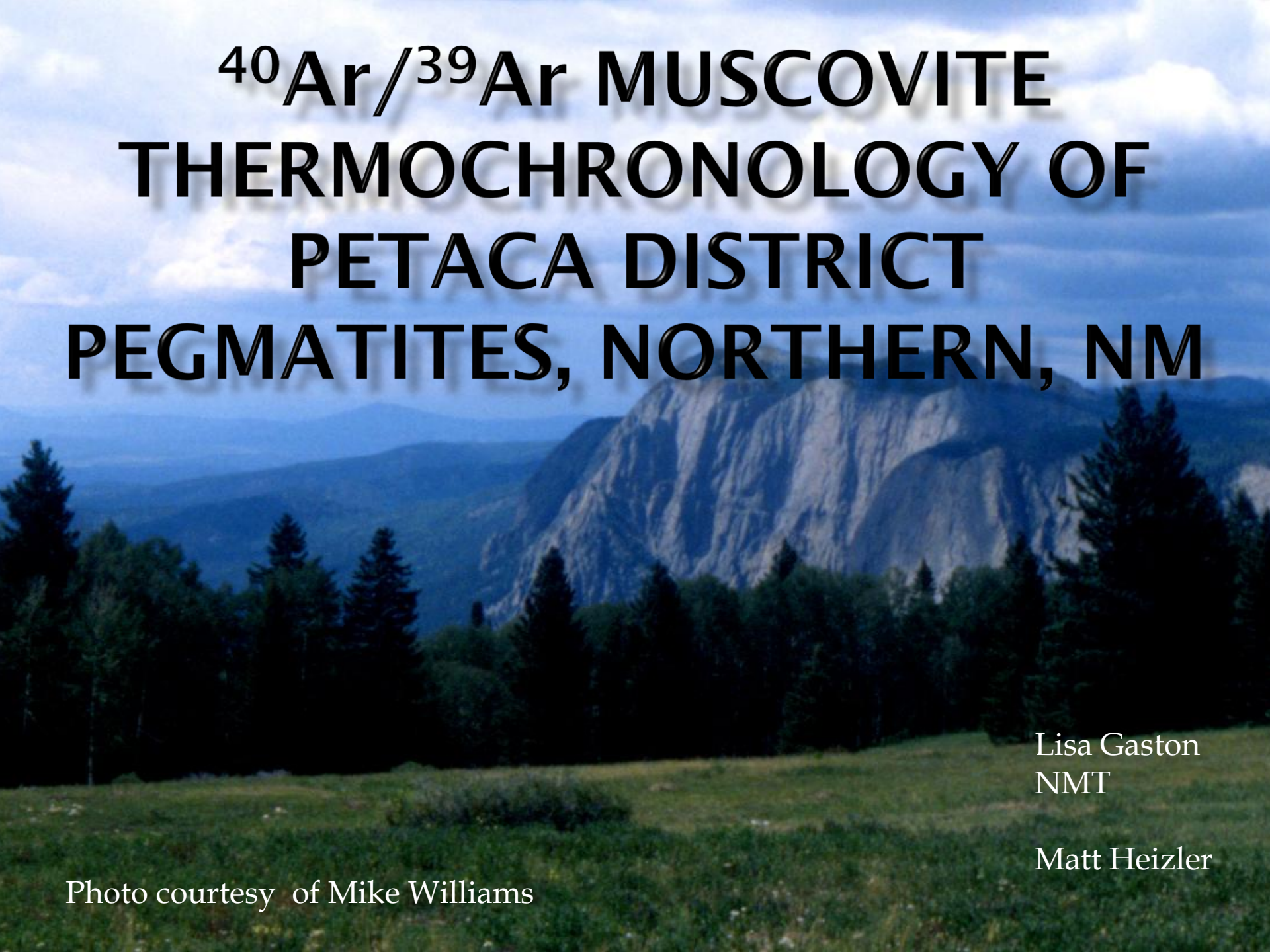
$^{40}Ar/^{39}Ar$ MUSCOVITE THERMOCHRONOLOGY OF PETACA DISTRICT PEGMATITES, NORTHERN, NM



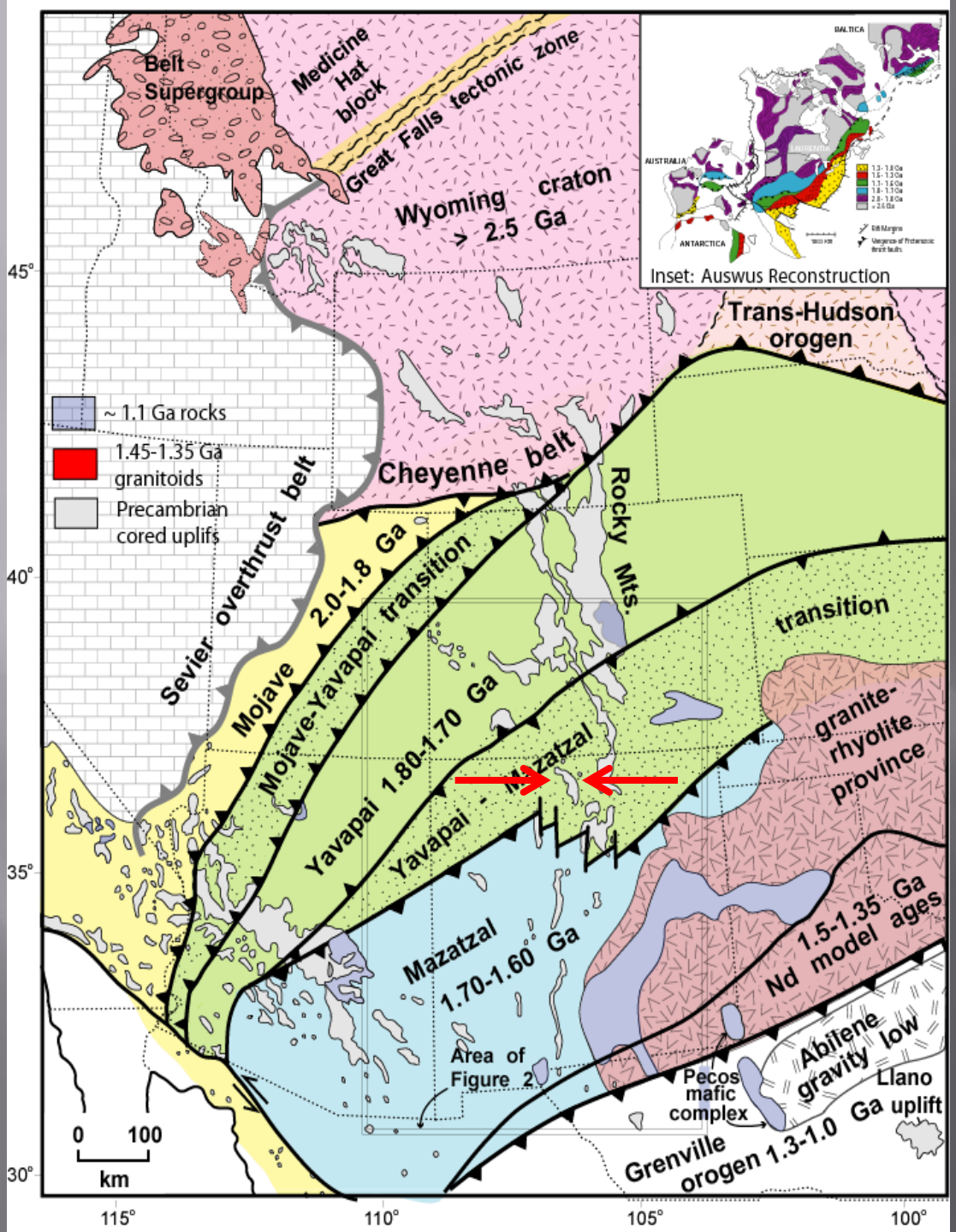
Lisa Gaston
NMT

Matt Heizler

Photo courtesy of Mike Williams

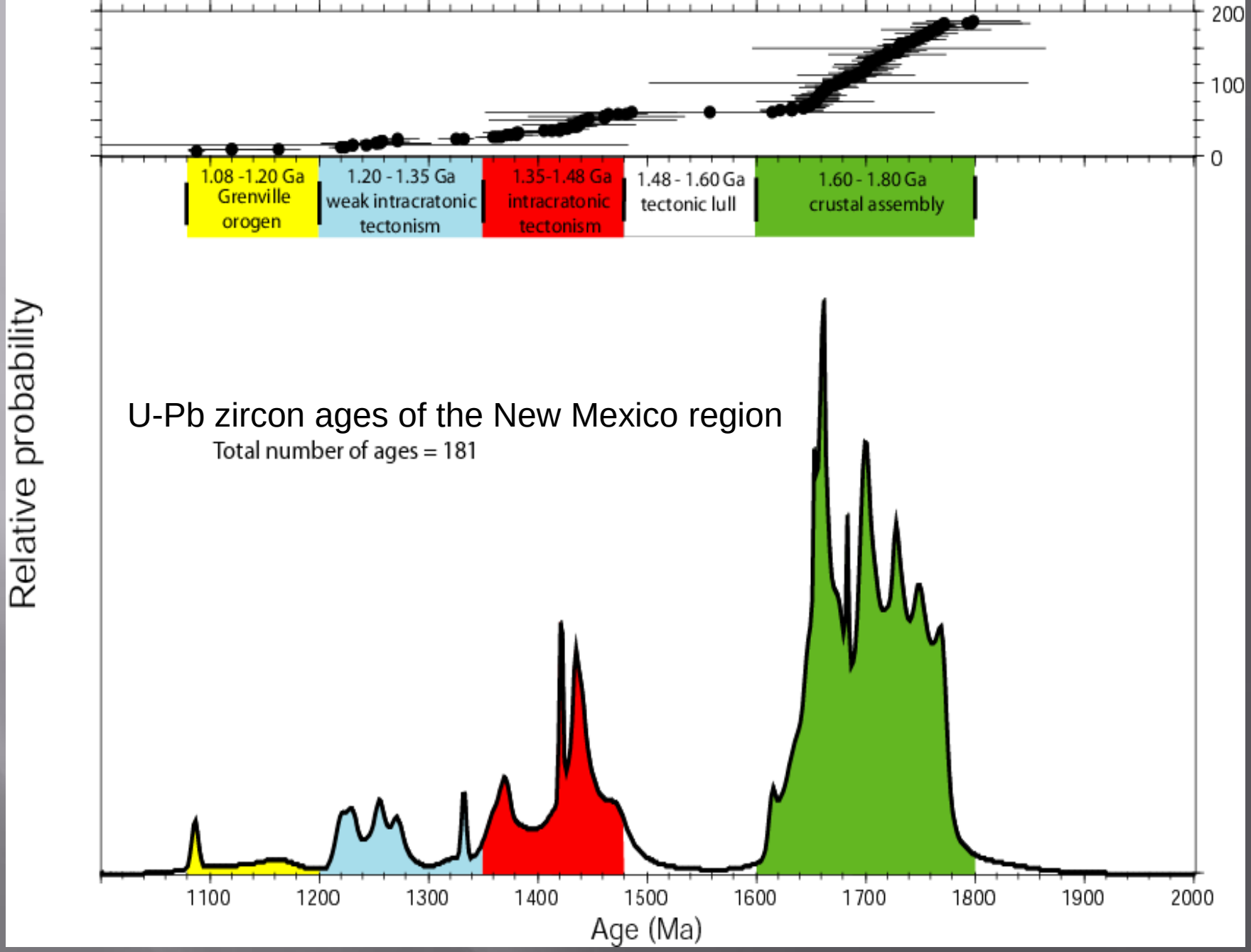
Outline

- Precambrian Geology
- Field Area
- $^{40}Ar/^{39}Ar$ results
- Do the pegmatites record intrusion ages?
- Conclusions
- Future work



