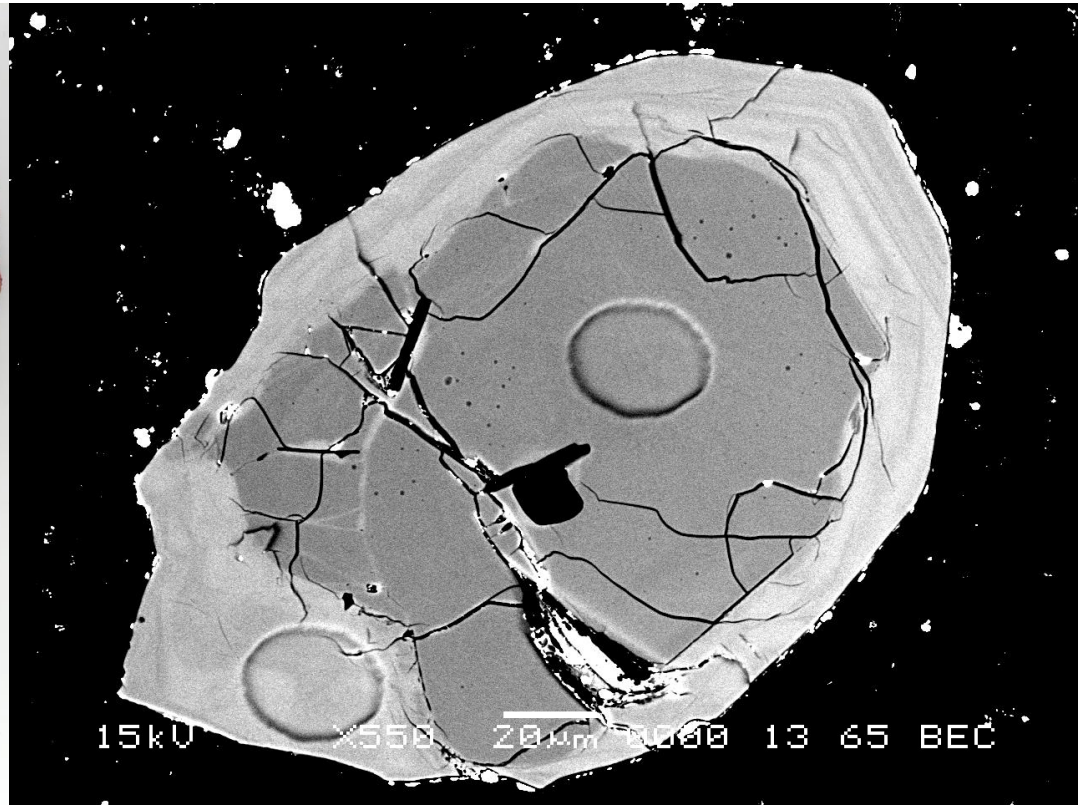
U-PB ZIRCON CONSTRAINTS ON DEFORMATION AND INTRUSION, NORTHWEST ADIRONDACK HIGHLANDS AND ADJACENT ADIRONDACK LOWLANDS, NEW YORK



Bruce Selleck, Department of Geology, Colgate University
Jeff Chiarenzelli, Department of Geology, St. Lawrence University
James M. McLelland, Geology, Colgate University
Marian Lupulescu , New York State Museum

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Megacrystic Gore Mountain–type garnets in the Adirondack Highlands: Age, origin, and tectonic implications

James M. McLelland and Bruce W. Selleck*

Author Affiliations

*bselleck@colgate.edu

Abstract

Spectacular exposures of the world's largest megacrystic garnets (to 35 cm diameter) occur in a coarse-grained amphibolite at the Barton Garnet Mine in the Adirondack Highlands (Gore Mountain, New York State, USA). Over the years, numerous geologists have concluded that the large size of the garnets resulted from an influx of fluids during ca. 1050 Ma upper amphibolite facies metamorphism of a ca. 1155 Ma olivine under such mid-crustal pressure-tempe warrants explanation. Evidence indicates t and close to, a steep border fault that garnet ore at the southern margin of the veins are present in the border zone and l

Geochronology has played a critical role Mountain garnets. Over the past 20 yr Sm

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v. 7 no. 5 p. 1194–1208

» Abstract

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Zircon U-Pb geochronology of the Ottawan Orogeny, Adirondack Highlands, New York: regional and tectonic implications

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[b] *Geological Survey Canada, 601 Booth St., Room 689, Ottawa, Ontario, Canada K1A 0EA*
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[f] *Department of Geosciences, Hobart and William Smith Colleges, Geneva, NY 14456, USA*

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Granite emplacement during tectonic exhumation: The Adirondack example

Geology, 2005

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Earth Sciences, Syracuse University, 204 Heroy Geology Laboratory, Syracuse, New York 13244-1070, USA

ABSTRACT

Sensitive high-resolution ion microprobe U-Pb zircon ages for late to posttectonic leucogranites fix the timing of extensional collapse of a portion of the Mesoproterozoic Grenville orogen of eastern North America. Plutons of Lyon Mountain Granite (LMG) were emplaced within the Carthage Colton shear zone synchronously with formation of extensional mylonite at 1045–1037 Ma. Leucogranite melts were generated in the hot granulite facies core of the Adirondack Highlands–Central Granulite terrane that served as the lower plate for down-to-the-northwest extension. The LMG suite is associated with high-temperature hydrothermal magnetite deposits in the Adirondack Highlands, and widespread Cl + CO_2 hydrothermal alteration of upper-plate rocks is localized along the Carthage Colton shear zone where LMG granites are present. The relationships between melt generation, granite intrusion, high strain rates, extensional collapse, and high-temperature hydrothermal activity provide a framework for understanding midcrustal processes in modern and ancient orogenic belts.

