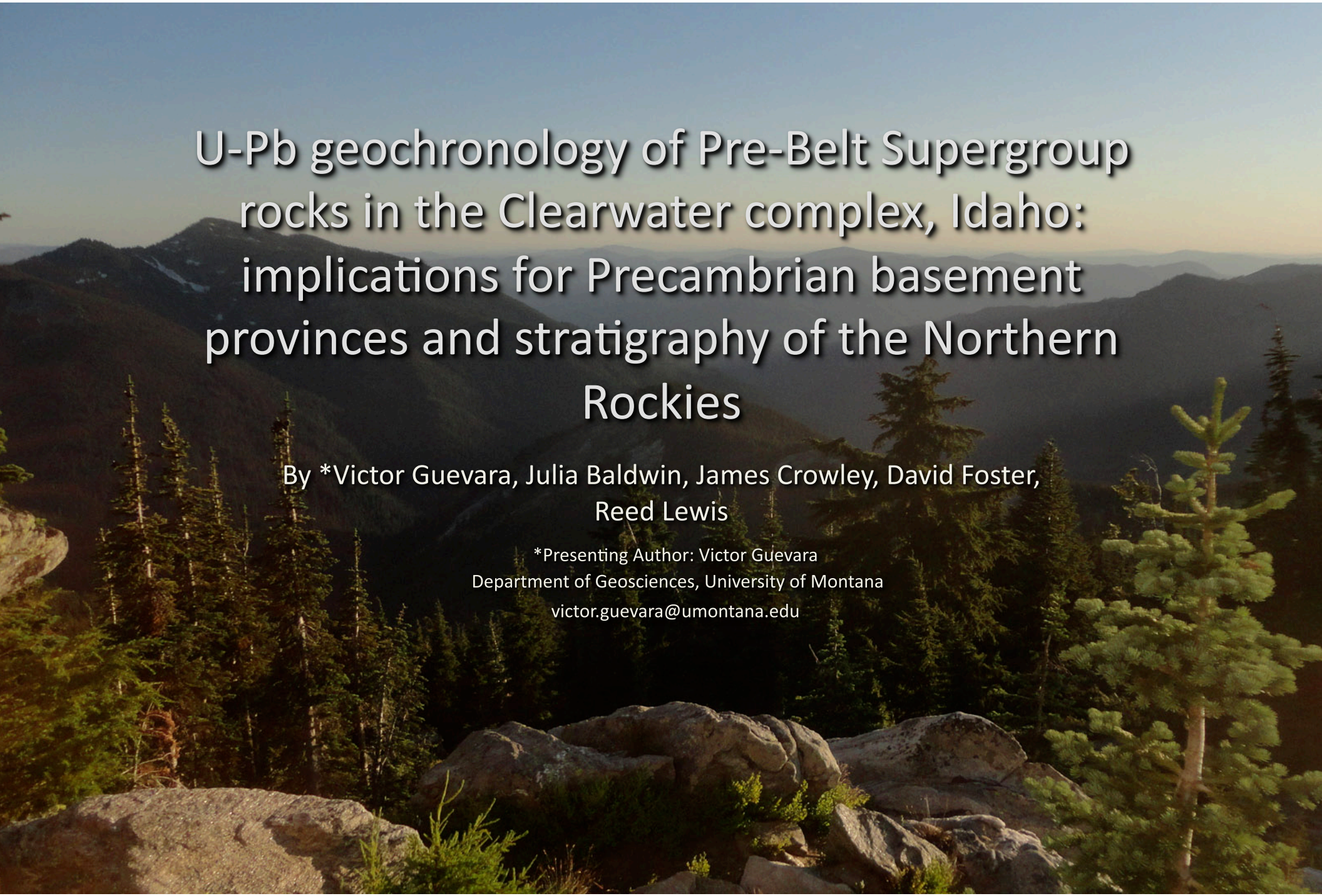

U-Pb geochronology of Pre-Belt Supergroup rocks in the Clearwater complex, Idaho: implications for Precambrian basement provinces and stratigraphy of the Northern Rockies

By *Victor Guevara, Julia Baldwin, James Crowley, David Foster, Reed Lewis

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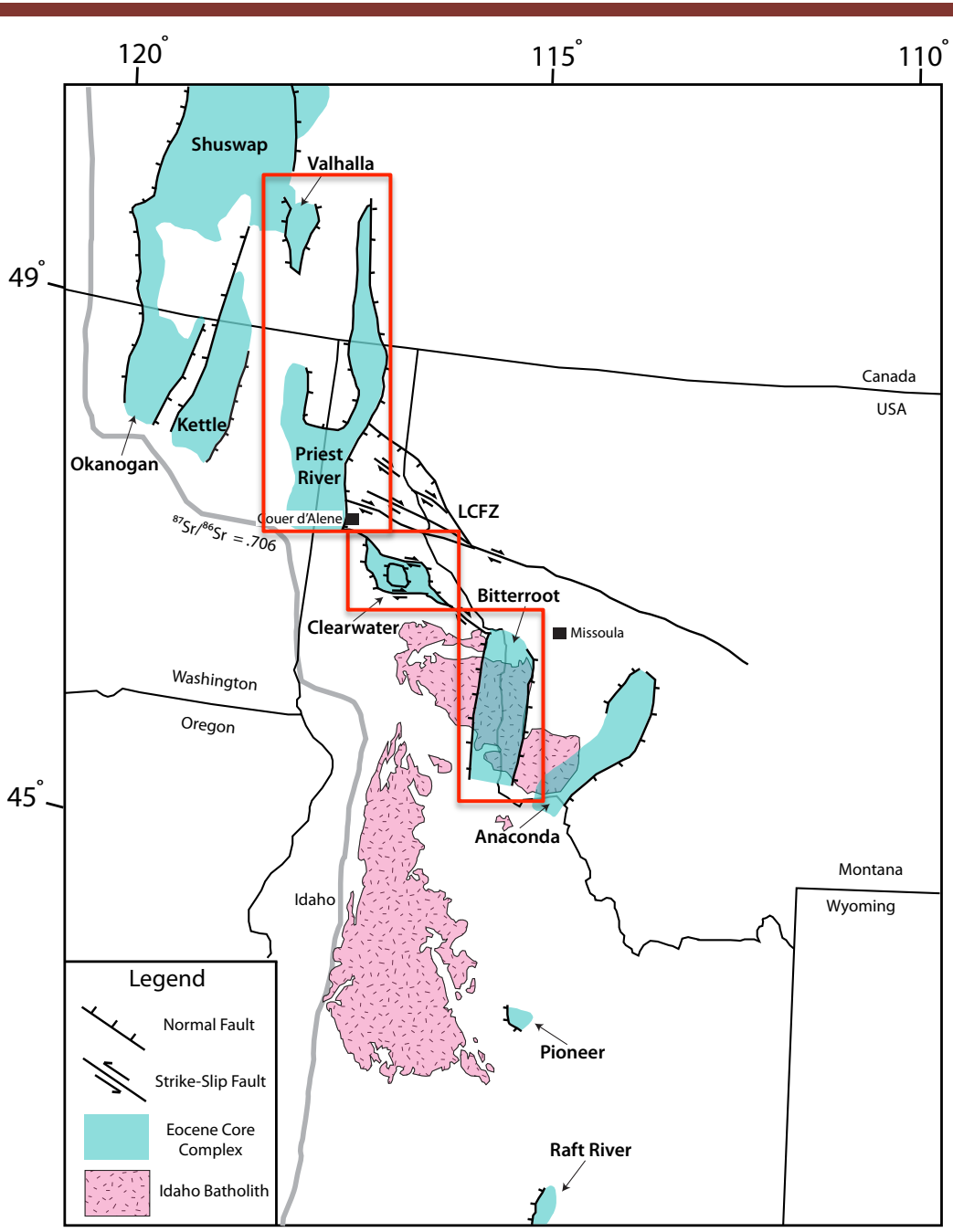
victor.guevara@umontana.edu

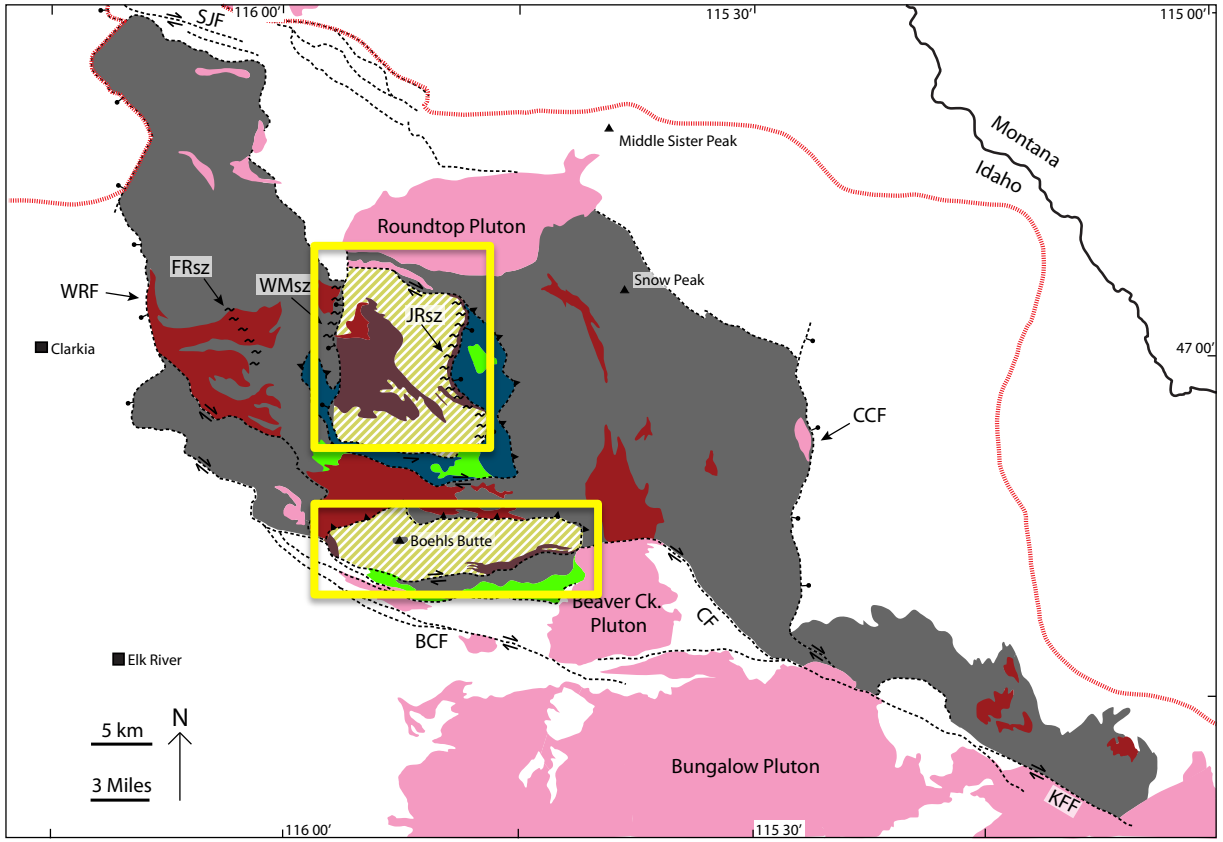
Outline

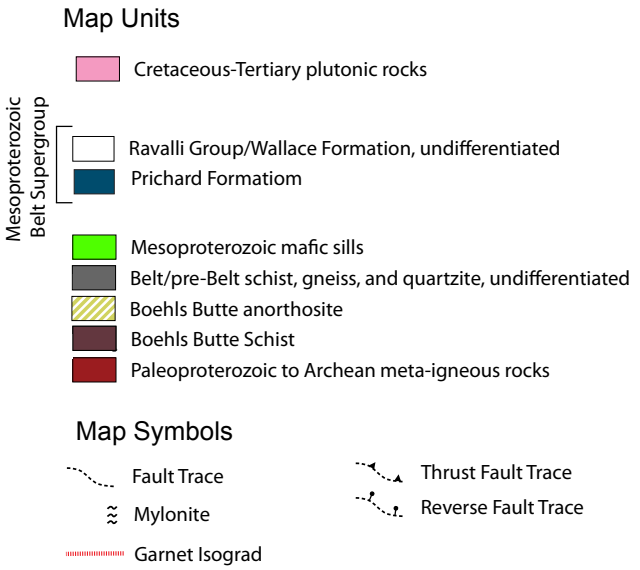
- Regional overview
- Basement in Clearwater - previous work
- Mesoproterozoic Belt Supergroup
- LA-ICP-MS zircon data
  - Pre-Belt quartzites: U-Pb on detrital grains
  - Paleoproterozoic orthogneiss
    - U-Pb
    - Lu-Hf
- Conclusions