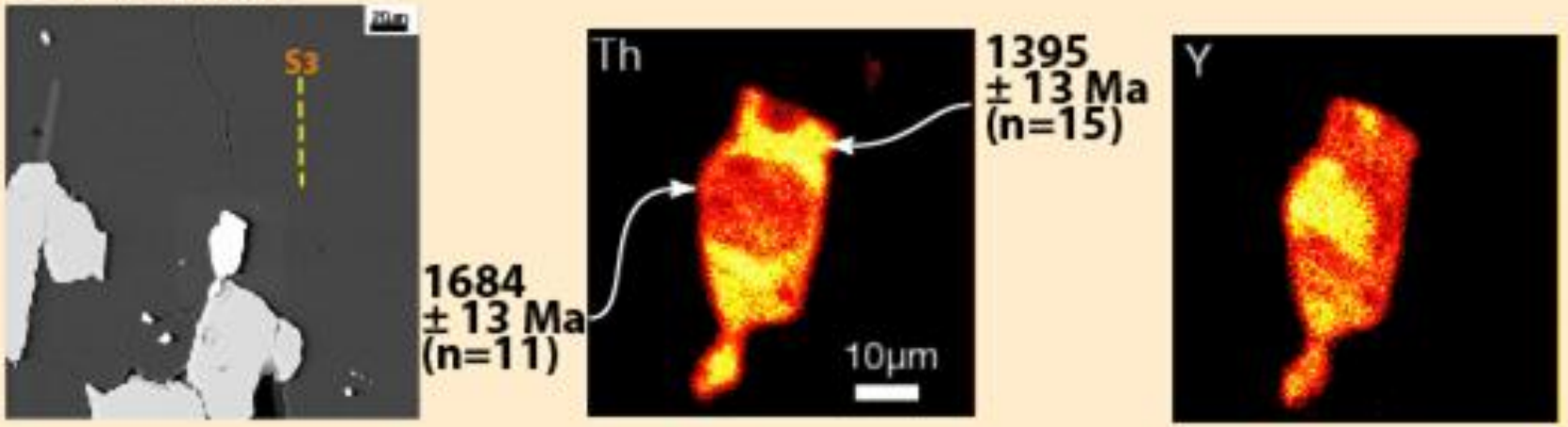
Precambrian provinces of the Southwest

Karlstrom 2004



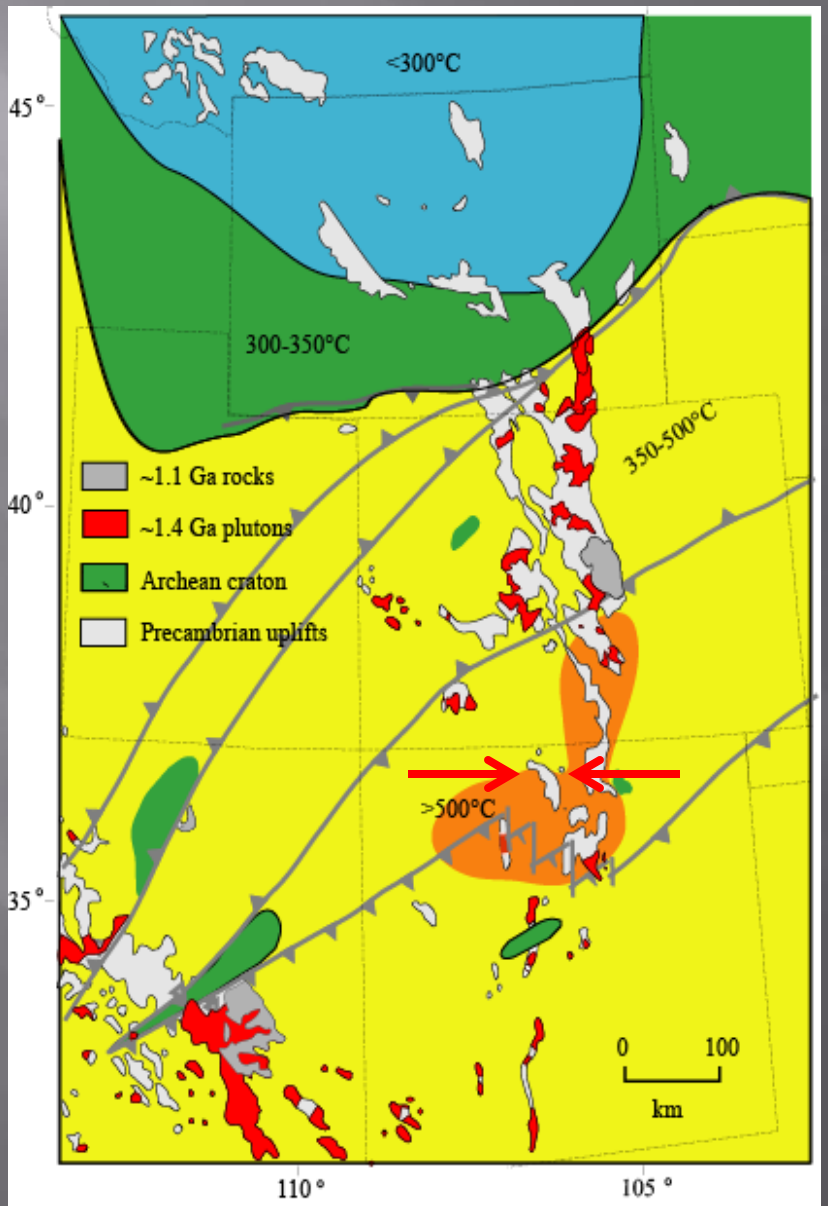
Karlstrom 2004

Monazite Dating

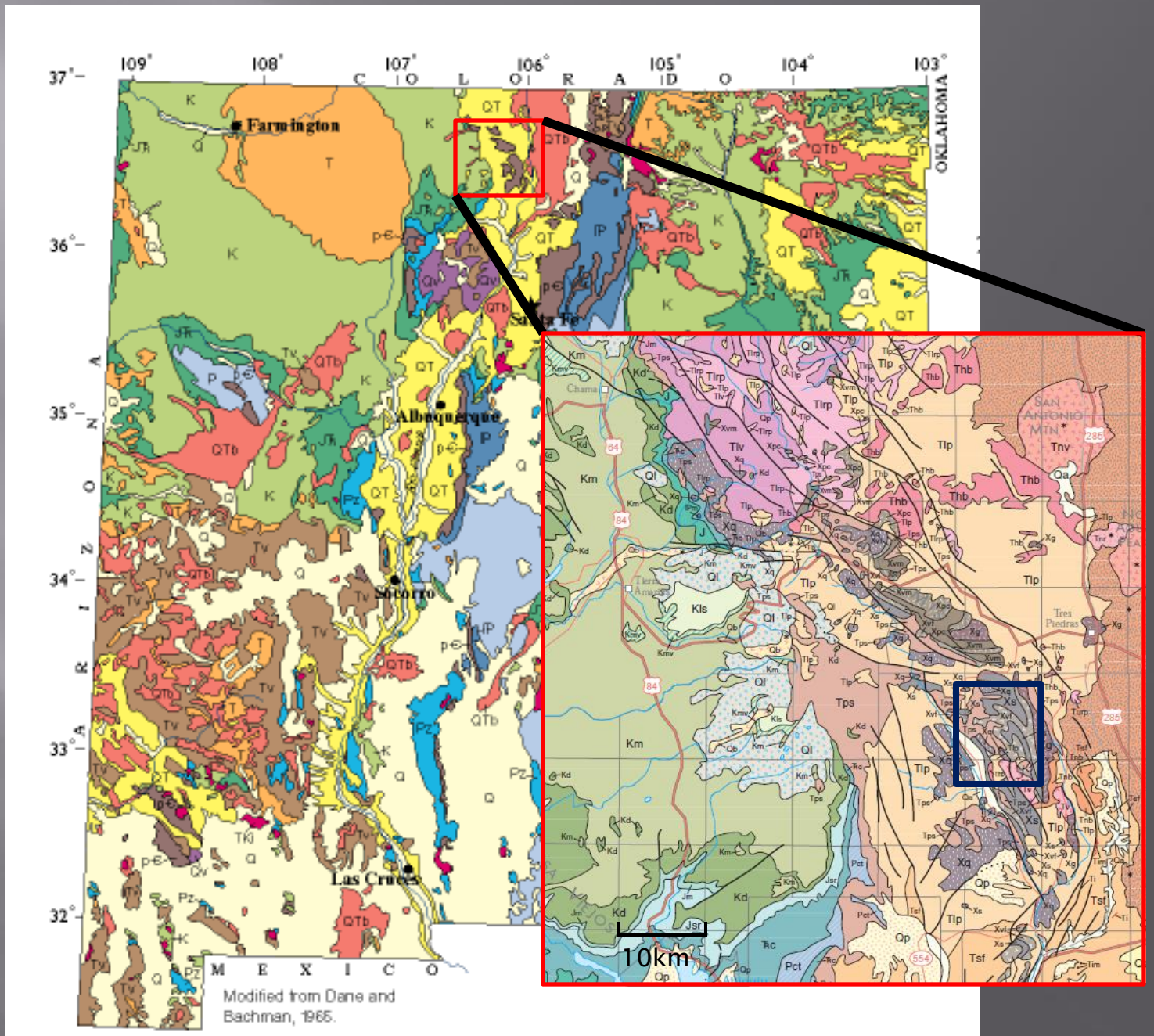


Williams

Thermal Map at 1.4 Ga

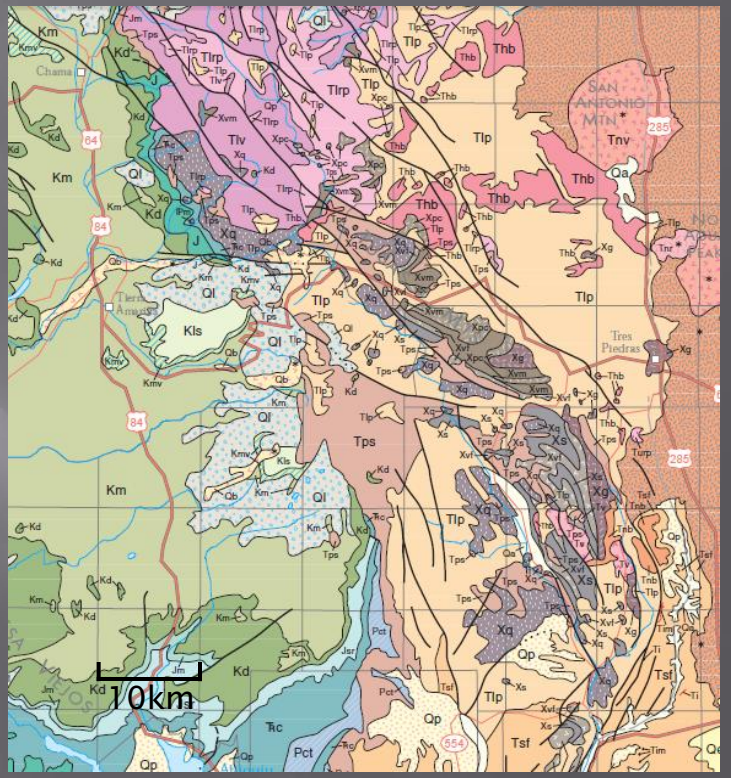


Shaw 2005


109°
108°
107°
106°
105°
104°
103°
37°
36°
35°
34°
33°
32°
COLORADO
OKLAHOMA
NEW MEXICO
MEXICO
Farmington
Albuquerque
Socorro
Las Cruces
Santa Fe
10km
Modified from Dane and Bachman, 1965.

Field Area

- Mining
  - Sheet and scrap mica
  - 250,000 lbs



Field Area