Keywords: Grenville, zircon, geochronology, leucogranite, extension, mylonite.

field guide: if you want to see the rocks

Friends of the Grenville Field Trip 2005

The nature and significance of the Carthage-Colton Shear Zone and related late-to-post tectonic granites and ore deposits; Adirondack Mountains, New York

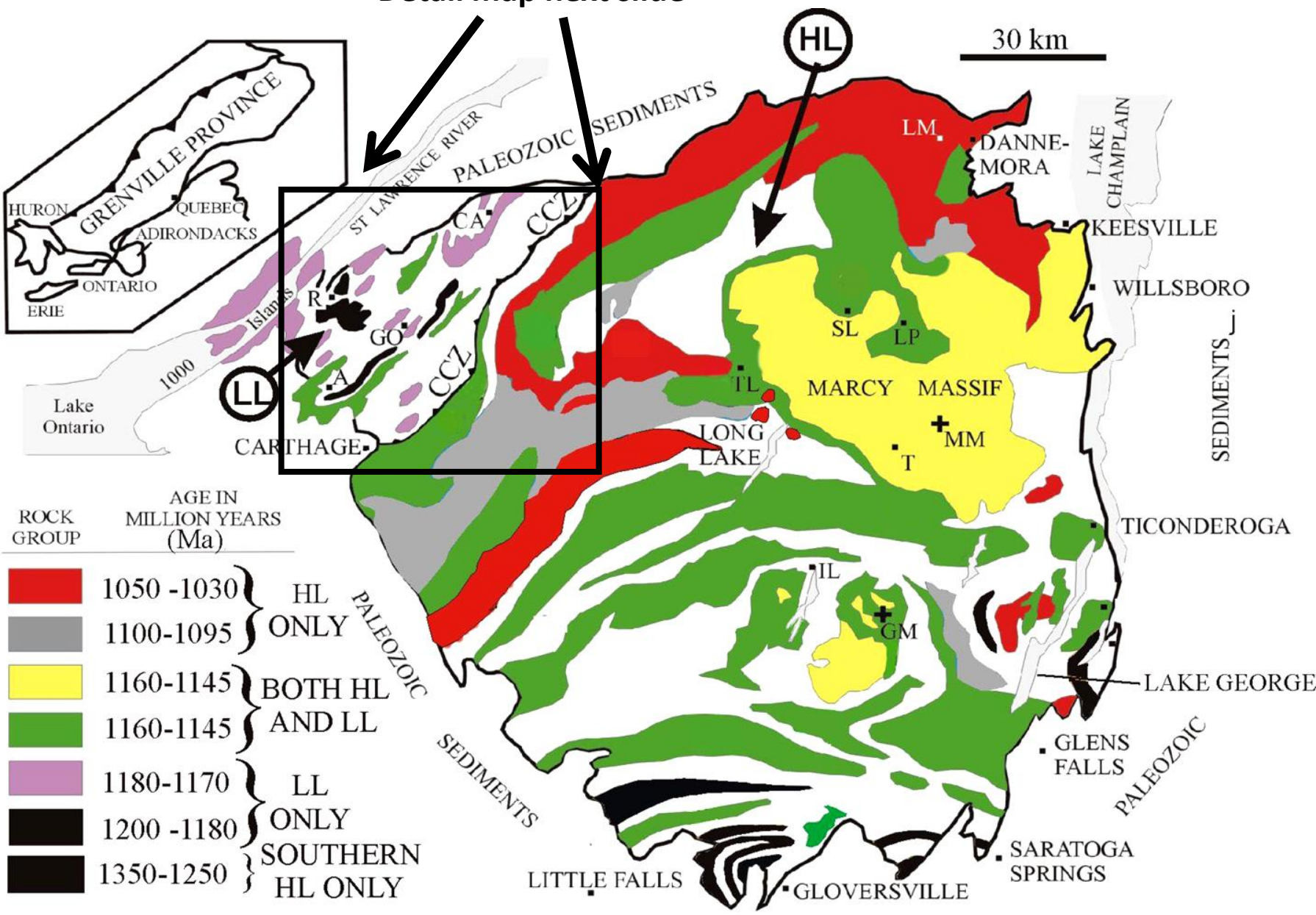
Leaders:
Eric Johnson, Department of Geology, Hartwick College
Bruce Selleck, Department of Geology and Upstate Institute, Colgate University

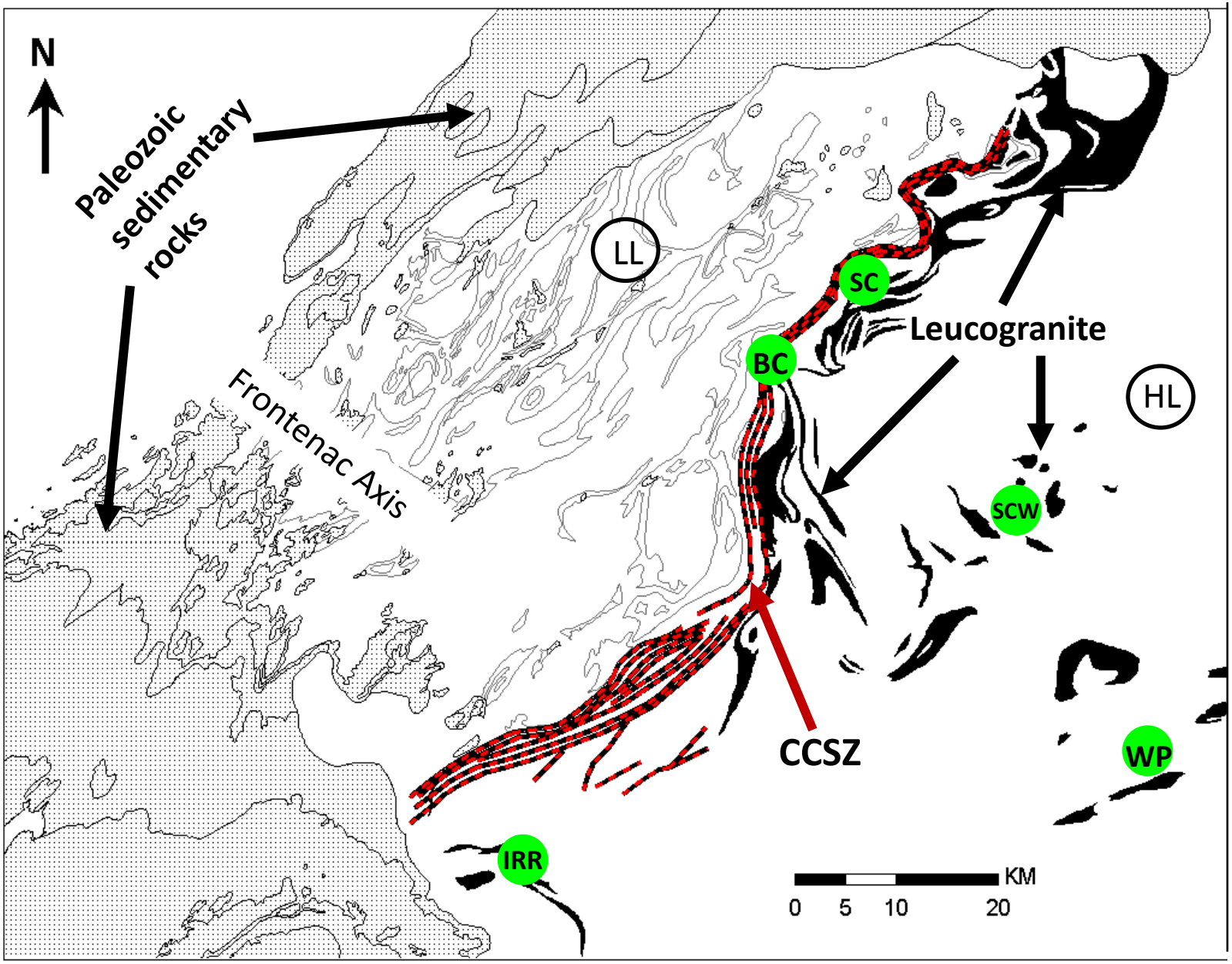
Diana Complex granitoid with 1-s tectonite fabric, Carthage Colton Shear Zone, Fine, NY