Modified after Foster et al. (2007), Lewis et al. (2010), and Gaschnig et al. (2011)

Clearwater metamorphic core complex



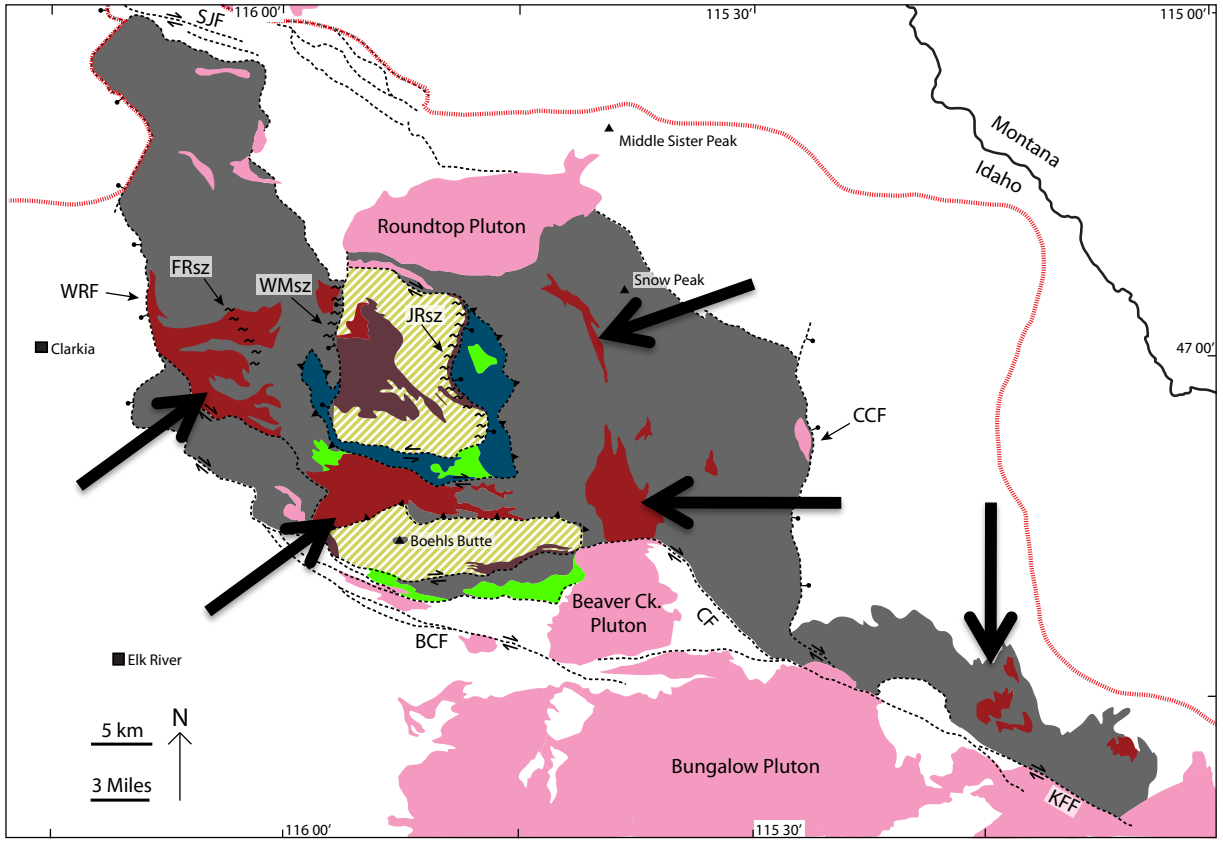


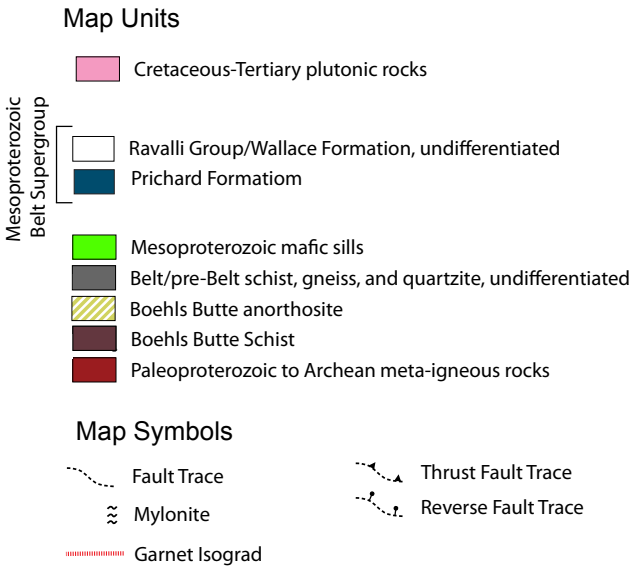
Modified after Nesheim et al. (2012), Lewis et al. (2000, 2005, 2007)

Basement Geochronology in the Clearwater – Previous Work

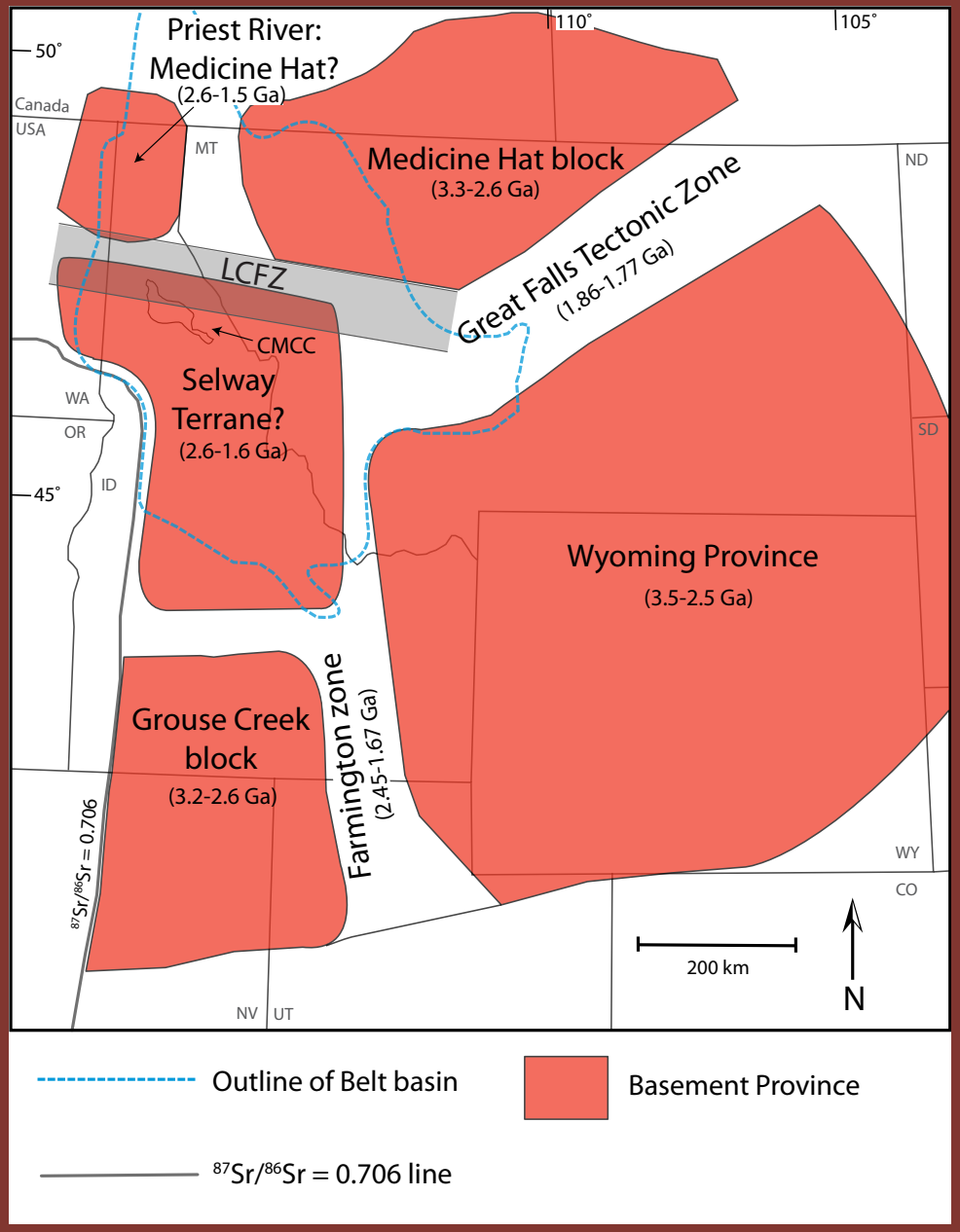
- *Hietanen (1963, 1968)* – first to map area
- *Reid et al. (1973)* – determined Paleoproterozoic age for anorthosite – discordant data
- *Doughty and Chamberlain (2007)* – 1787 Ma anorthosite, 1587 Ma garnet amphibolite, Pre-Belt schist and quartzite in internal zone
- *WSU (Vervoort group): Jansen et al. (2011); Brewer et al. (2008); Lewis et al. (2011)* – Paleoproterozoic (~1.86 Ga) and Archean (~2.67 Ga) orthogneiss, Pre-Belt quartzite in external zone