- Mining (1870-1945)
  - Sheet and scrap mica
  - 250,000 lbs
- Rare Earth Elements

Field Area

- Mining (1870-1945)
  - Sheet and scrap mica
  - 250000 lbs
- REE
- Pegmatites with large muscovites

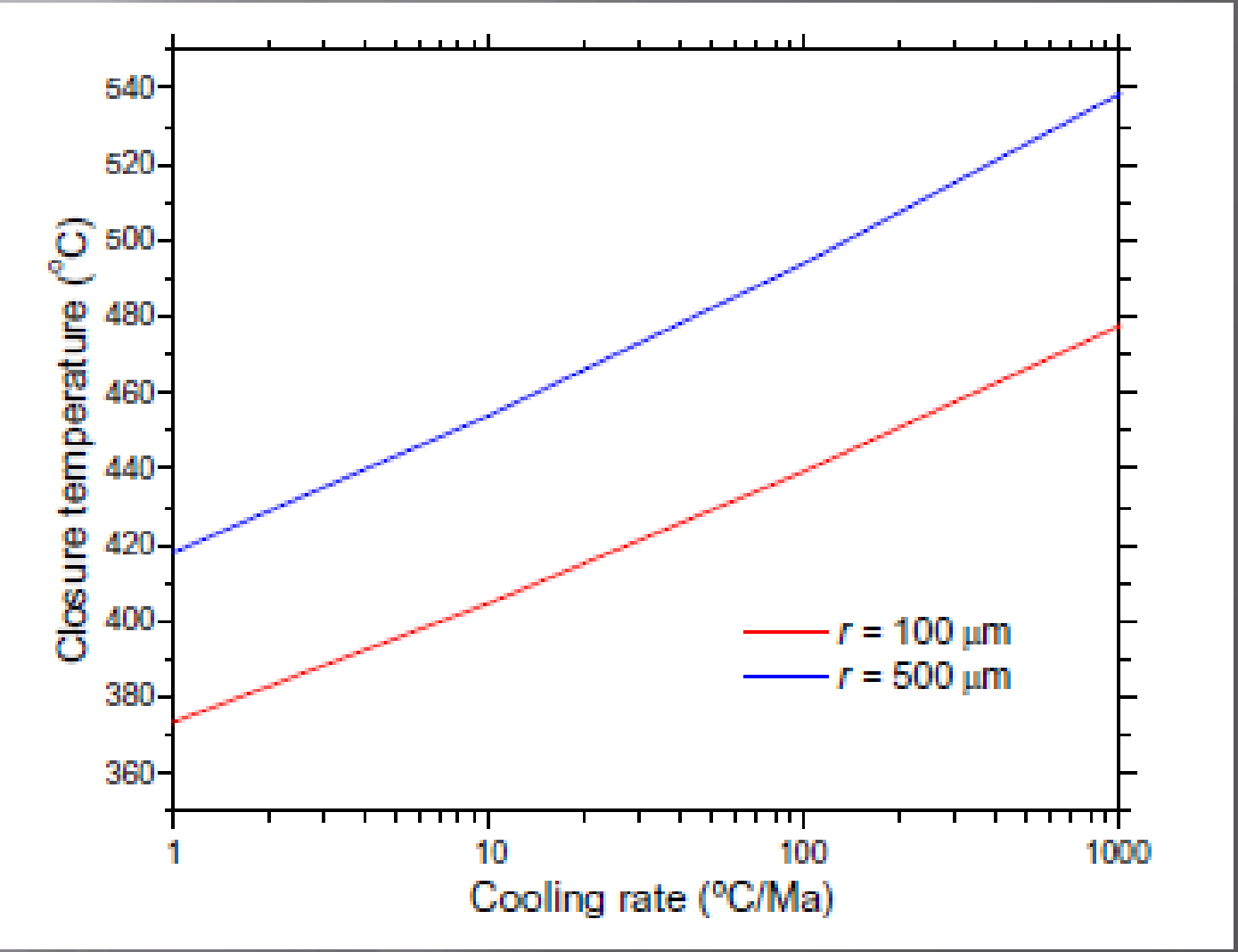
Field Area

- Mining (1870-1945)
  - Sheet and scrap mica
  - 250000 lbs
- REE
- Pegmatites with large muscovites
- Country rock schist

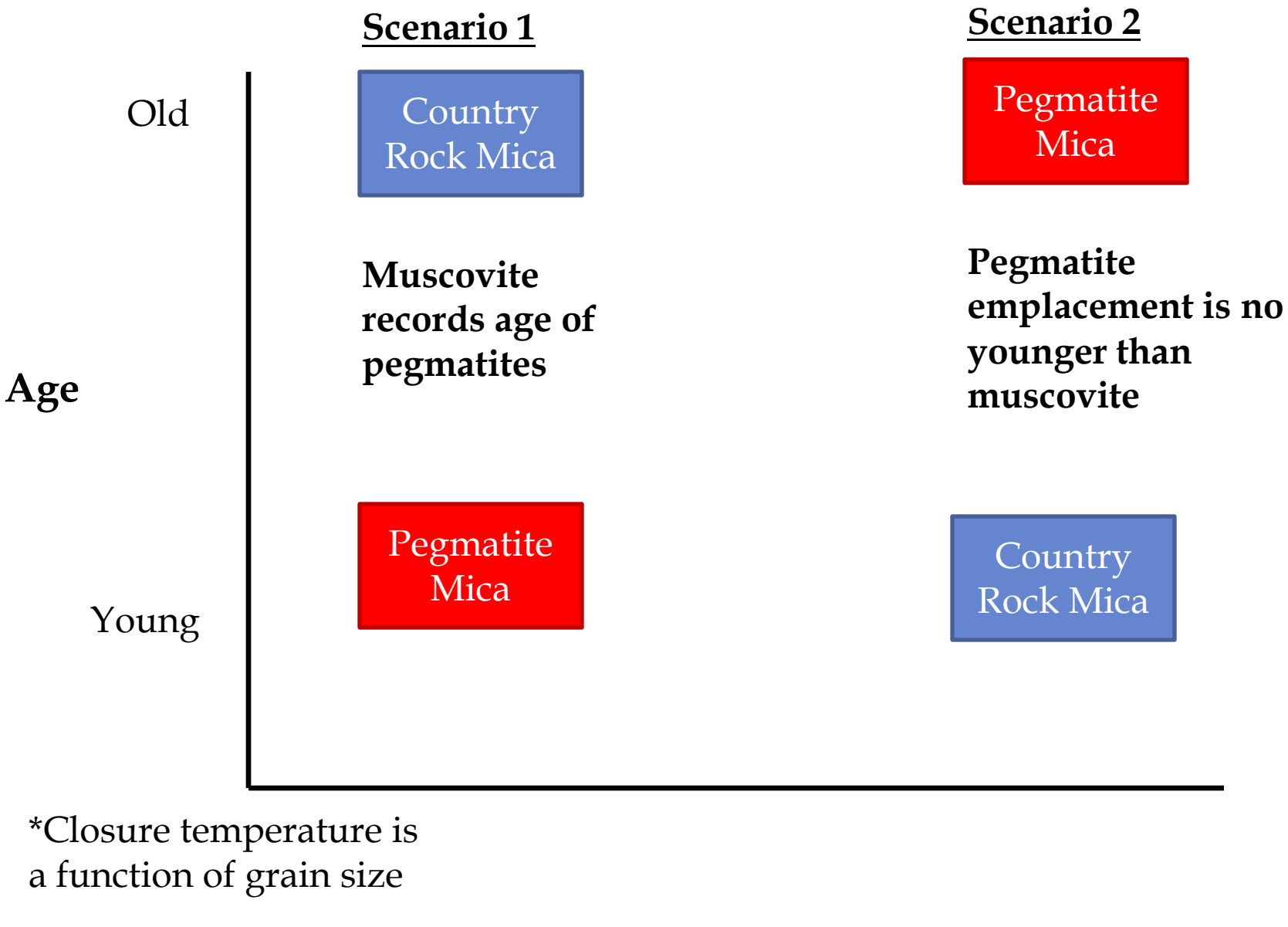
Hypothesis

- Because coarse muscovite from pegmatites have a high argon closure temperature (>400˚C) the muscovite age may record the intrusion age of the pegmatites