Contributors:
Bill DeLorraine, Consulting Geologist
Marian Lupulescu, NYS Geol. Survey

new data: thanks to the Boyce Fund, Colgate University, Department of Geology

ADIRONDACK GEOLOGY/GEOCHRONOLOGY





IRR – Indian River Road near Croghan, NY
BC – Brouses Corners, Clare, NY
SC – Sellecks Corners, Pierrepont, NY

SCW – Seveys Corners, Colton, NY
WP – Whitney Portal, Long Lake, NY

Indian River Road

Foliated xenoliths in equigranular granite

Intrusive age of Diana is 1164±9 *(Hamilton, et al 2004)*

Diana Complex mafic syenite with strong foliation intruded by quartz mesoperthite granite dikes

IRR

IRR leucogranite zircon SHRIMP results *(Selleck, et al 2005)*

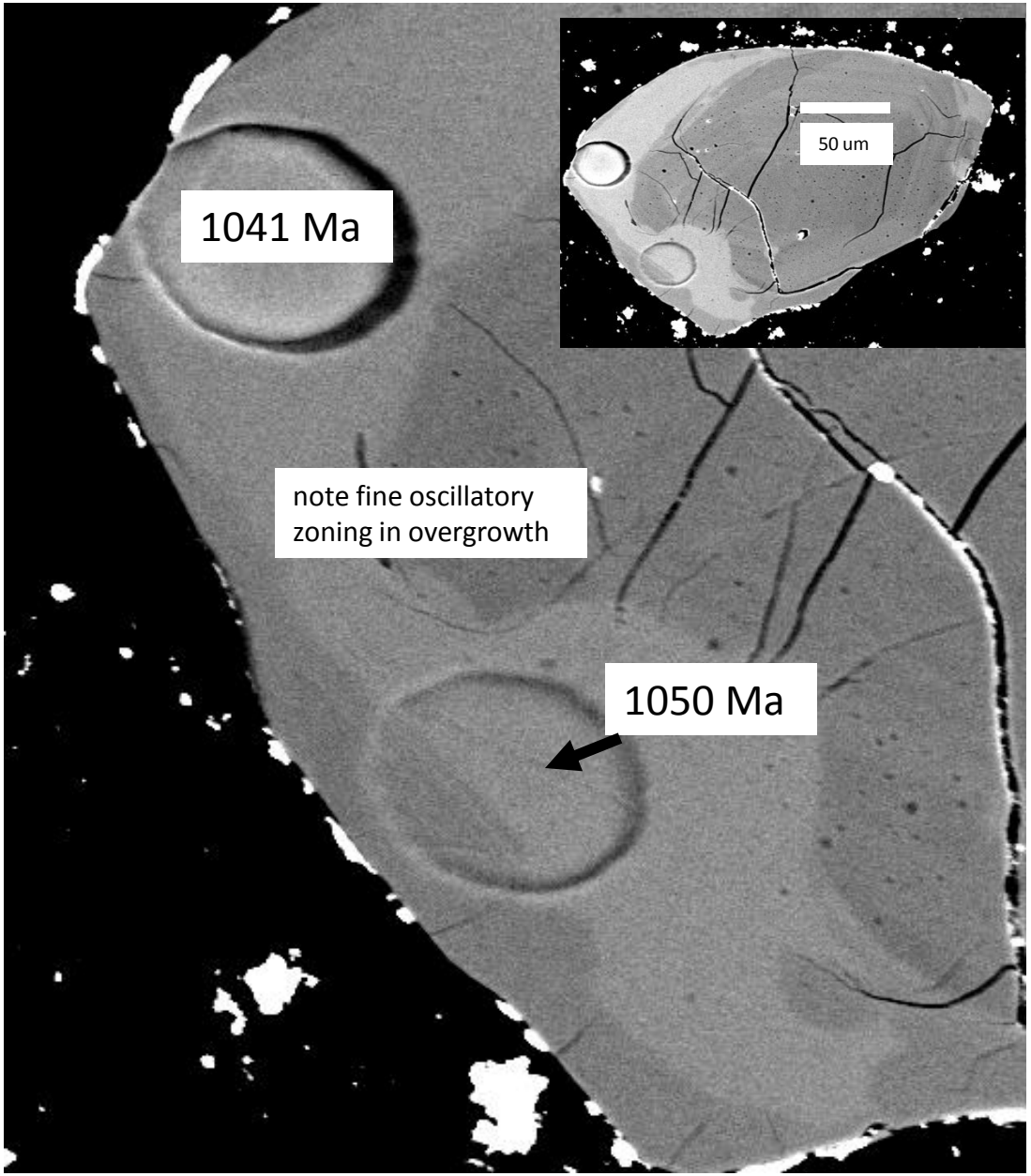
Zoned igneous overgrowths (leucogranite intrusive age)