Clearwater metamorphic core complex



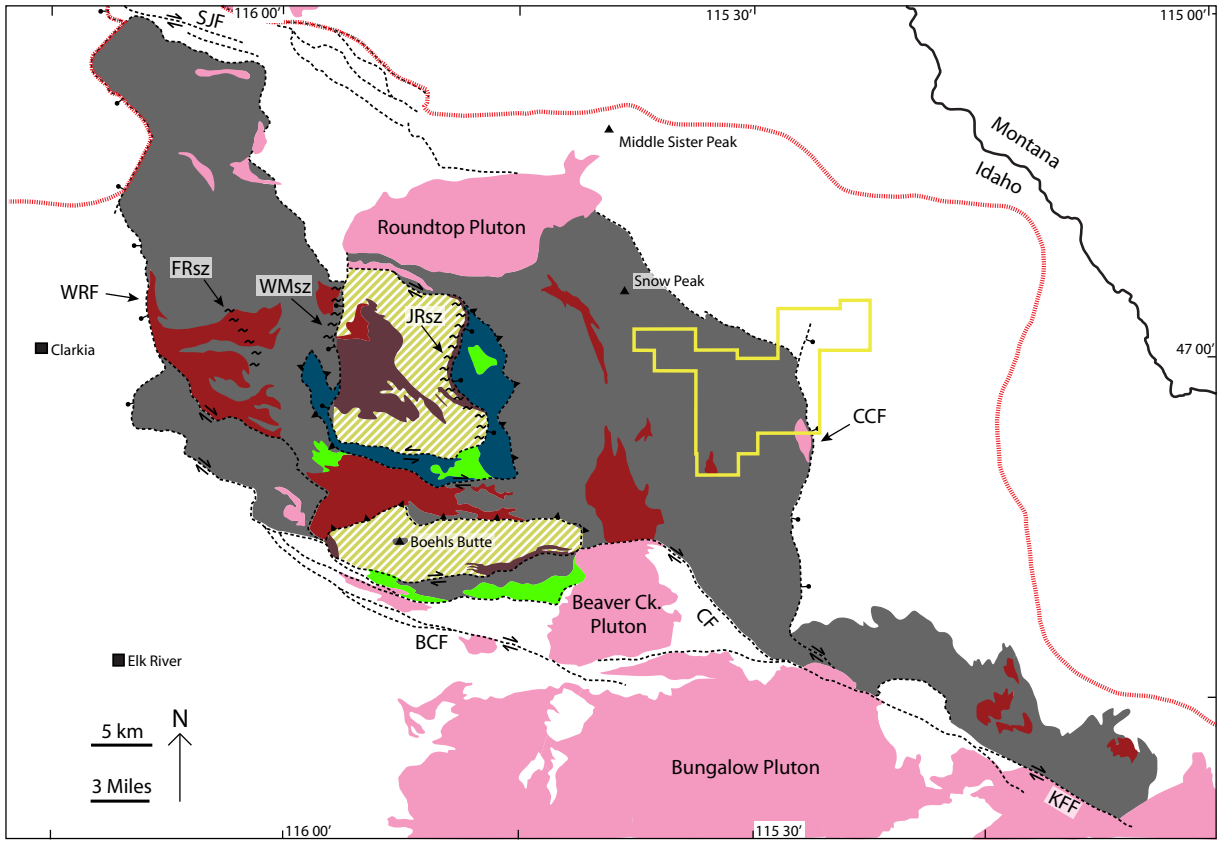


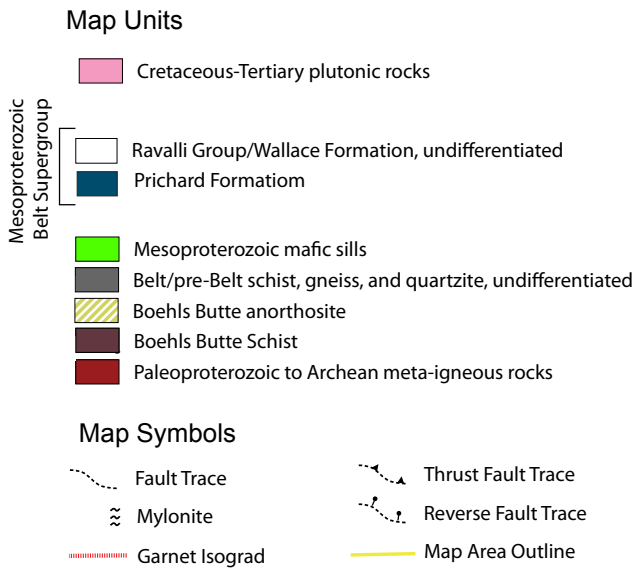
Modified after Nesheim et al. (2012), Lewis et al. (2000, 2005, 2007)



Modified after Foster et al. (2006)

Clearwater metamorphic core complex





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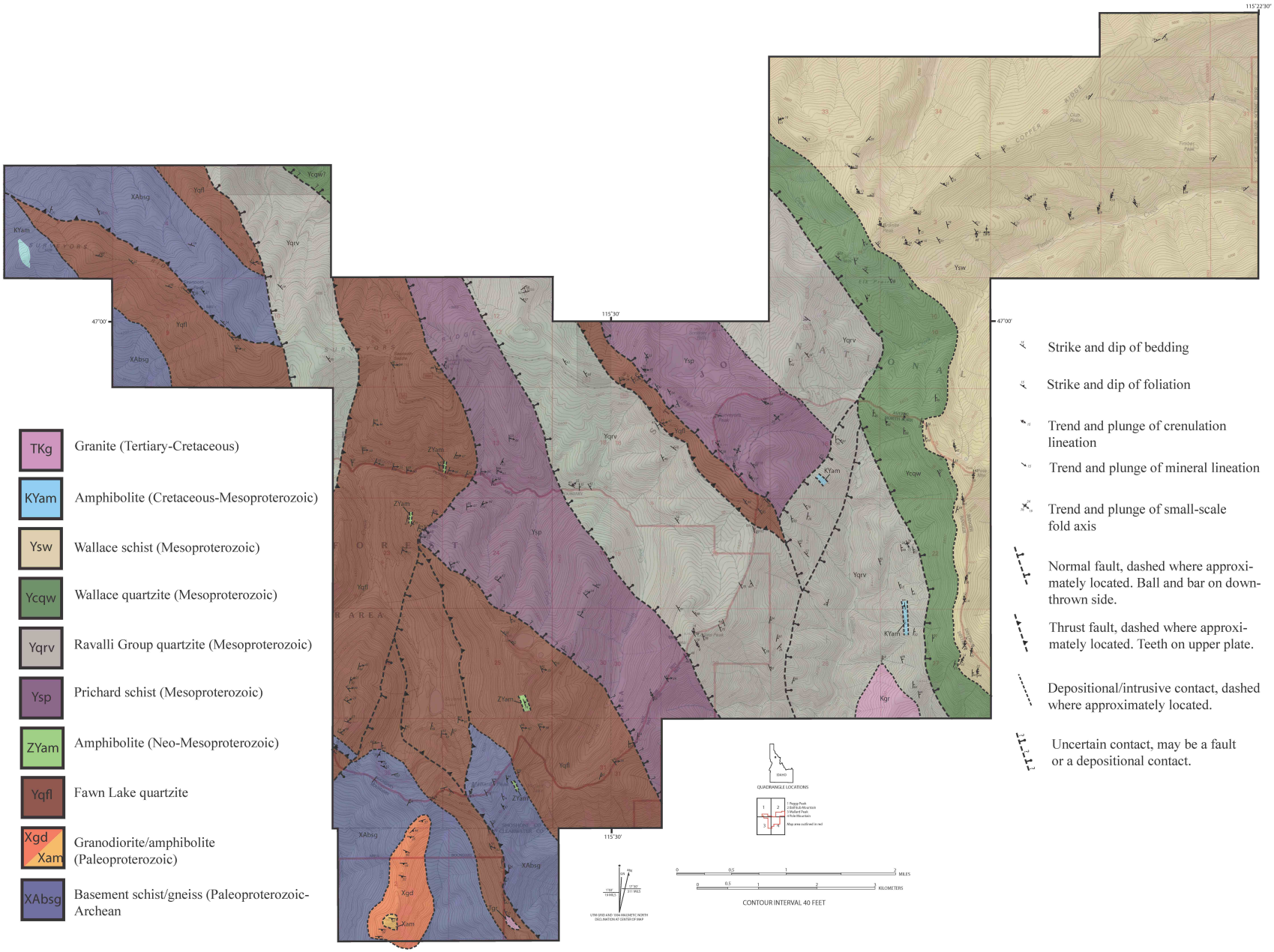
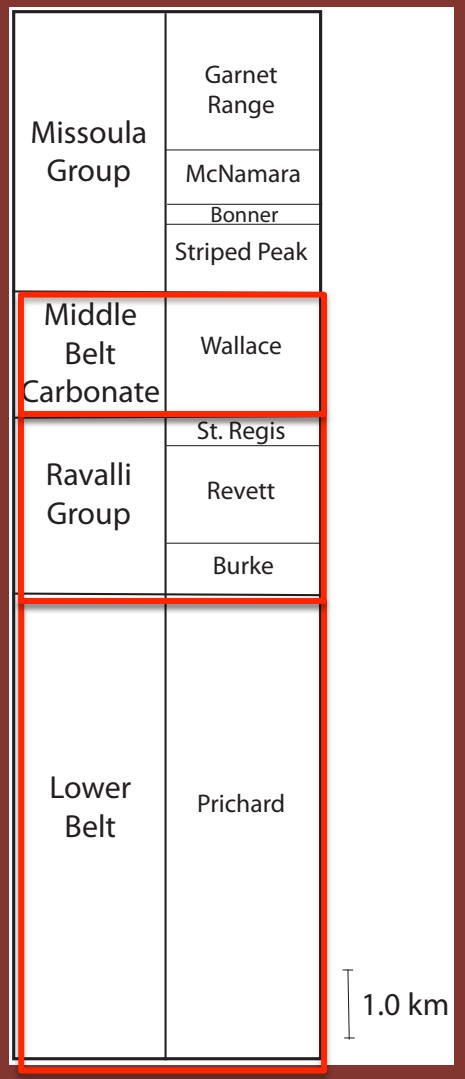

TKg
Granite (Tertiary-Cretaceous)
KYam
Amphibolite (Cretaceous-Mesoproterozoic)
Ysw
Wallace schist (Mesoproterozoic)
Ycqw
Wallace quartzite (Mesoproterozoic)
Yqrv
Ravalli Group quartzite (Mesoproterozoic)
Ysp
Prichard schist (Mesoproterozoic)
ZYam
Amphibolite (Neo-Mesoproterozoic)
Yqfl
Fawn Lake quartzite
Xgd
Xam
Granodiorite/amphibolite (Paleoproterozoic)
XAbsg
Basement schist/gneiss (Paleoproterozoic-Archean
Strike and dip of bedding
Strike and dip of foliation
Trend and plunge of crenulation lineation
Trend and plunge of mineral lineation
Trend and plunge of small-scale fold axis
Normal fault, dashed where approximately located. Ball and bar on downthrown side.
Thrust fault, dashed where approximately located. Teeth on upper plate.
Depositional/intrusive contact, dashed where approximately located.
Uncertain contact, may be a fault or a depositional contact.
115°22'30"
47°00'
115°30'
QUADRANGLE LOCATIONS
CONTOUR INTERVAL 40 FEET
MILES
KILOMETERS

Belt Supergroup

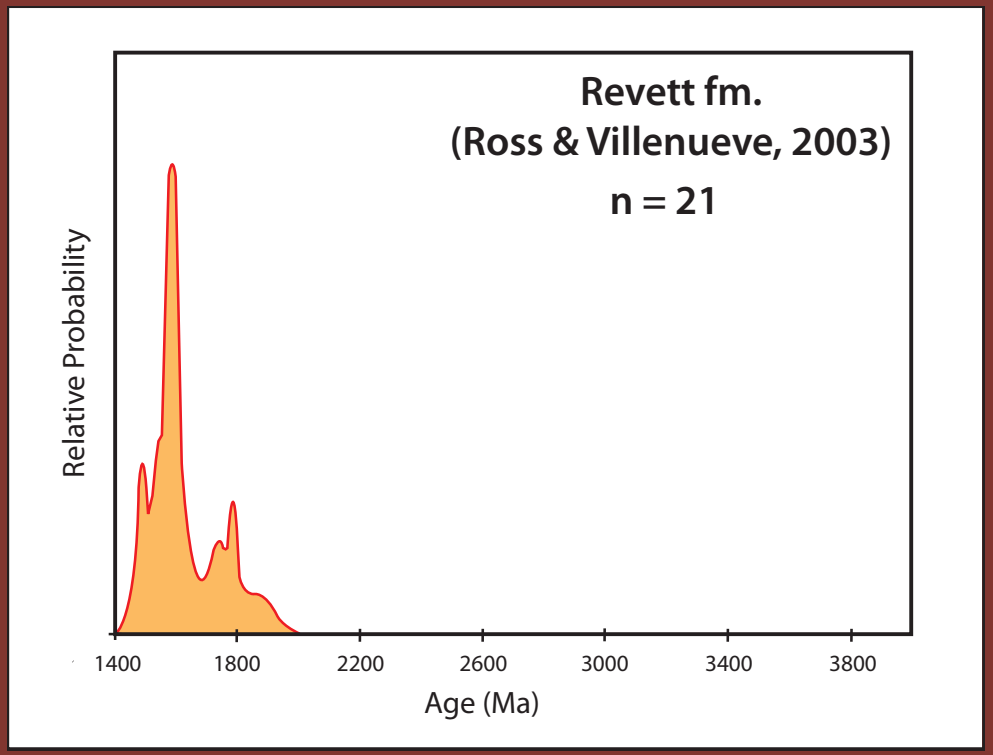
- 15-18 km thick sedimentary package
- Intracratonic Rift – began at 1.47 Ga
- Underlain by Neihart quartzite
- In region around Clearwater complex: Lower Belt (Prichard Formation) – Middle Belt carbonate (Wallace Formation)



Modified after Ross and Villenueve (2003)

Ravalli Group – Revett fm.