- To test this hypothesis we compare ages of coarse-grained muscovite to ages of finer grained muscovite within the metamorphic host rocks

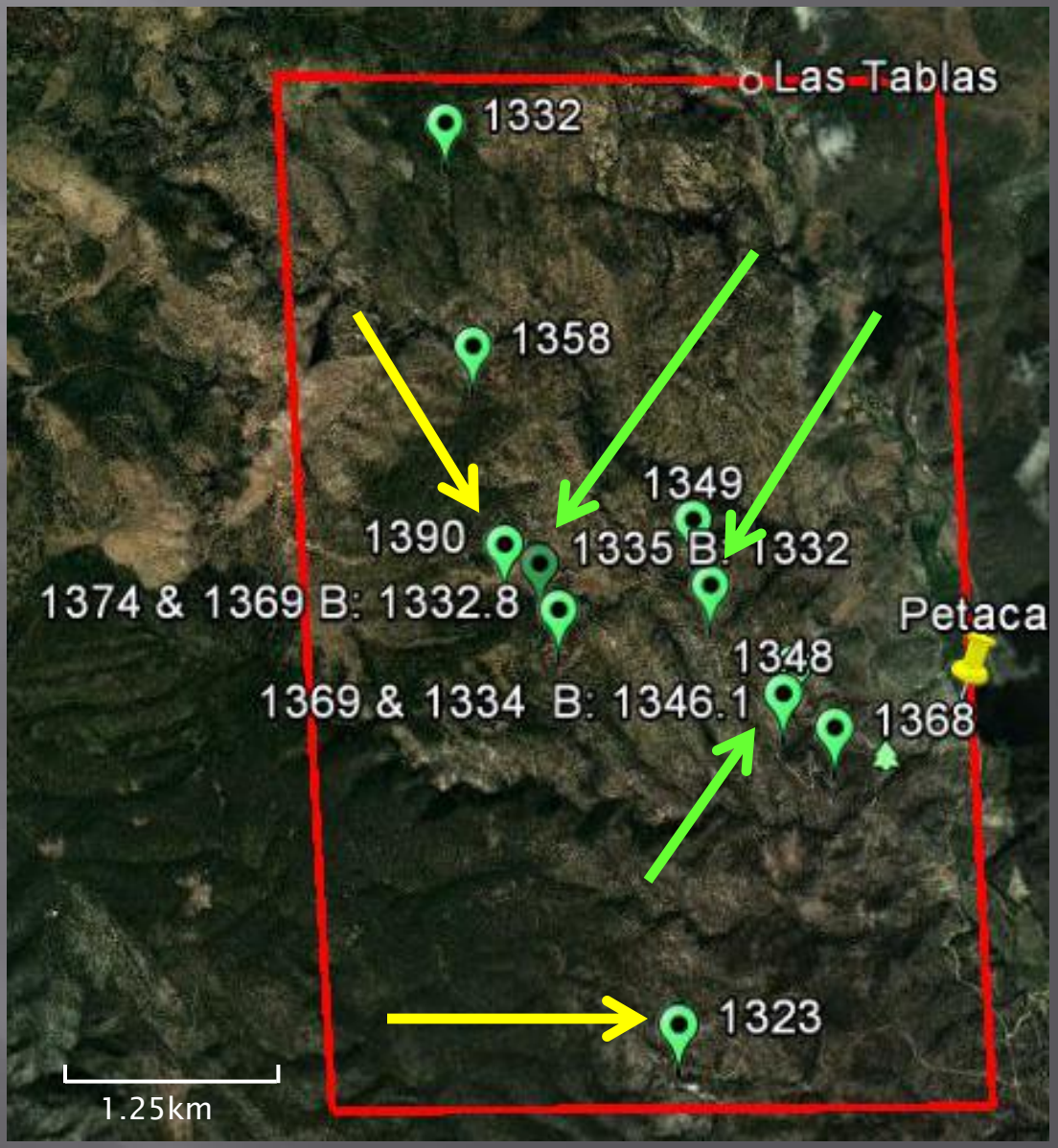


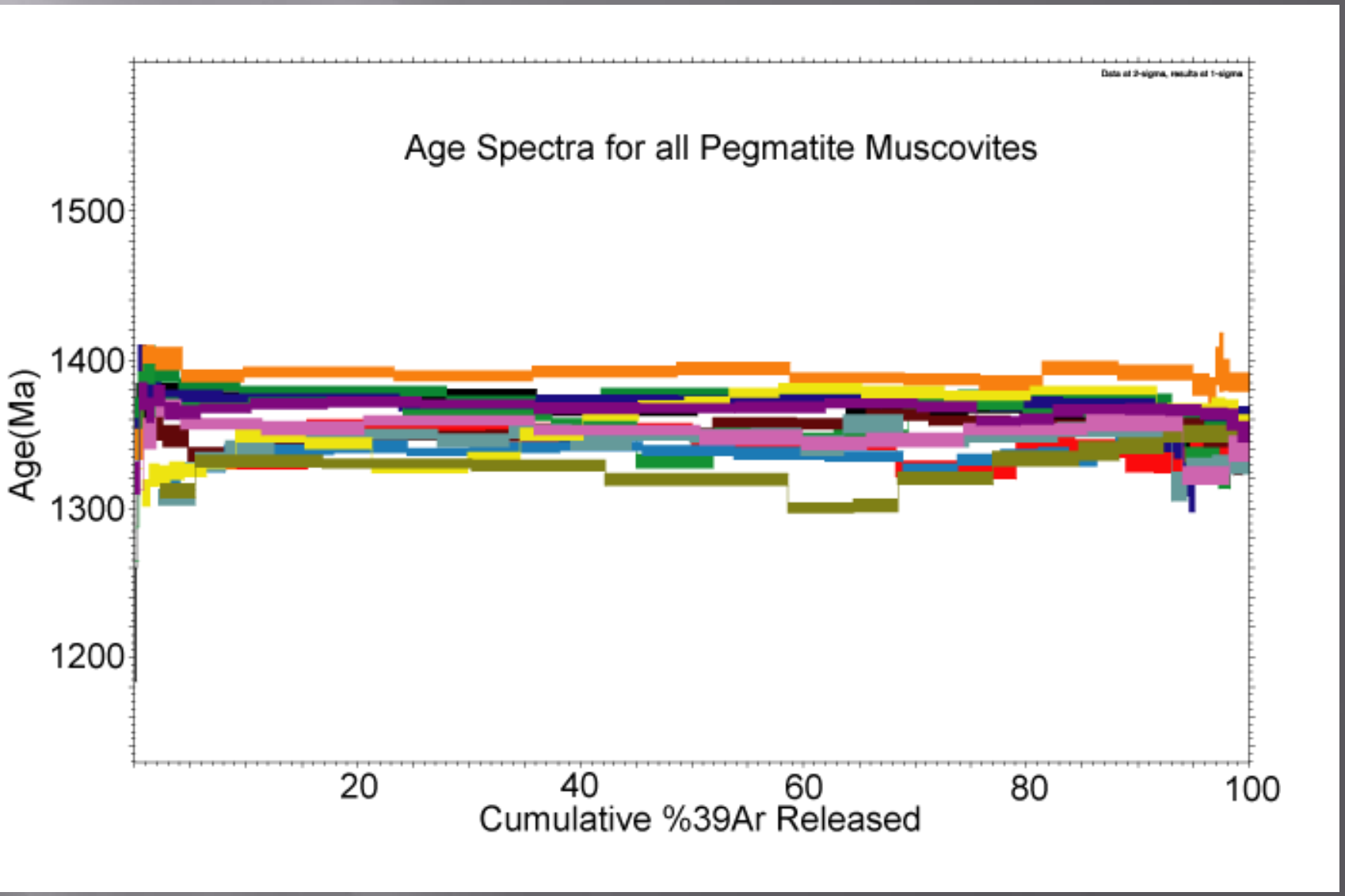
Harrison et al., 2009