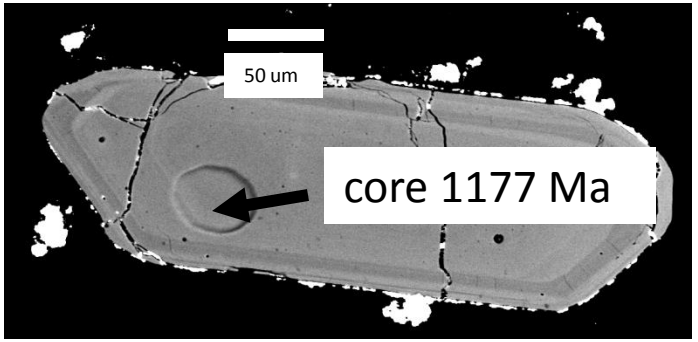
Mean = **1039 ± 10 Ma** [0.92%]
95% conf.
MSWD = 0.63, probability = 0.68; n=6

Four xenocryst/core ages:

1211±22
1202±11
1999±14
} Antwerp/Rossie Suite?

1177±11
} Diana Complex – host mafic syenite





Brouses Corners – Carthage-Colton Zone

leucogranite sills intrude gneiss and calcsilicate

sills parallel strong mylonitic fabric

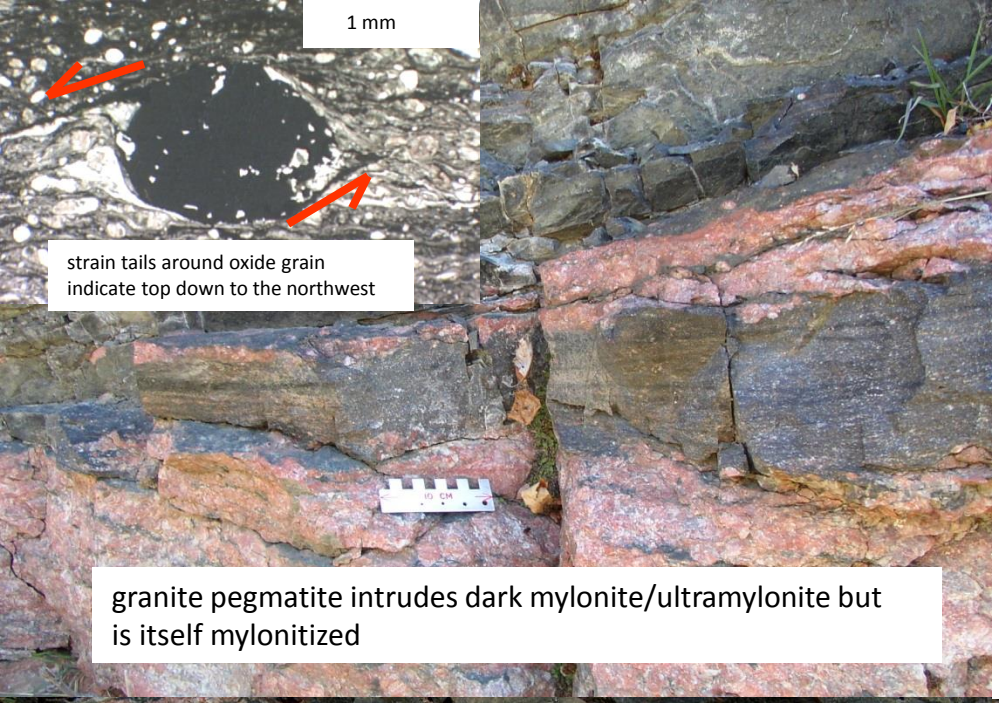
nearby leucogranite with quartz-sillimanite nodules and veins

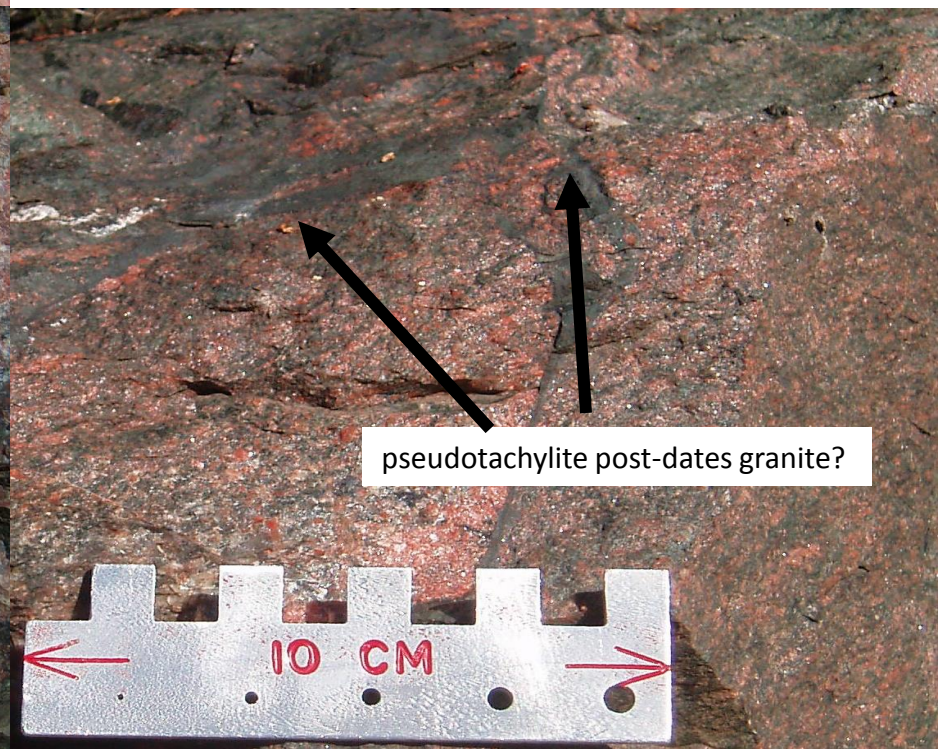
Brouses Corners (BC)

Granite pegmatite sills intrude NW dipping mylonitic gneiss. Strain indicators give consistent top-down to the NW shear sense.