- Dominant peak at 1.6 Ga
- Non-North American input
- Small 1.8 Ga peak - no Archean zircons
- Feldspathic, interbedded with siltite and argillite



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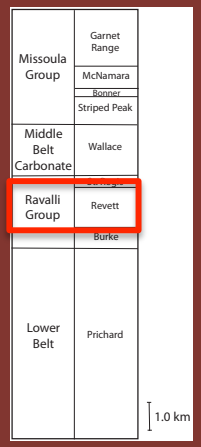
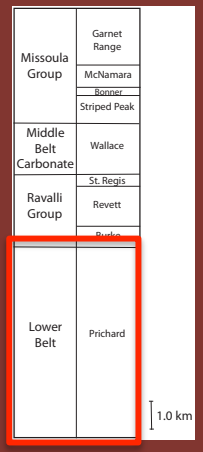
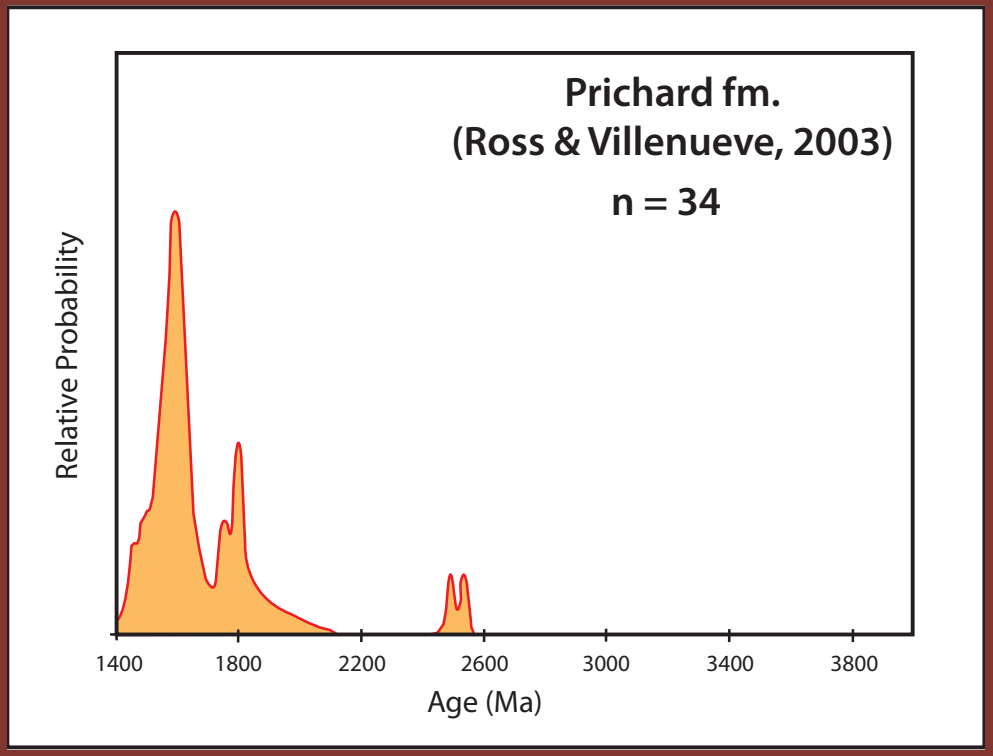


Lower Belt - Prichard

- Dominant peak at 1.6 Ga
- Non-North American input
- Small 1.8 Ga peak - few Neoarchean zircons
- Feldspathic, interbedded with siltite and argillite

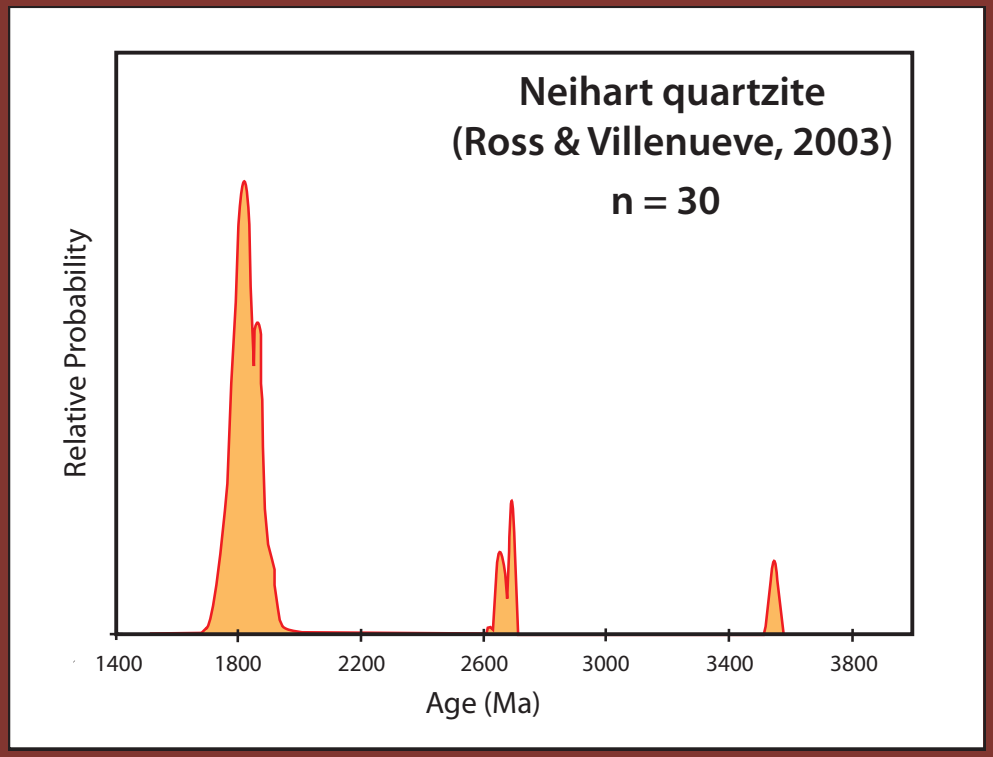




Modified after Ross and Villenueve (2003)

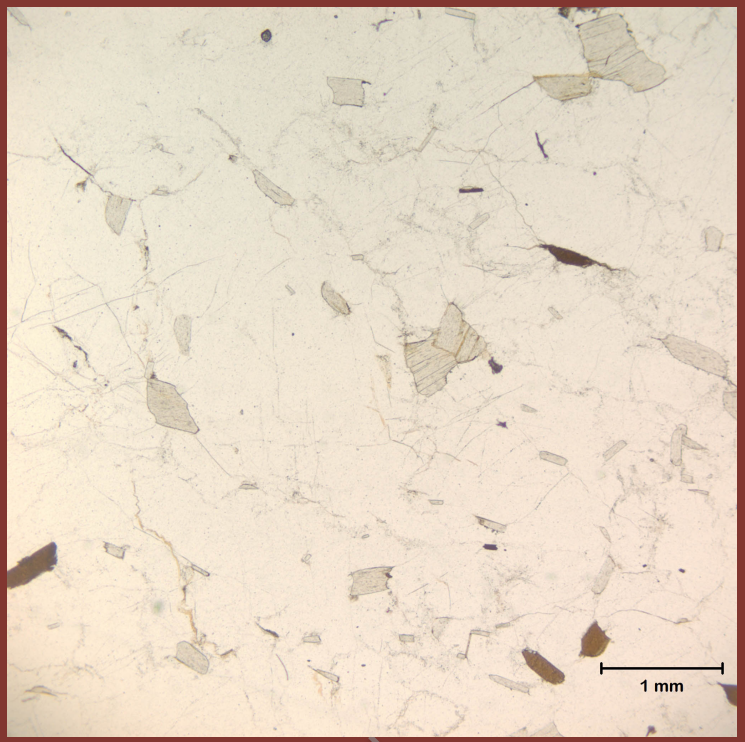
Neihart quartzite

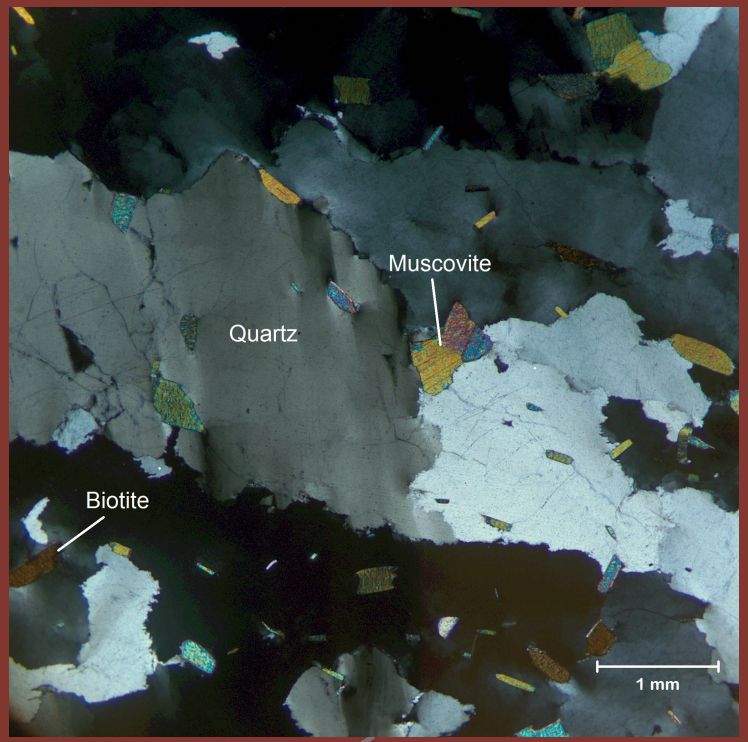
- Predates Belt deposition
- Dominant peak at 1.8 Ga
- Lack of non-North American input
- Smaller Neo- and Mesoarchean components
- Pure quartz arenite