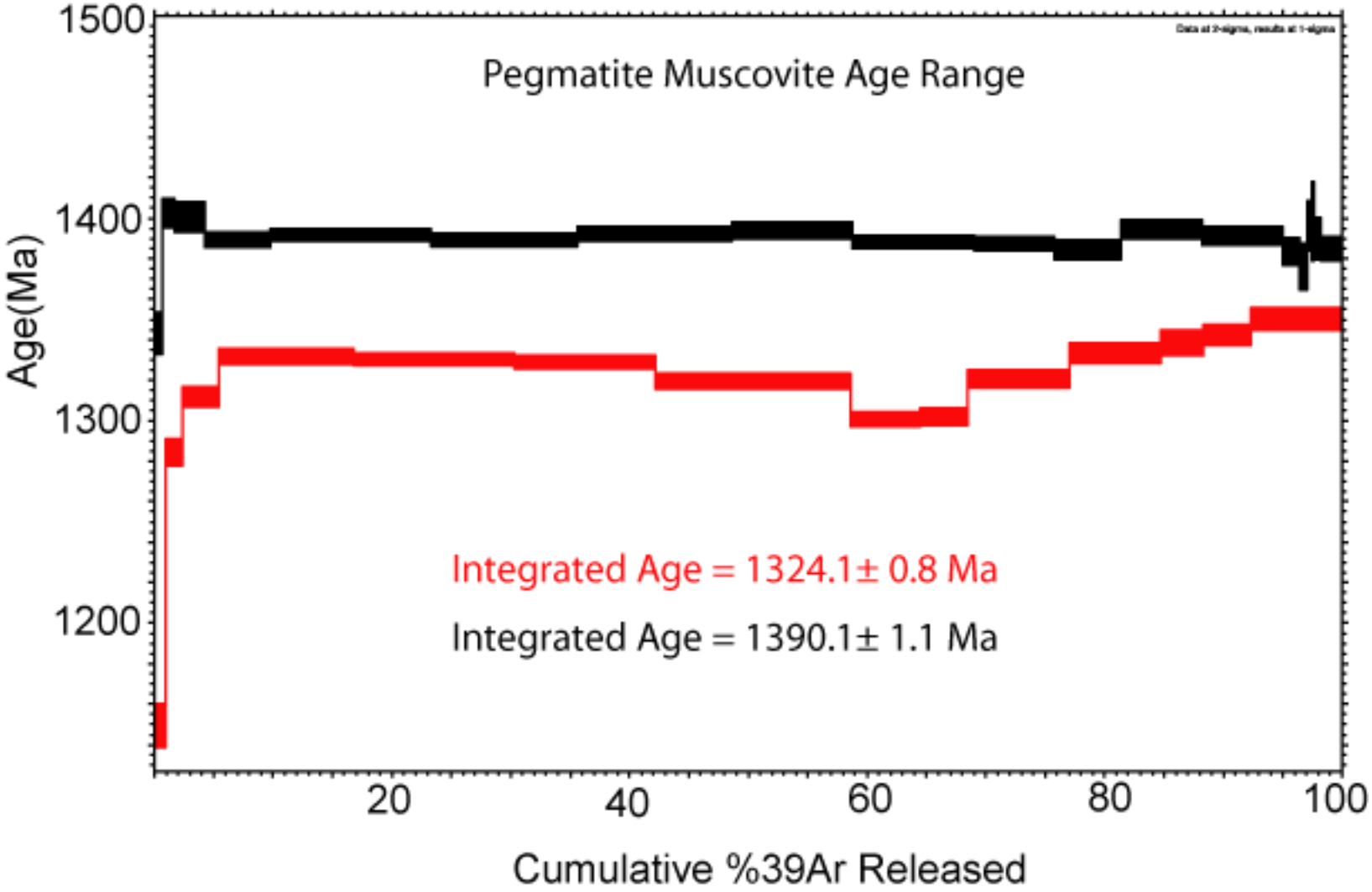


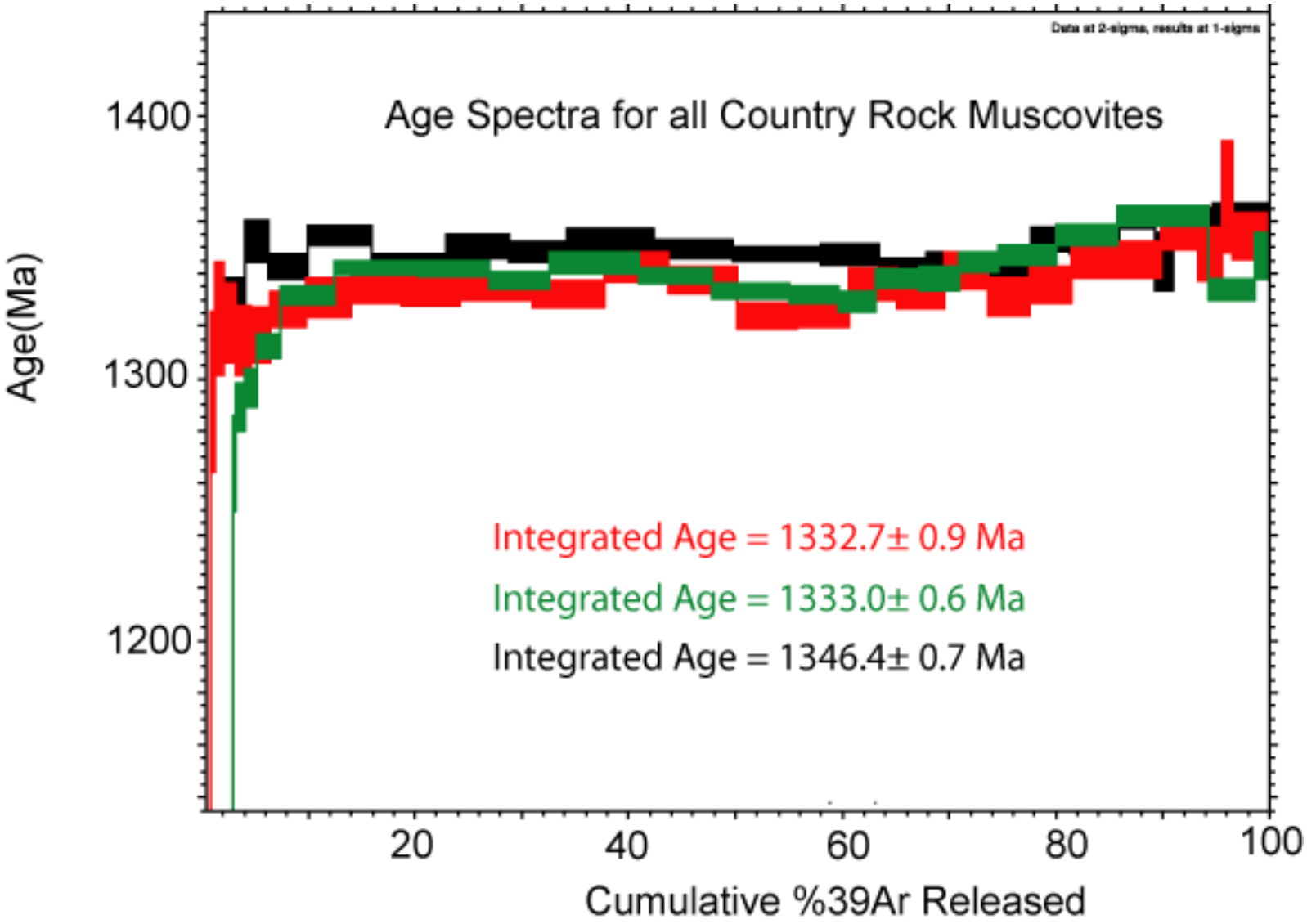
*Closure temperature is a function of grain size

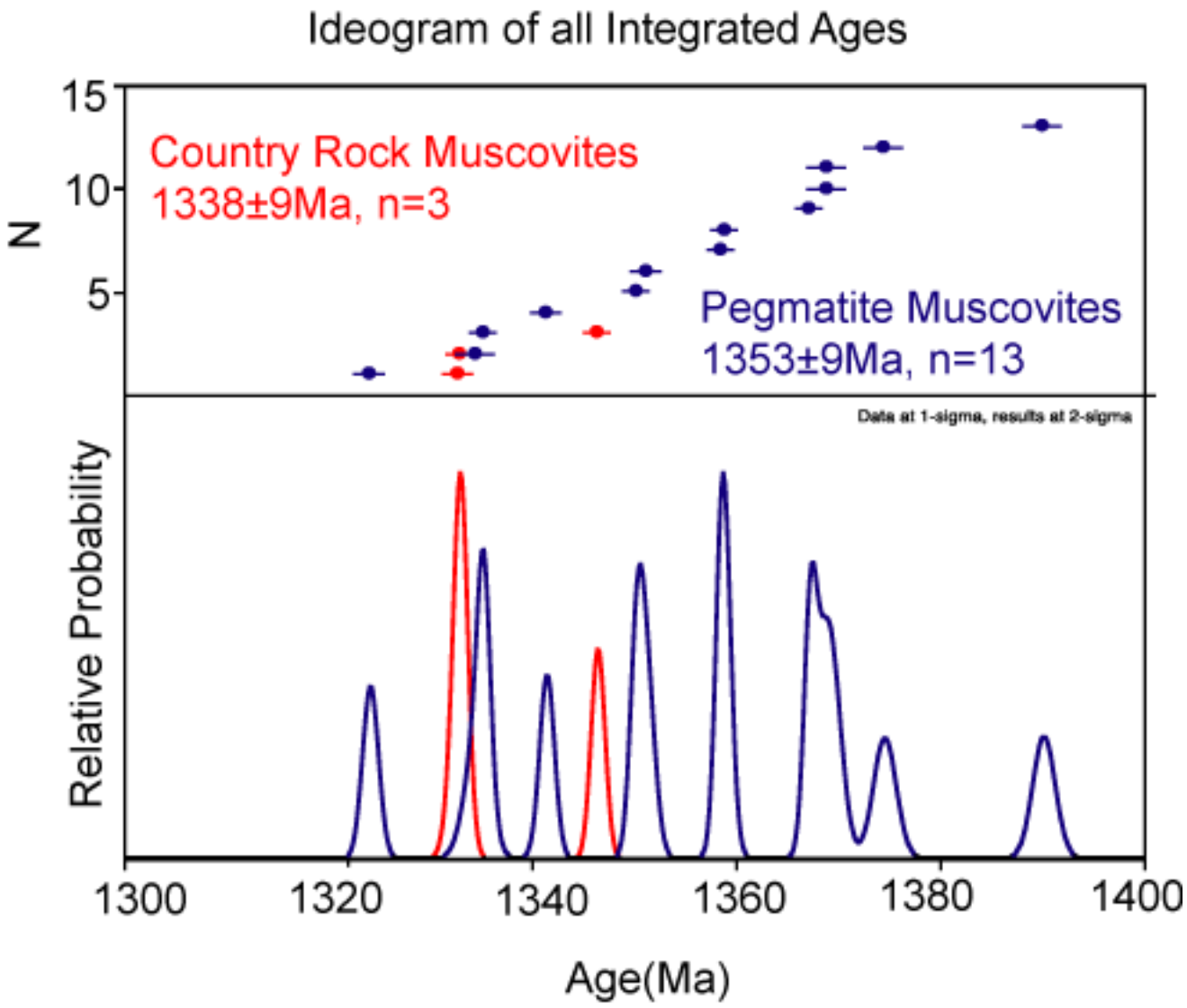
- 16 Samples
  - 13 Pegmatite
  - 3 Country Rock