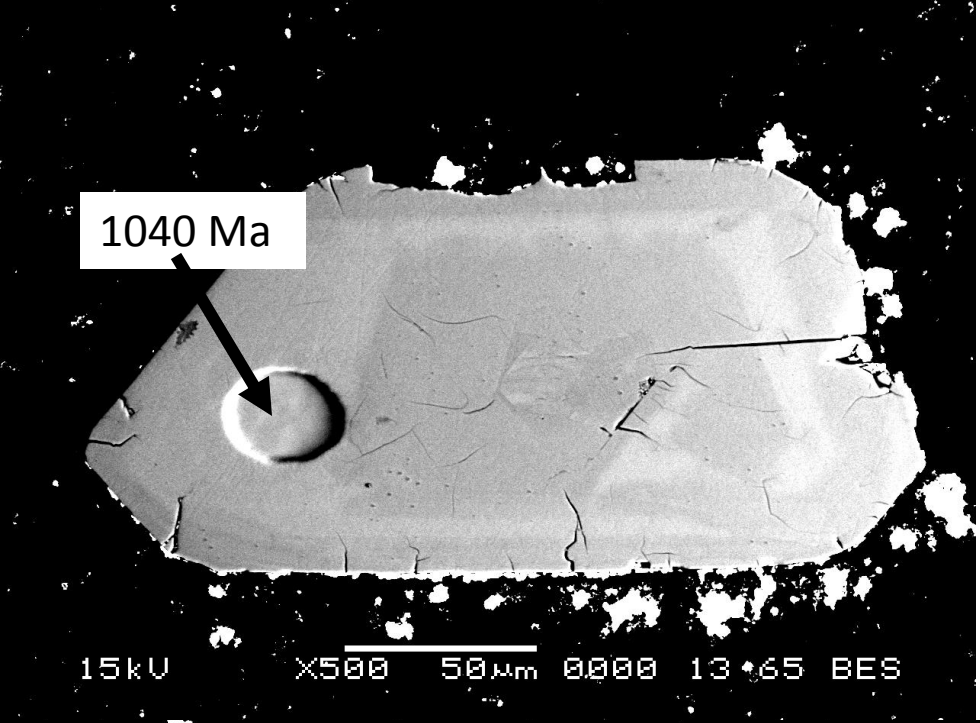
Synmagmatic mylonite and ultramylonite suggest intrusion during rapid CCSZ extension.

Zircons from coarse granite pegmatite.