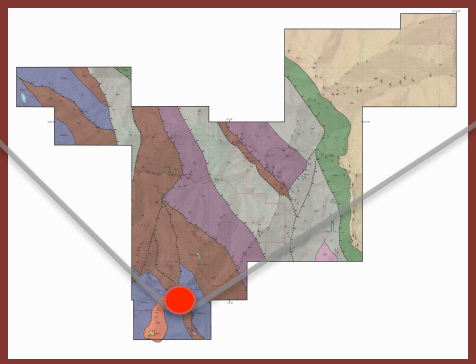


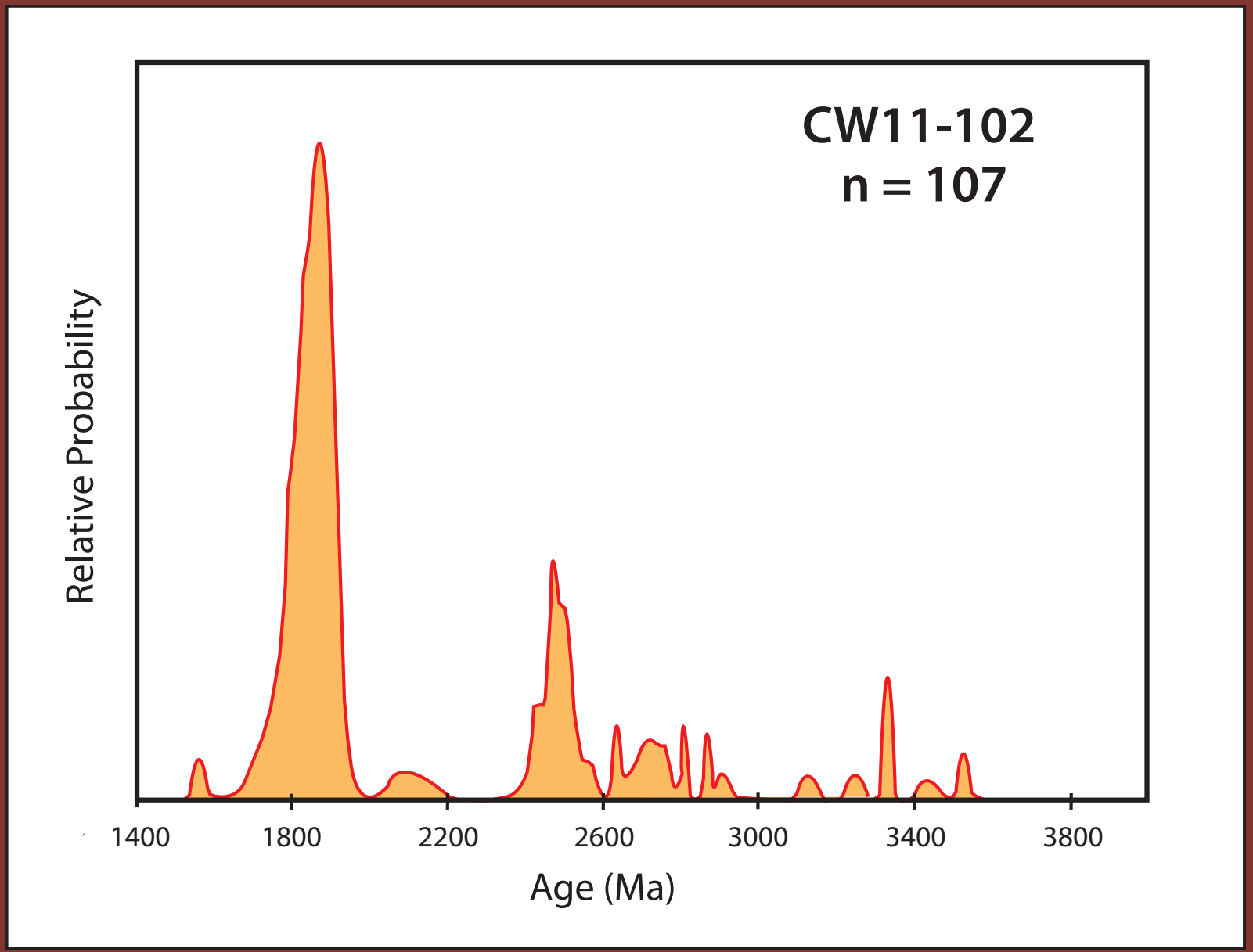
Modified after Ross and Villenueve (2003)

CW11-102





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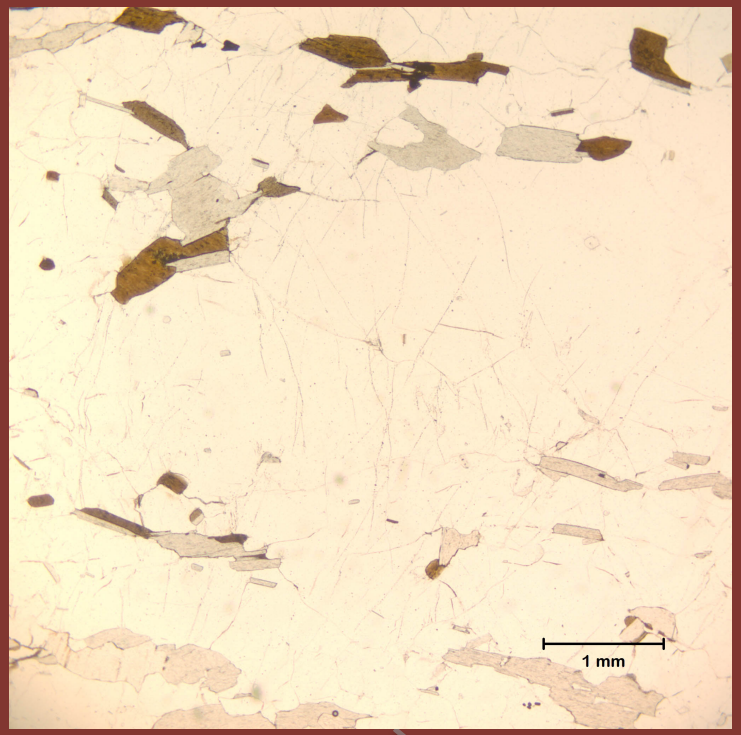
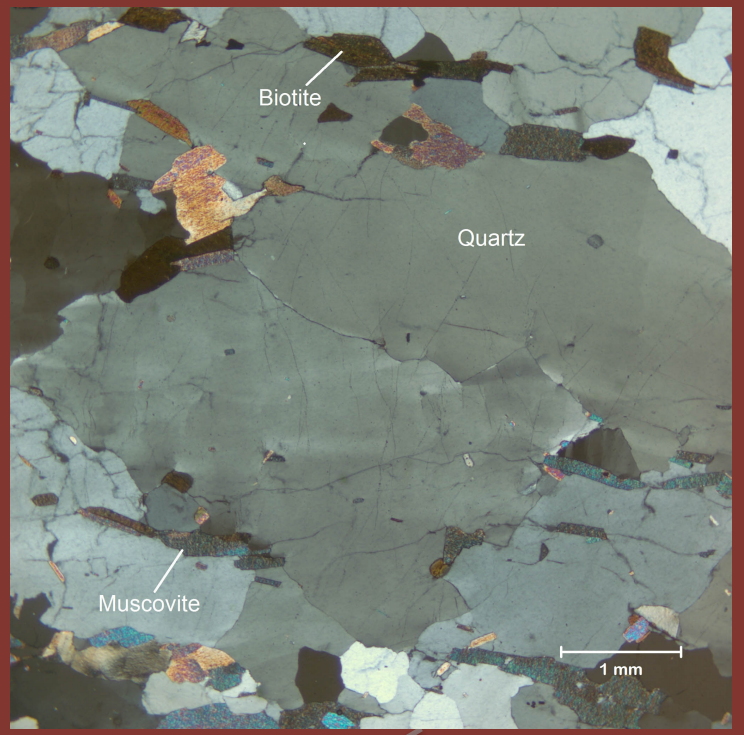
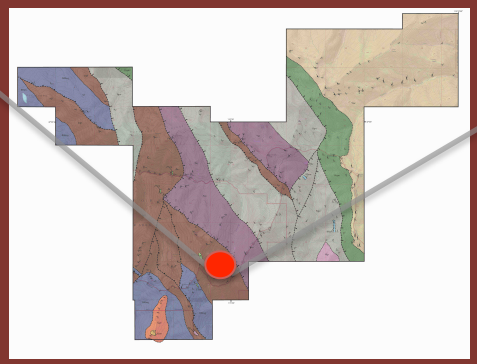
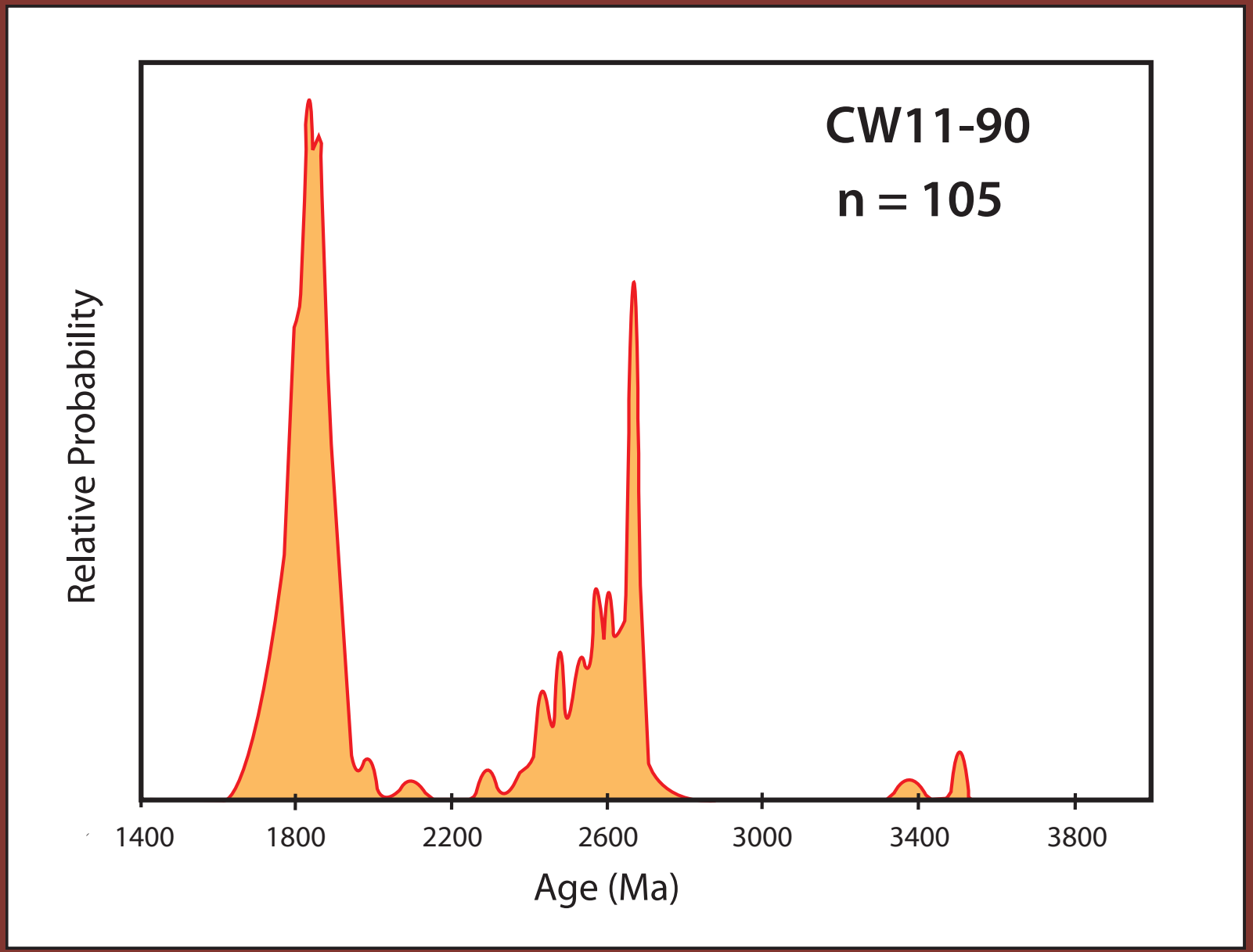
Relative Probability
1400
1800
2200
2600
3000
3400
3800
Age (Ma)