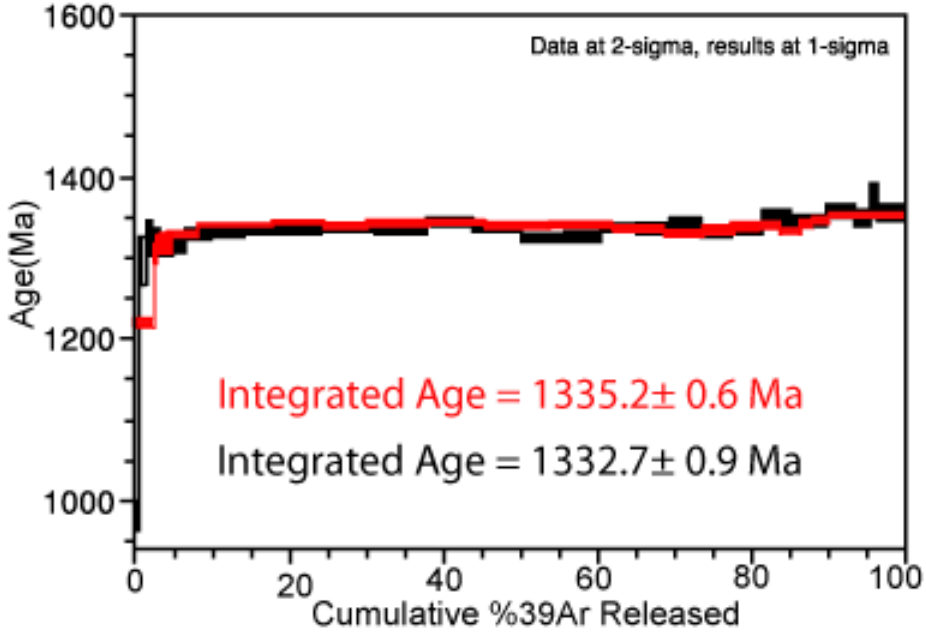

Age Spectra for all Pegmatite Muscovites
1500
1400
1300
1200
Age(Ma)
20
40
60
80
100
Cumulative %39Ar Released


Pegmatite Muscovite Age Range
Age(Ma)
1500
1400
1300
1200
Integrated Age = 1324.1± 0.8 Ma
Integrated Age = 1390.1± 1.1 Ma
20
40
60
80
100
Cumulative %39Ar Released


Data at 2-sigma, results at 1-sigma
Age Spectra for all Country Rock Muscovites
1400
1300
1200
Age(Ma)
Integrated Age = 1332.7± 0.9 Ma
Integrated Age = 1333.0± 0.6 Ma
Integrated Age = 1346.4± 0.7 Ma
20
40
60
80
100
Cumulative %39Ar Released

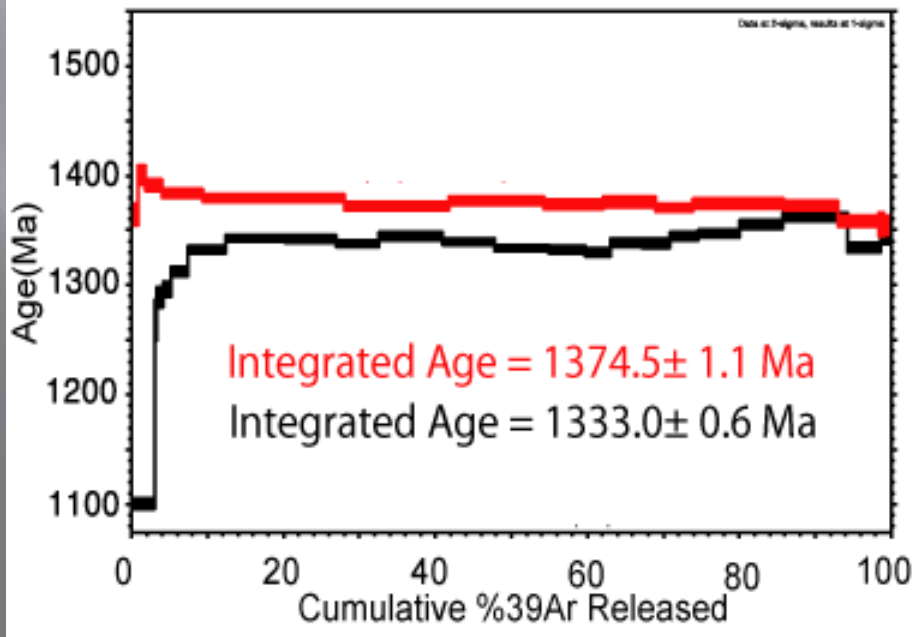

Ideogram of all Integrated Ages
Country Rock Muscovites
1338±9Ma, n=3
Pegmatite Muscovites
1353±9Ma, n=13
Data at 1-sigma, results at 2-sigma
N
15
10
5
Relative Probability
1300
1320
1340
1360
1380
1400
Age(Ma)