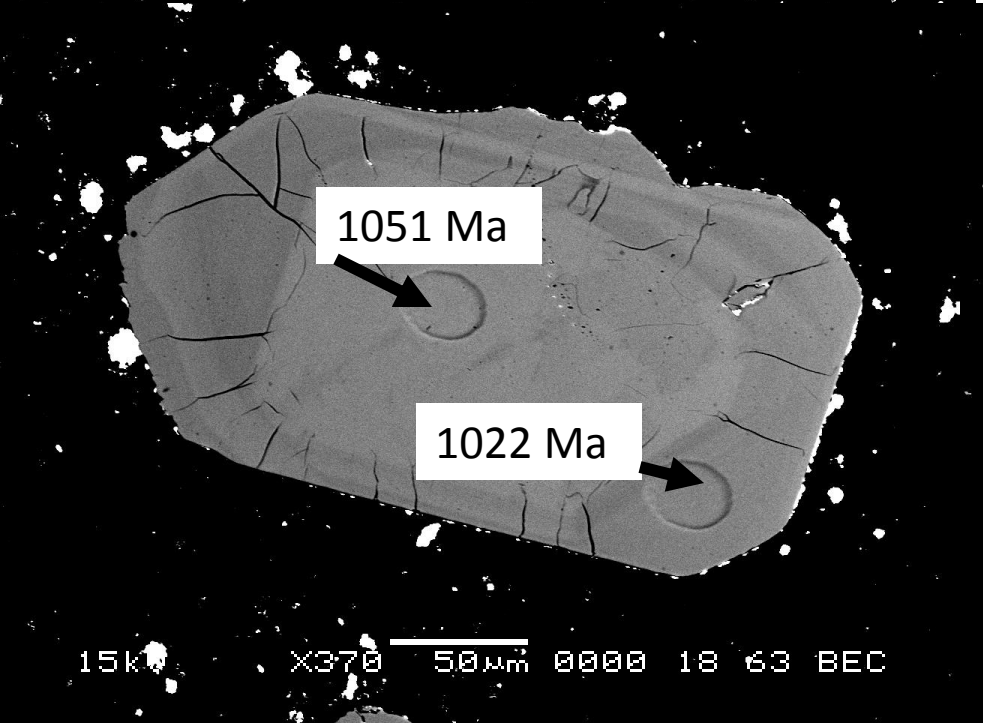


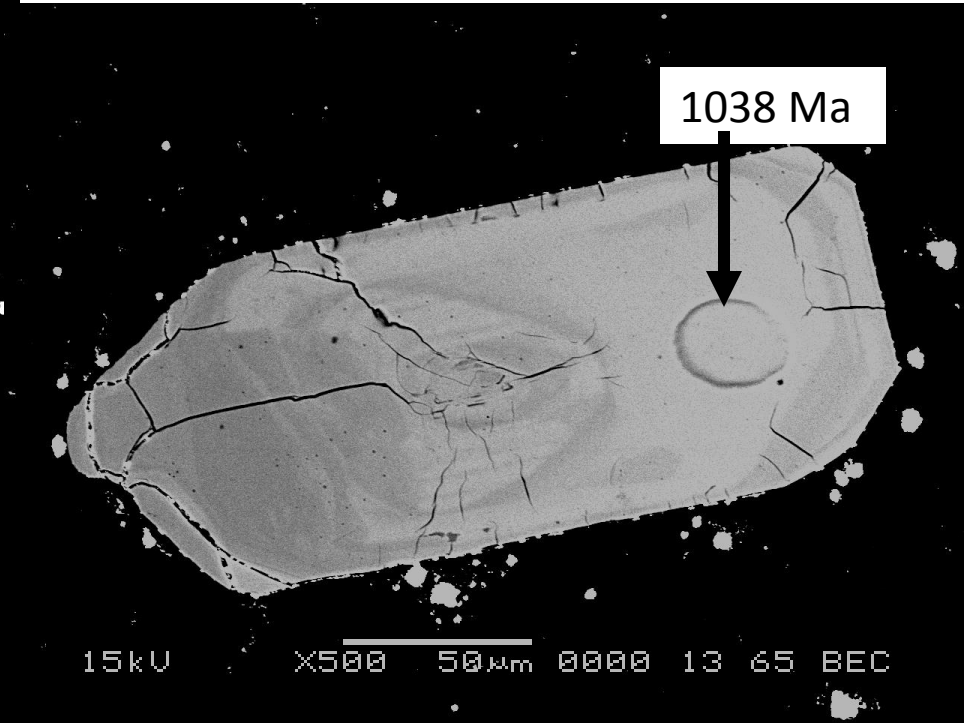


Brouses Corners pegmatite –
SHRIMP results *(Selleck, et al 2005)*



Mean = **1044 ± 7 Ma** [0.70%] 95% conf.
N=9 MSWD = 0.88, probability = 0.53



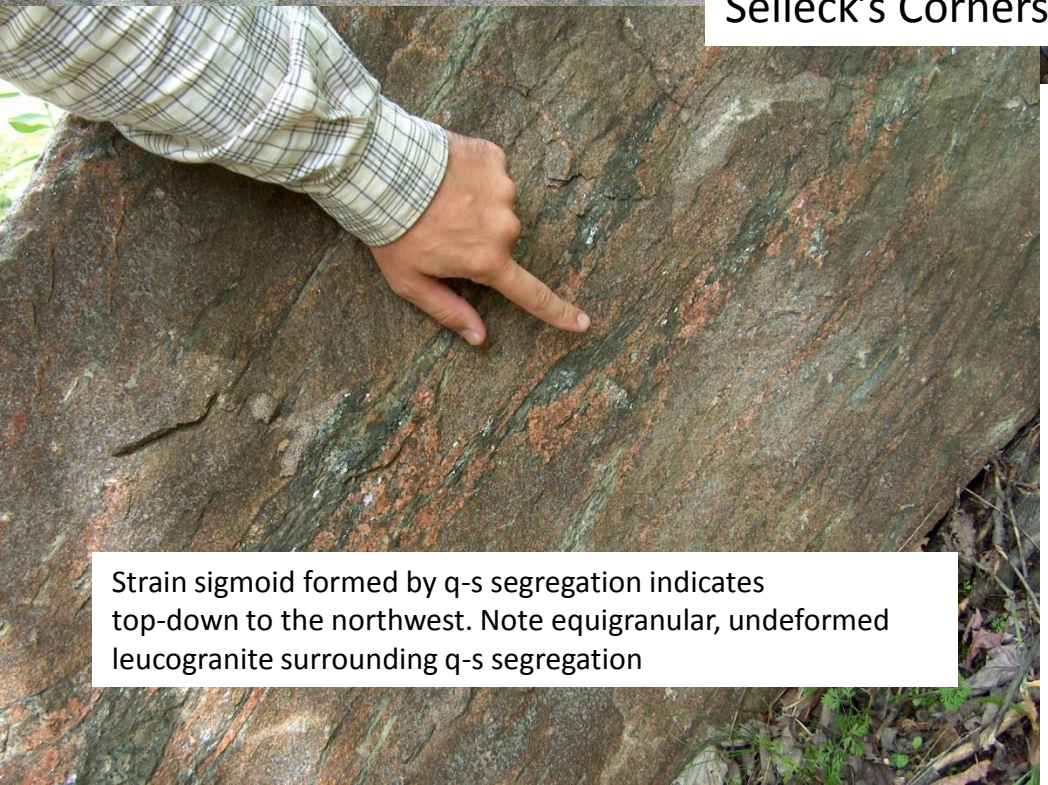


Sellecks Corners Field Relationships

Flattened, cigar-shaped quartz-sillimanite nodules surrounded by equigranular leucogranite; nodules plunge NW; view looking down-plunge

Granite pegmatite dike cored by quartz+sillimanite (plus retrograde muscovite) cross-cuts tablular quartz-sillimanite sheaves that dip NW