CW11-90








CW11-90
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Relative Probability
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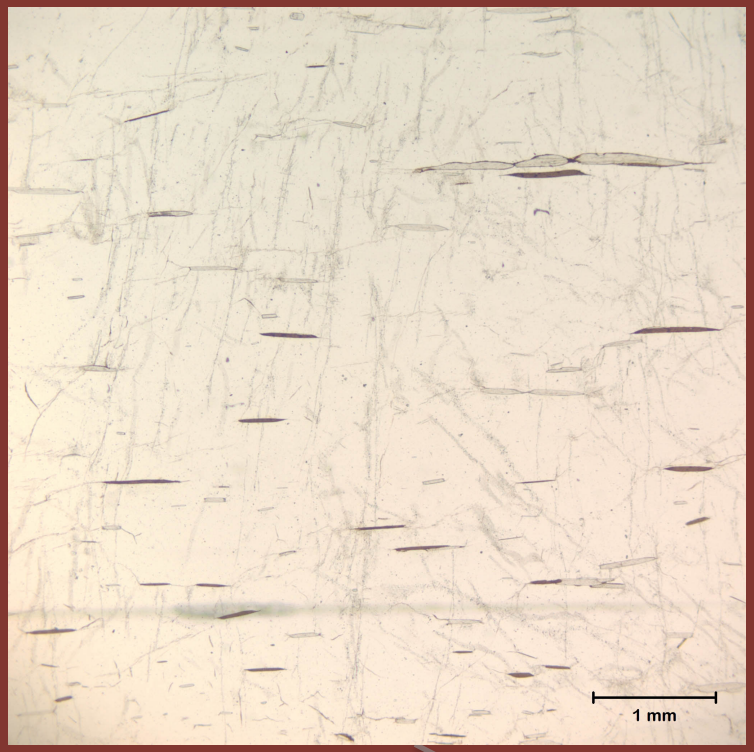
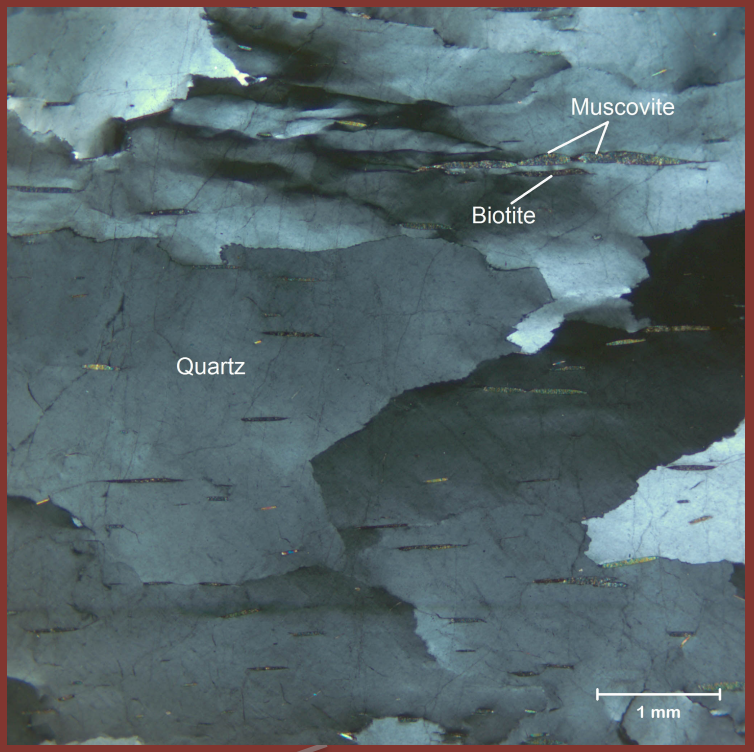
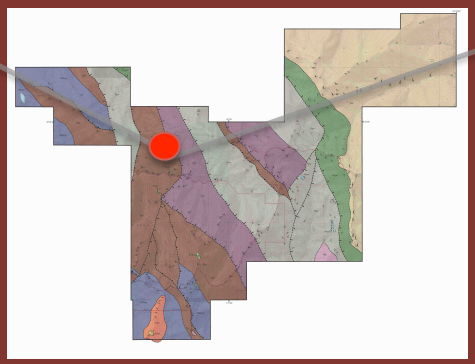
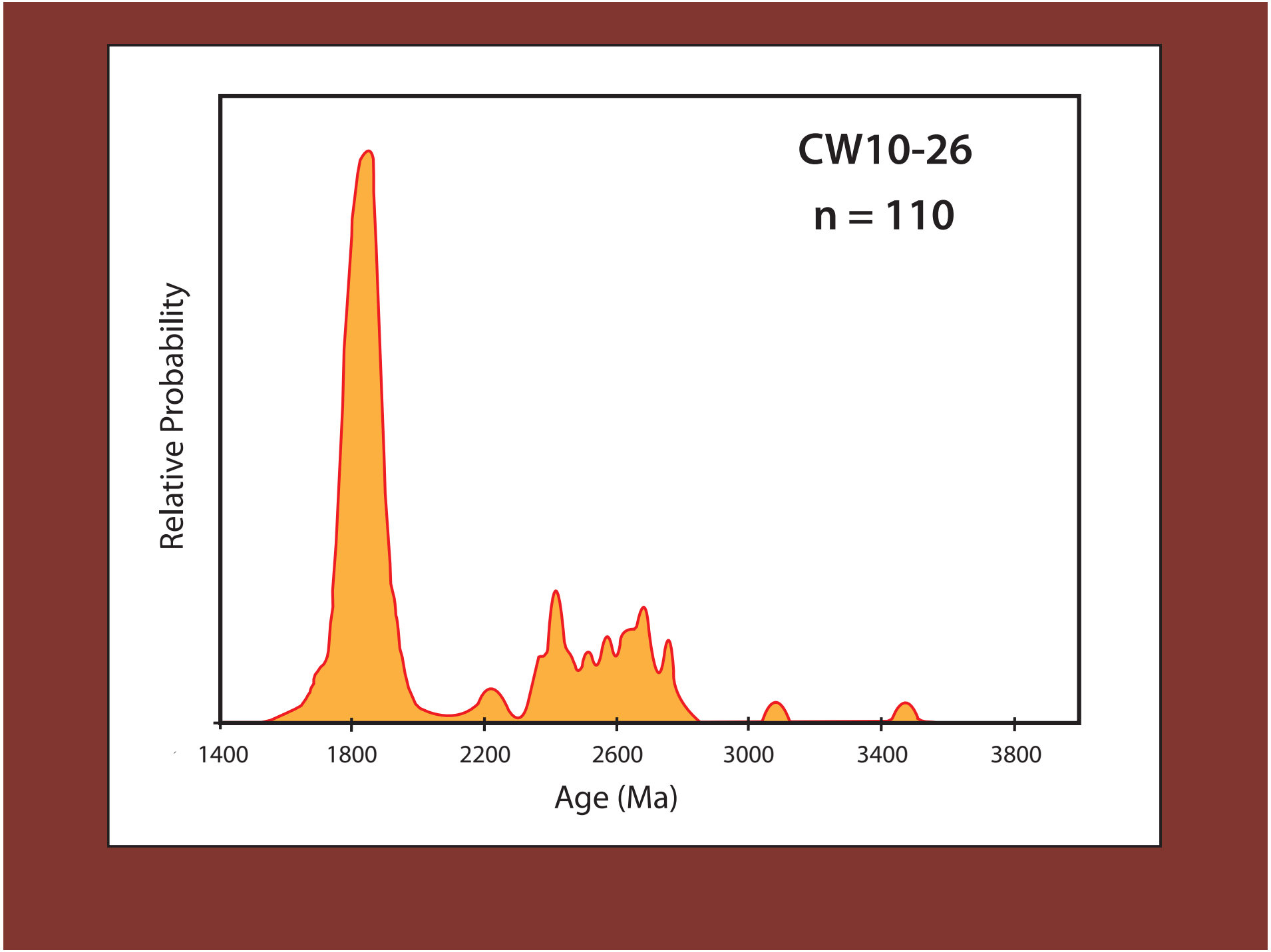
1800
2200
2600
3000
3400
3800
Age (Ma)