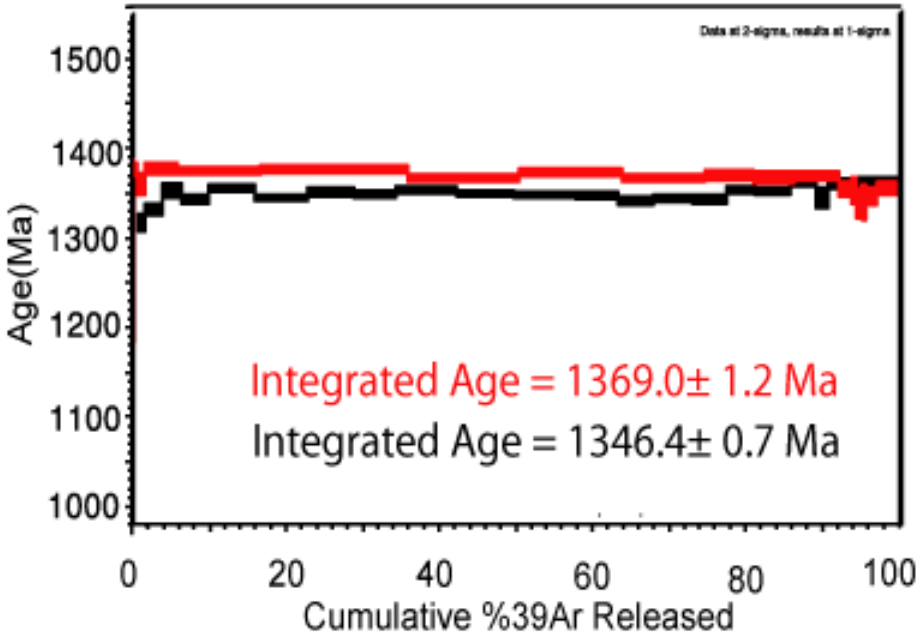
Country Rock-Pegmatite Pairs



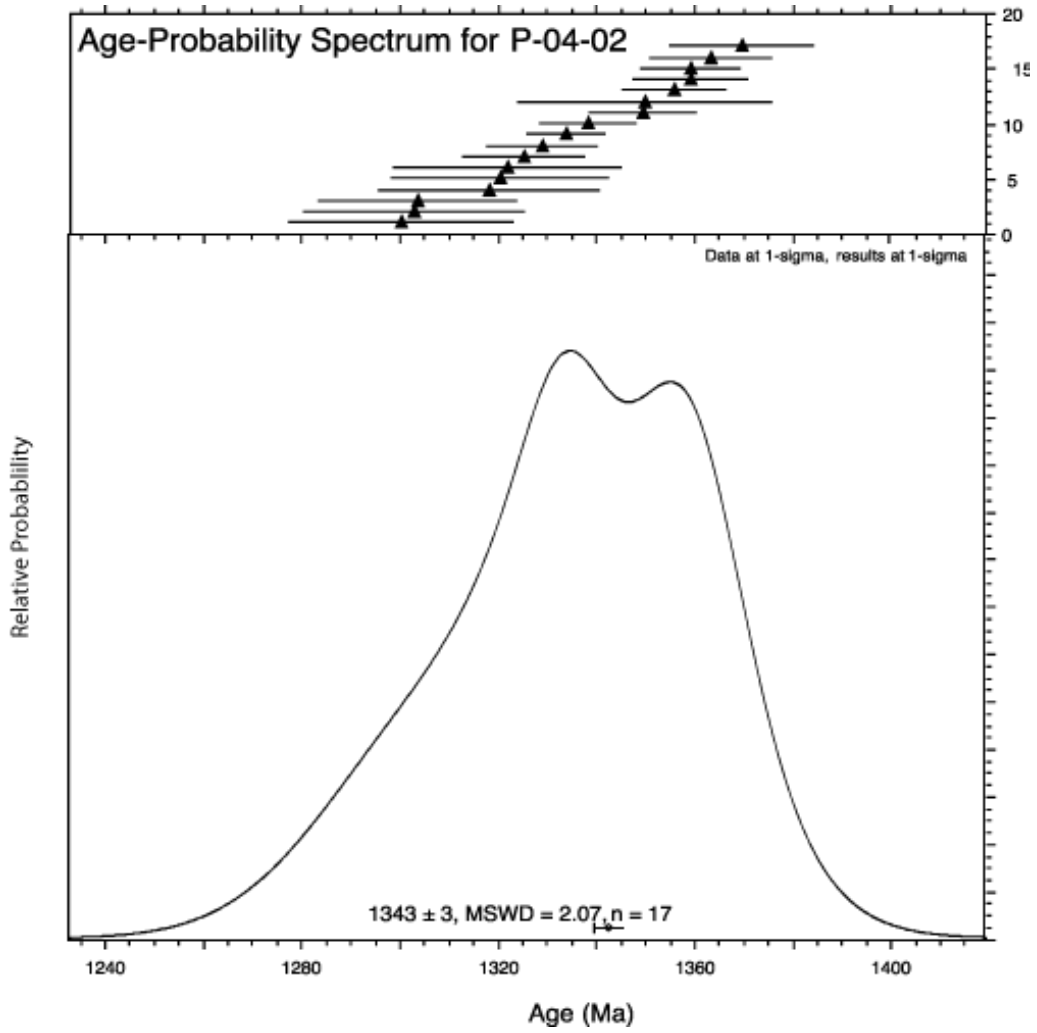
Pegmatite Muscovite

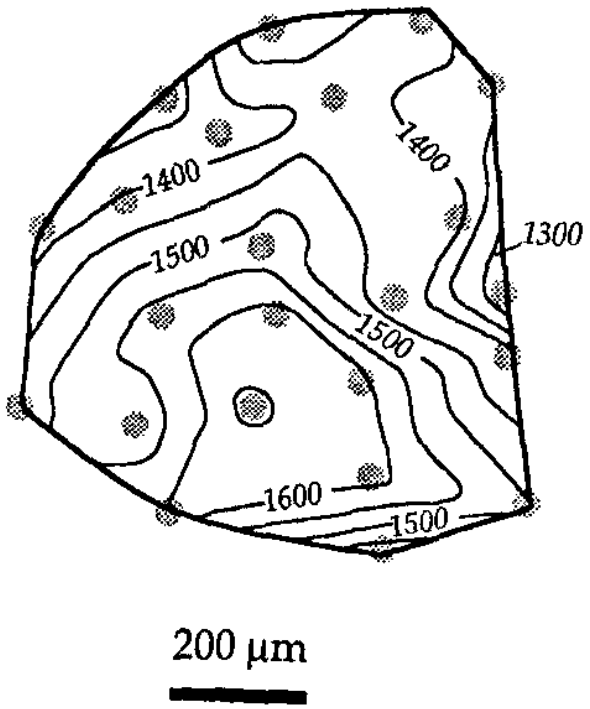
Country Rock Muscovite





In situ work



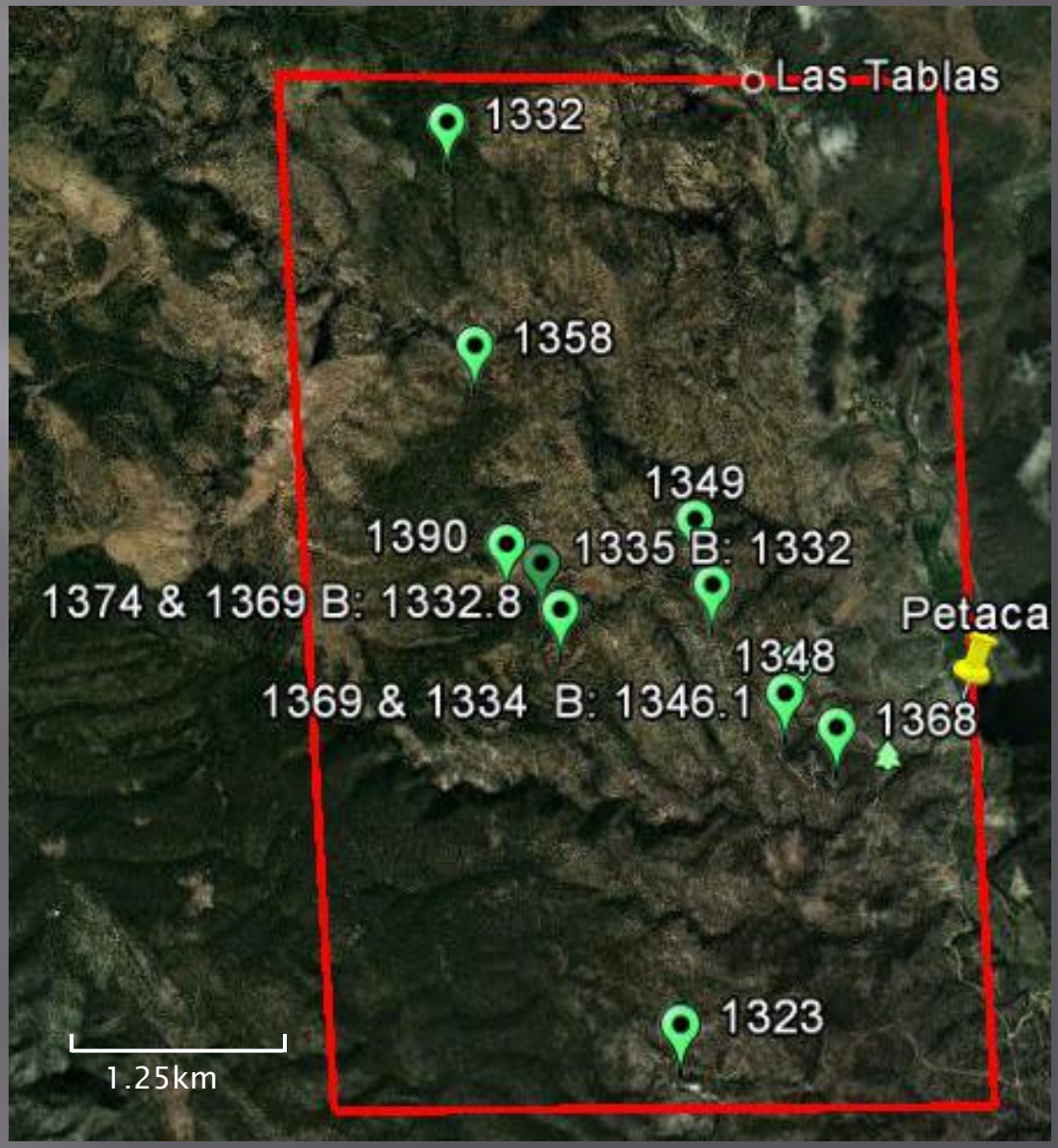


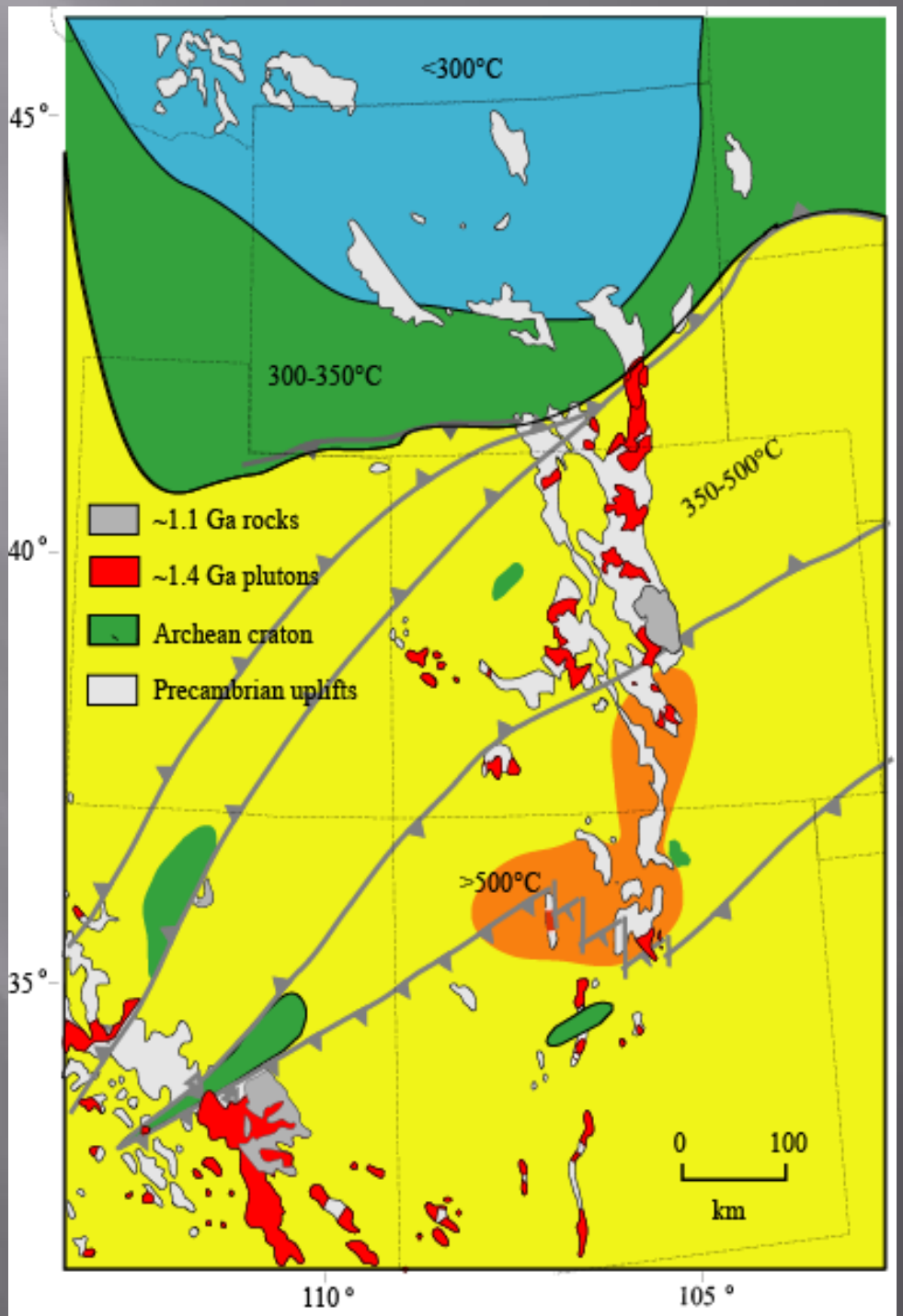
Hodges et al., 1994

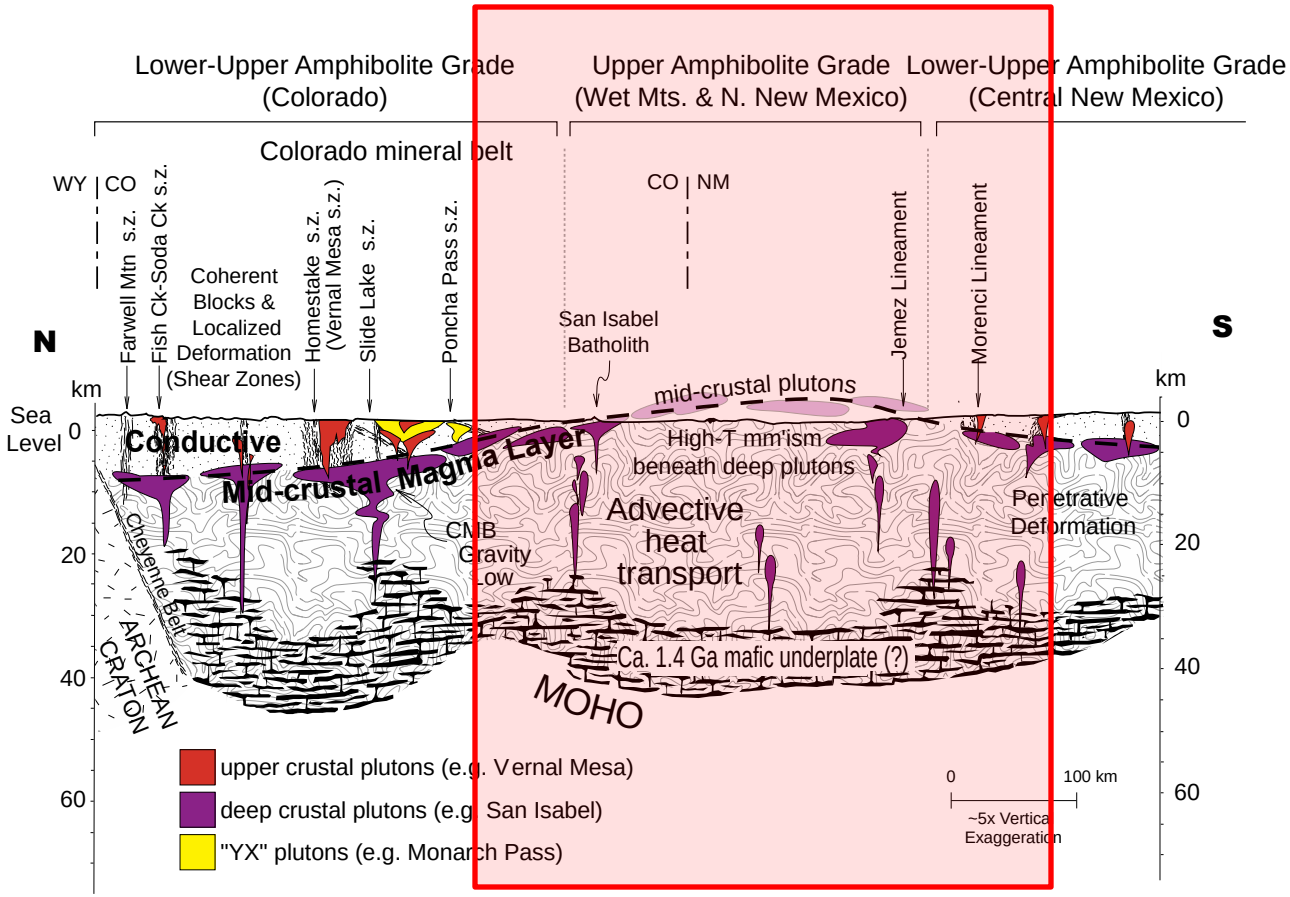
Pegmatite Emplacement

- Post metamorphism
  - Pegmatites are observed to cross-cut folding and metamorphism
- Late syn-metamorphism
  - Pegmatites are hard to deform
- Dates ranging from 1390Ma to 1323Ma

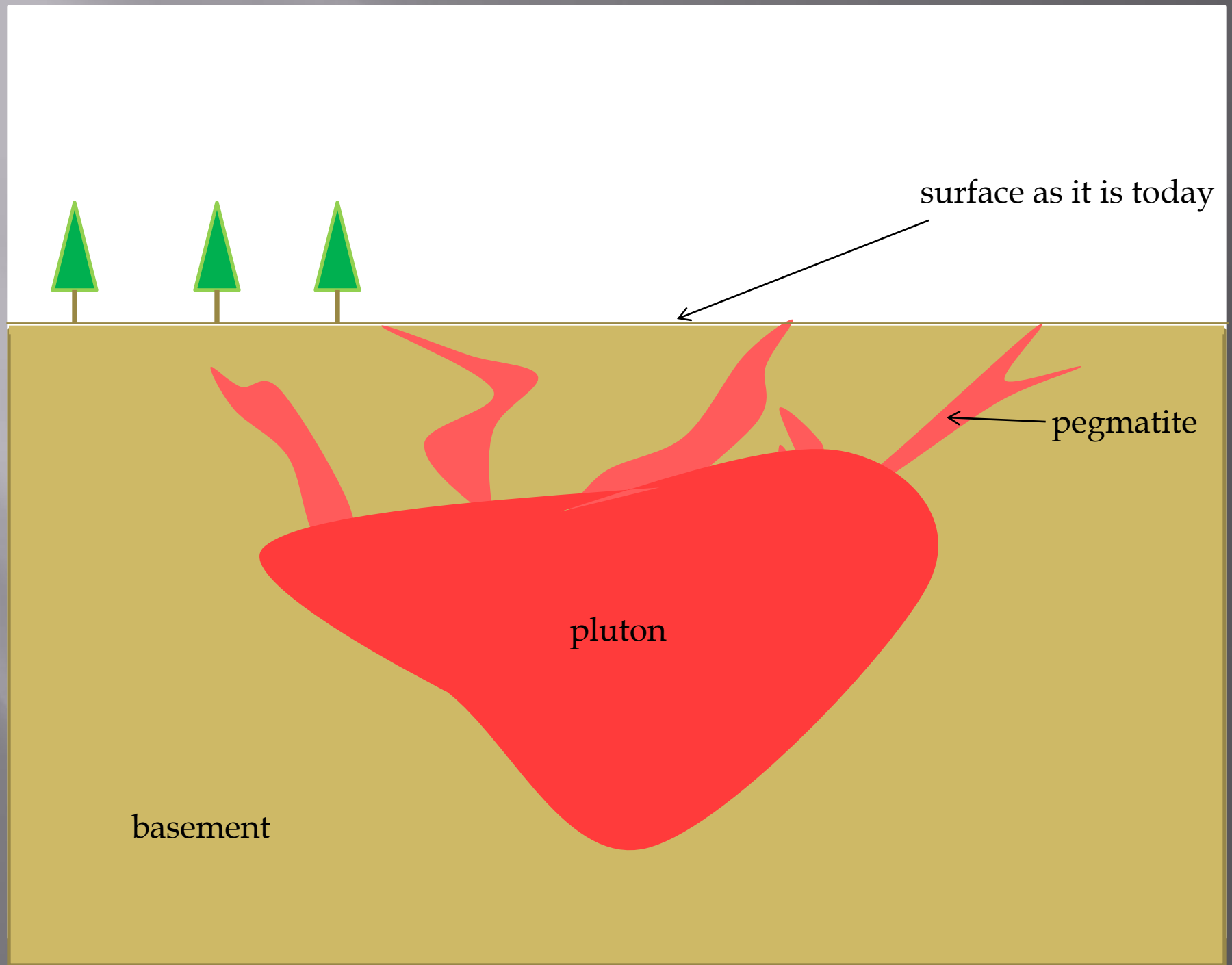
- All pegmatites are ~1390Ma and each record different cooling ages
- There were multiple intrusions over time




<300°C
300-350°C
350-500°C
>500°C
~1.1 Ga rocks
~1.4 Ga plutons
Archean craton