Selleck's Corners

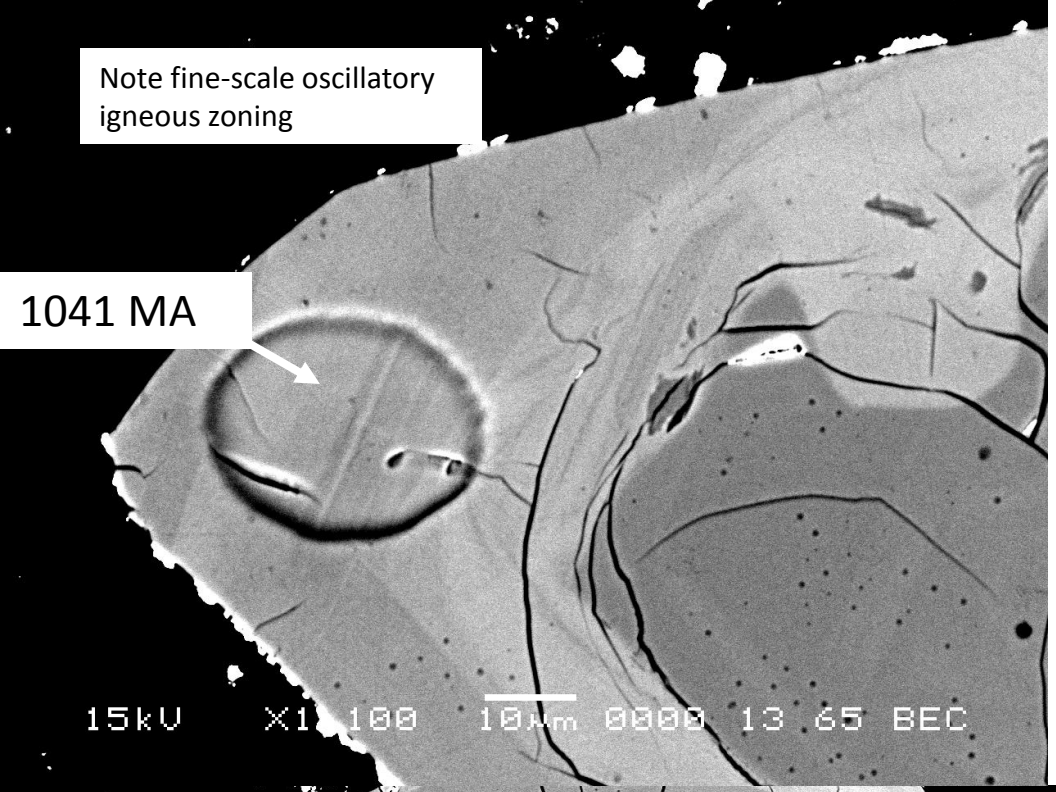


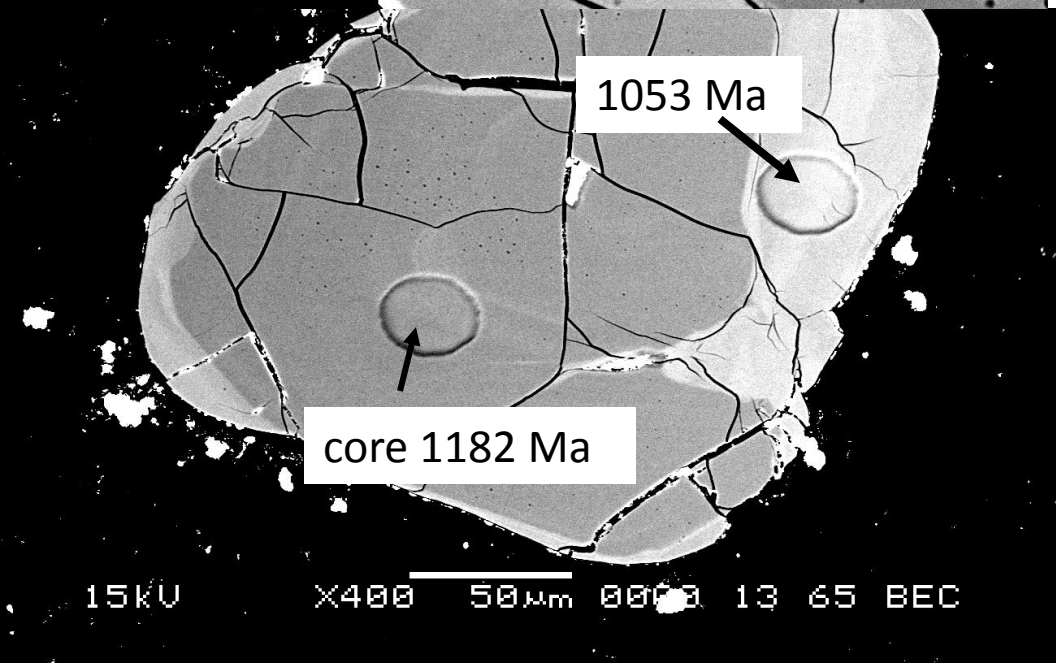
Strain sigmoid formed by q-s segregation indicates top-down to the northwest. Note equigranular, undeformed leucogranite surrounding q-s segregation

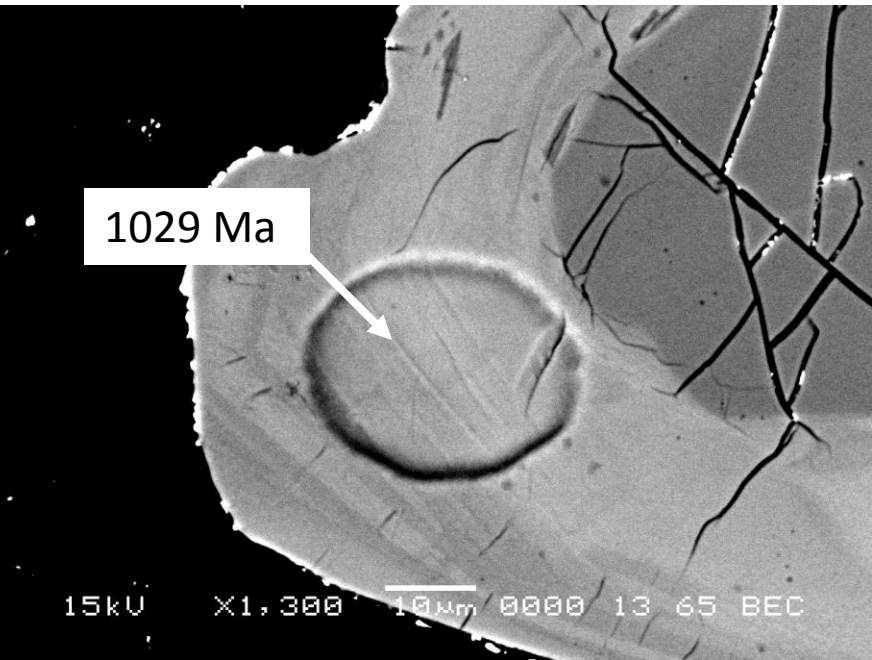
Quartz-sillimanite nodules and veins result from high-temperature synmagmatic acidic leaching *(McLelland, et al 2001).* Zircon separates were prepared from equigranular granite surrounding q-s segregations.