CW10-26








CW10-26
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Relative Probability
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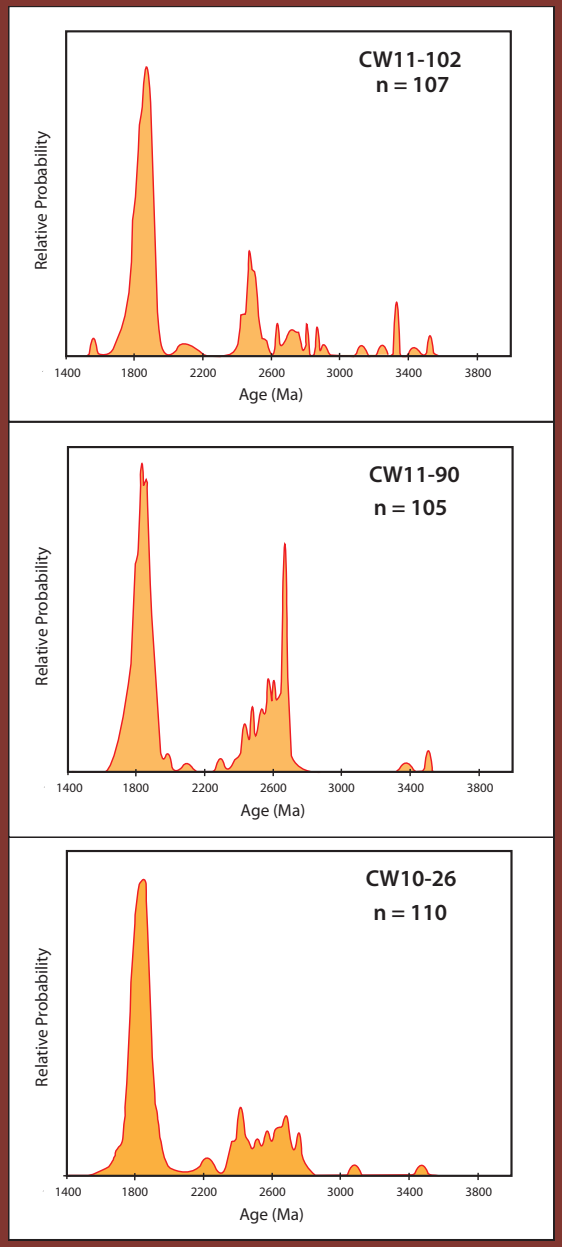
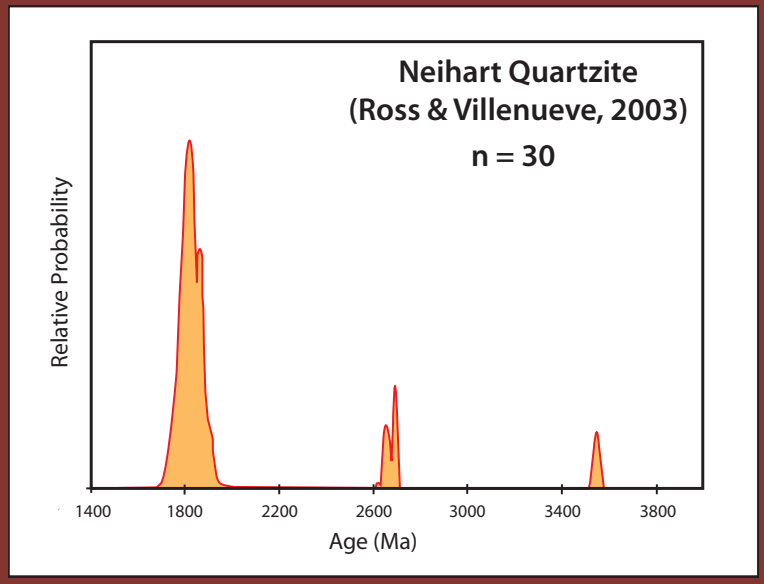
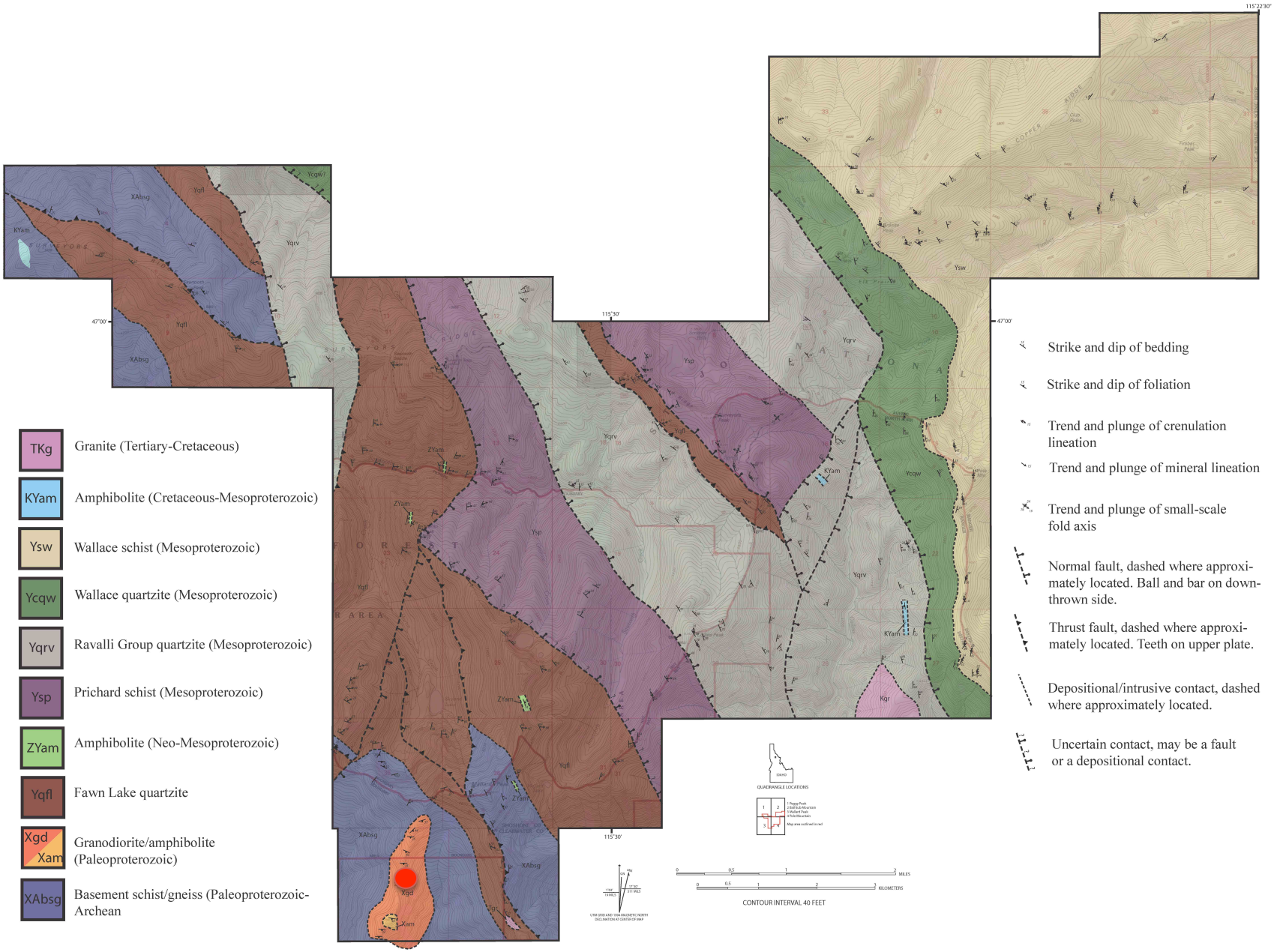
1800
2200
2600
3000
3400
3800
Age (Ma)



- Dominant population at ~1.8 Ga
- Smaller Paleoproterozoic – Mesoarchean component
- Lack of non-North American grains
- Predates Belt Supergroup
- Similar to other Pre-Belt quartzites in Clearwater and Priest River (Doughty and Chamberlain, 2007; Doughty et al., 2008)
- Correlates with Neihart quartzite (Pre-Belt)




TKg
Granite (Tertiary-Cretaceous)
KYam
Amphibolite (Cretaceous-Mesoproterozoic)
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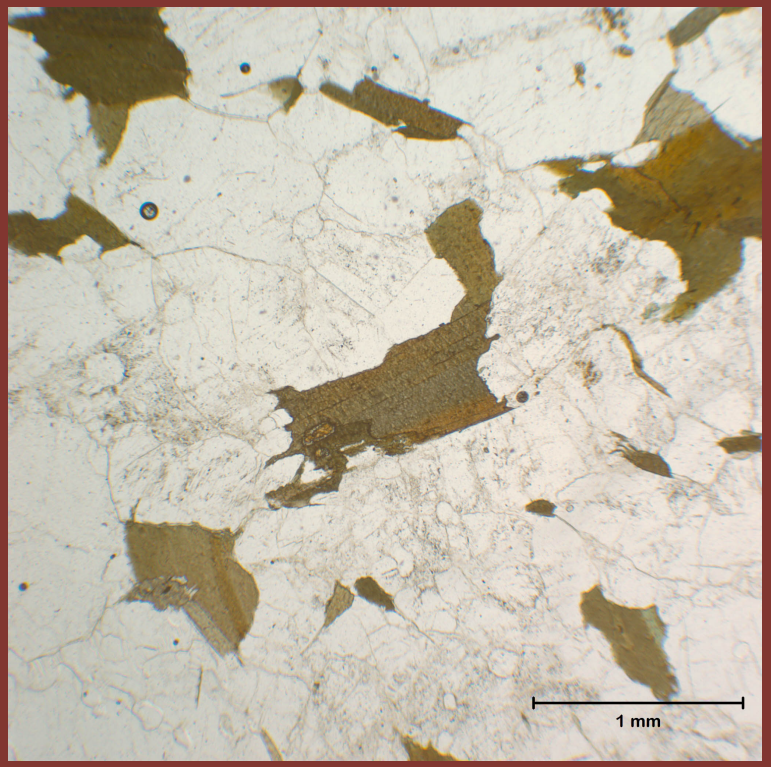
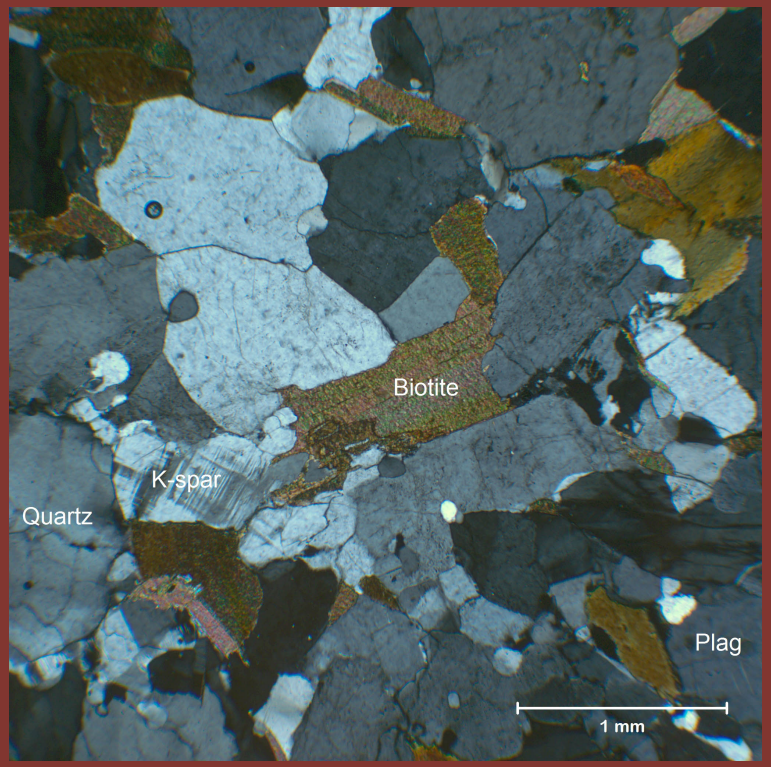
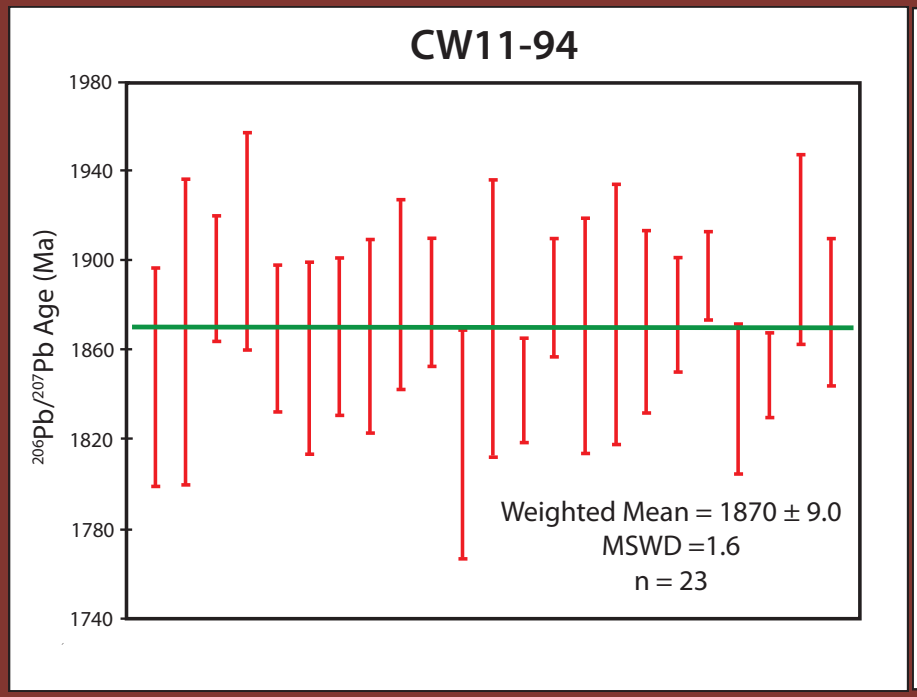
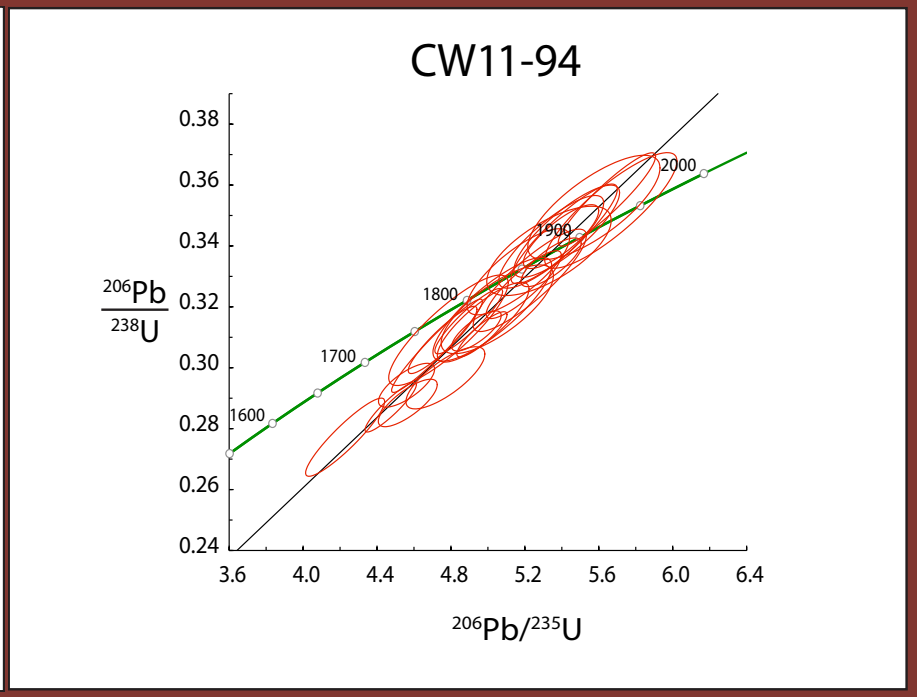
Wallace schist (Mesoproterozoic)
Ycqw
Wallace quartzite (Mesoproterozoic)
Yqrv
Ravalli Group quartzite (Mesoproterozoic)
Ysp
Prichard schist (Mesoproterozoic)
ZYam
Amphibolite (Neo-Mesoproterozoic)
Yqfl
Fawn Lake quartzite
Xgd
Xam
Granodiorite/amphibolite (Paleoproterozoic)
XAbsg
Basement schist/gneiss (Paleoproterozoic-Archean
Strike and dip of bedding
Strike and dip of foliation
Trend and plunge of crenulation lineation
Trend and plunge of mineral lineation
Trend and plunge of small-scale fold axis
Normal fault, dashed where approximately located. Ball and bar on downthrown side.
Thrust fault, dashed where approximately located. Teeth on upper plate.
Depositional/intrusive contact, dashed where approximately located.
Uncertain contact, may be a fault or a depositional contact.
115°22'30"
47°00'
115°30'
QUADRANGLE LOCATIONS
CONTOUR INTERVAL 40 FEET
MILES
KILOMETERS