Precambrian uplifts
45°
40°
35°
110°
105°
0
100
km



Shaw et al. 2005


surface as it is today
pegmatite
pluton
basement

Conclusion

- Pegmatite muscovite ages range from 1390-1323Ma
- Country rock muscovite ages range from 1348-1332Ma
- Relationship cannot conclusively give intrusion ages
- So now what?

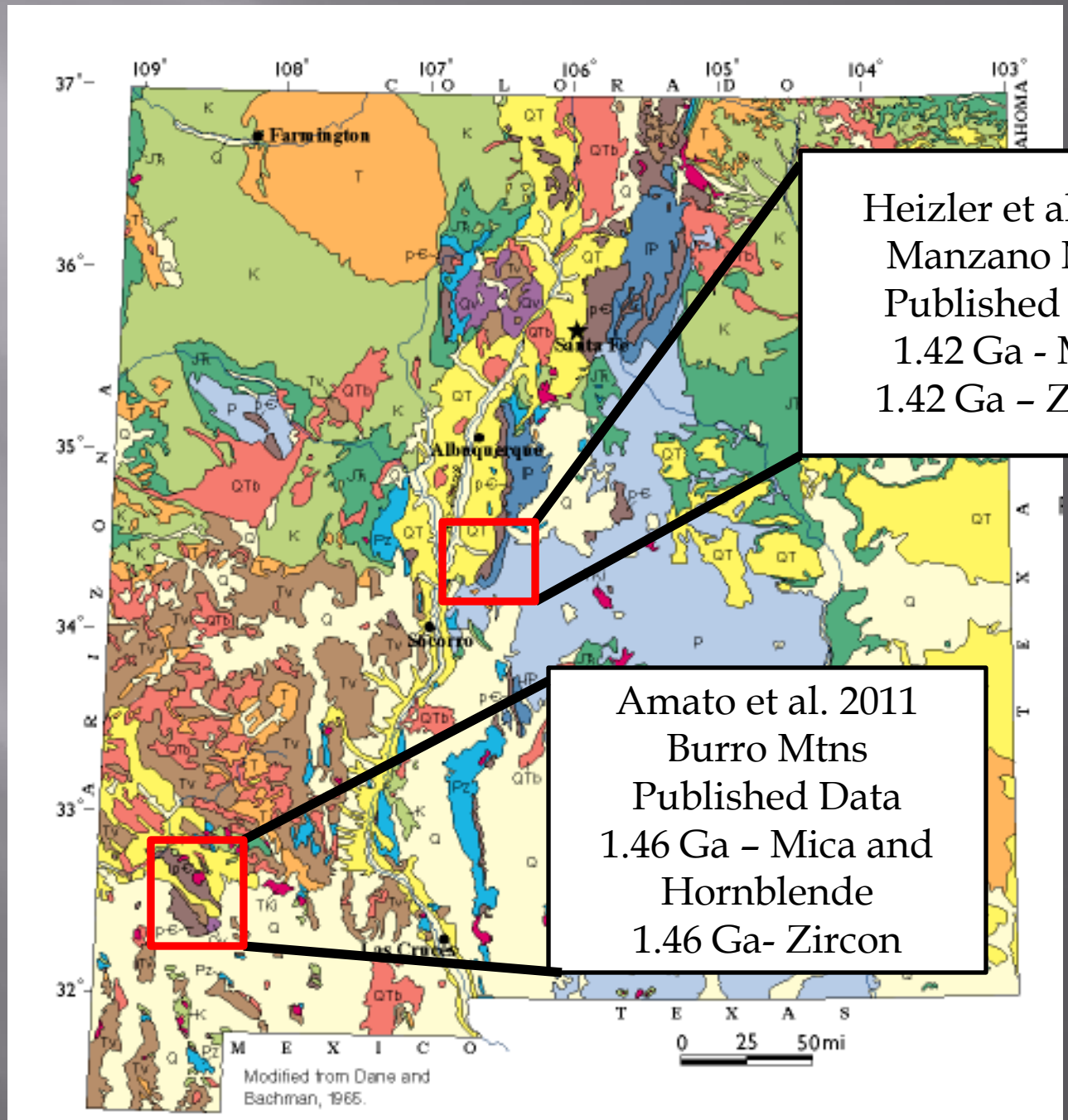

Heizler et al. 1997
Manzano Mtns
Published Data
1.42 Ga - Mica
1.42 Ga – Zircon
Amato et al. 2011
Burro Mtns
Published Data
1.46 Ga – Mica and
Hornblende
1.46 Ga- Zircon
Farmington
Albuquerque
Santa Fe
Socorro
Las Cruces
MEXICO
TEXAS
0 25 50mi
Modified from Dane and Bachman, 1965.

Photo courtesy of Mike Williams

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- Detailed NM Map from http://geoinfo.nmt.edu/publications/maps/geologic/state/