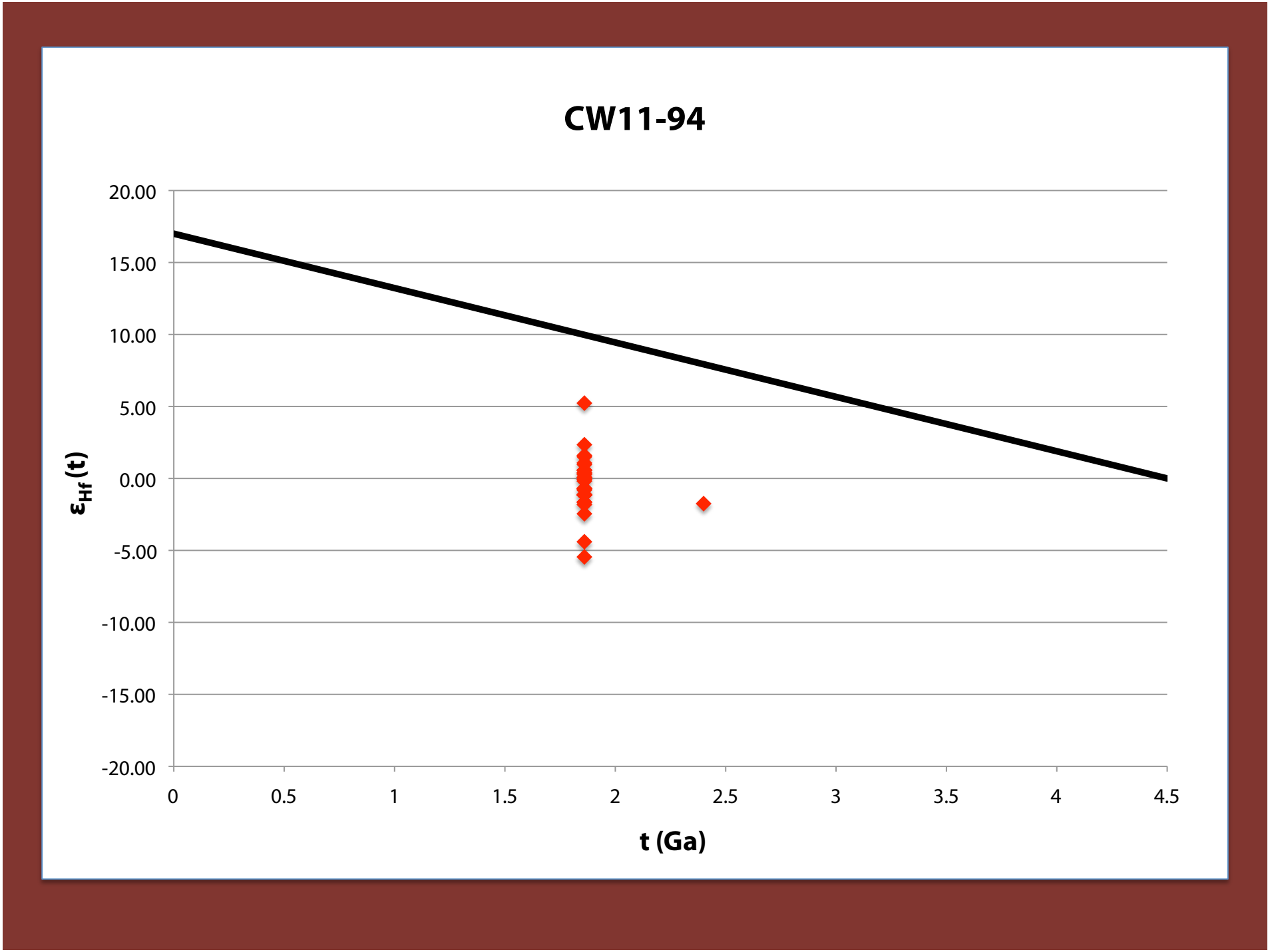

1 mm

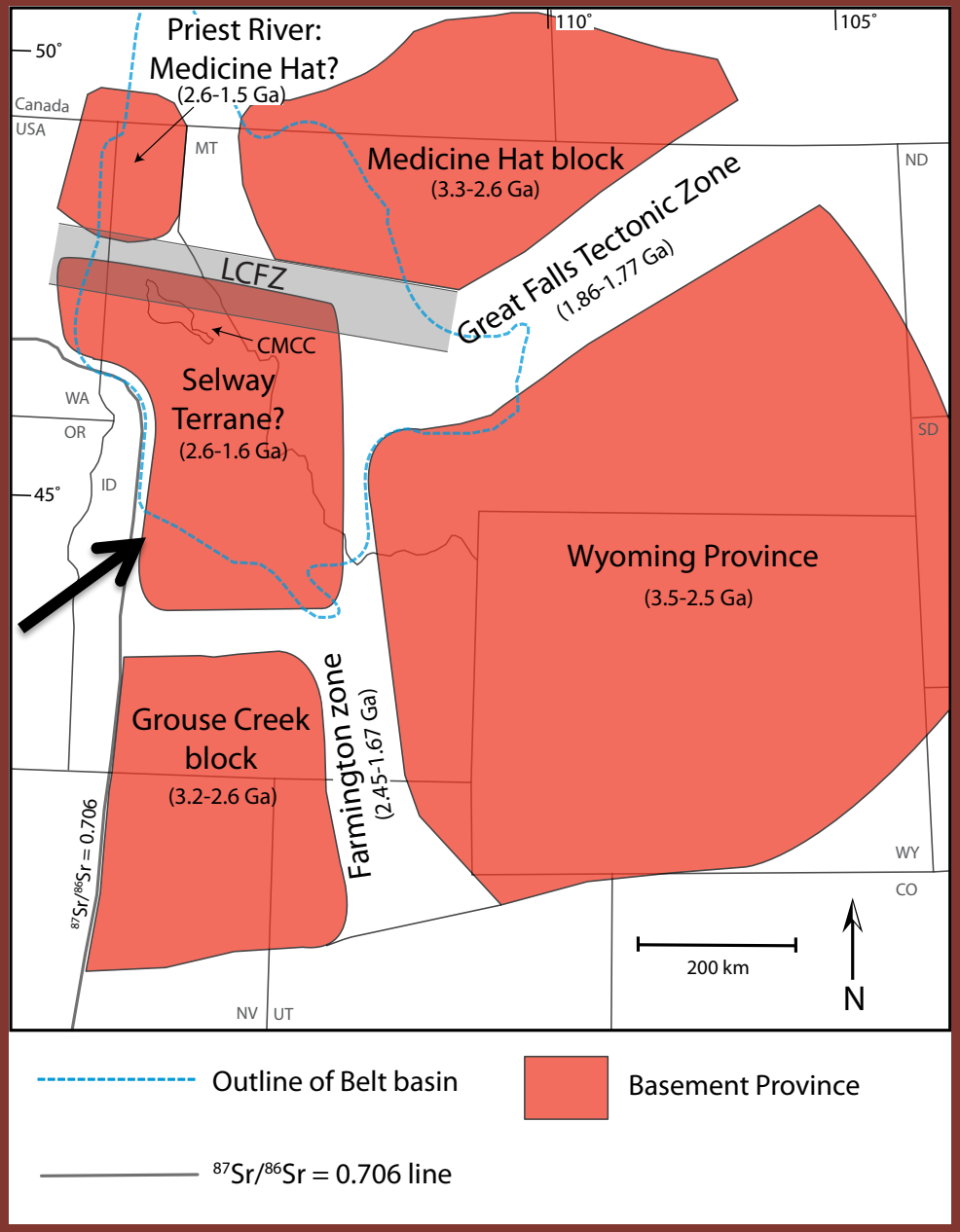

Biotite
K-spar
Quartz
Plag
1 mm


CW11-94
1980
1940
1900
1860
1820
1780
1740
206Pb/207Pb Age (Ma)
Weighted Mean = 1870 ± 9.0
MSWD =1.6
n = 23


CW11-94
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
206Pb/238U
1600
1700
1800
1900
2000
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4
206Pb/235U


60 µm


CW11-94
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
εHf(t)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
t (Ga)



Modified after Foster et al. (2006)

Conclusions

- Quartzite
  - Feldspar-poor – suggests arenite protolith
  - Dominant population at 1.8 Ga with smaller Neo- and Mesoarchean peaks
  - Correlated to Pre-Belt Neihart quartzite

- Orthogneiss
  - 1.87 Ga - similar in age to other orthogneiss in:
    - Clearwater (e.g. Jansen et al., 2011)
    - Little Belt Mtns. magmatic arc in GFTZ (Mueller et al., 2004)
  - Zircon Hf: Two magma sources – 1) mantle and 2) juvenile Paleoproterozoic (2.0-2.5 Ga) crust

Acknowledgements

- This project was funded by:
  - Belt Association
  - Colorado Scientific Society
  - USGS EDMAP
  - GSA Foundation
  - Tobacco Root Geological Society
- Special recognition to Don Winston and Chelsea Ward-Waller