left – polished slab shows q-s segregations surrounded by equigranular granite

SC



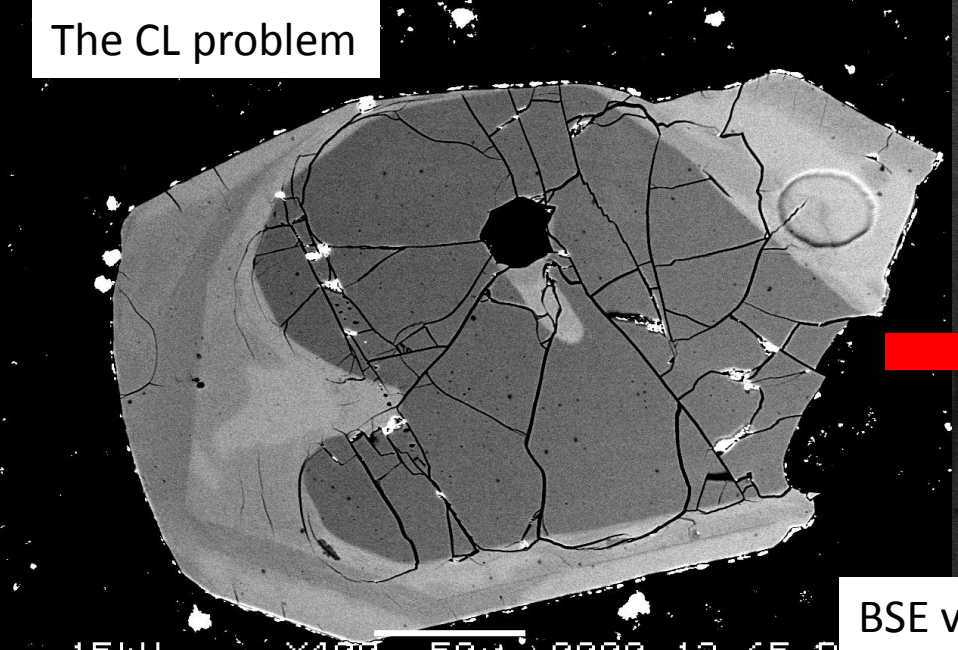


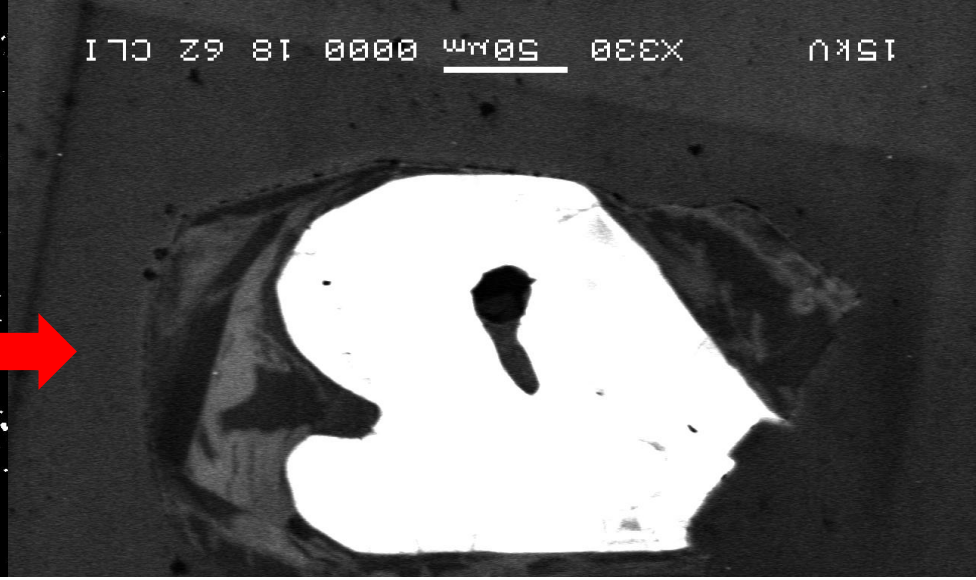


Sellecks Corners leucogranite -
zircon SHRIMP results *(Selleck, et al 2005)*

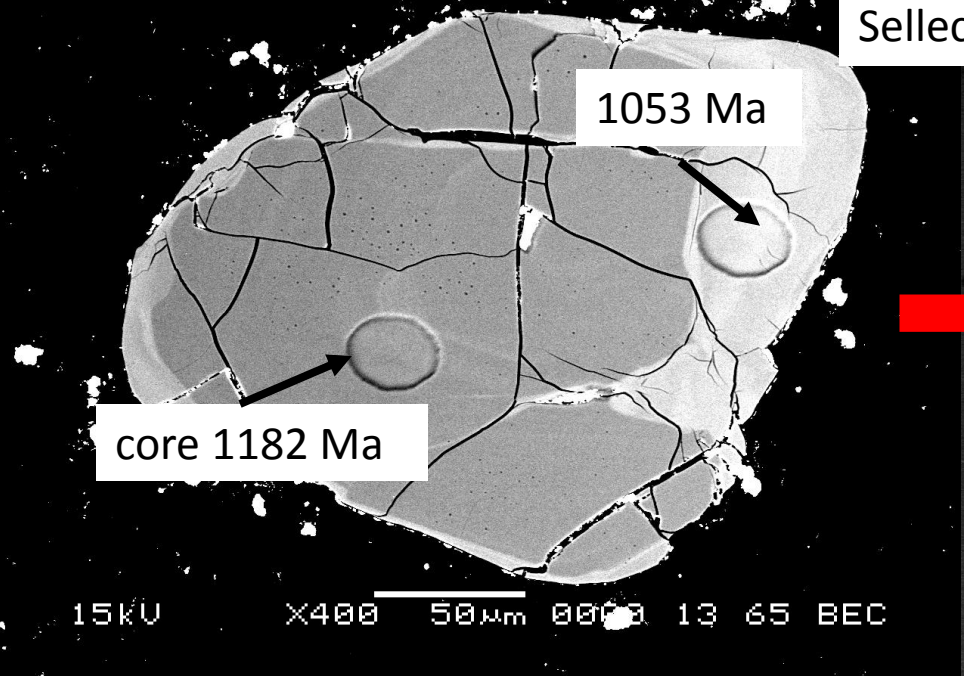
Mean 7/6 age = **1046 ± 7 Ma**
[0.65%] n=9
MSWD = 1.20, probability = 0.29

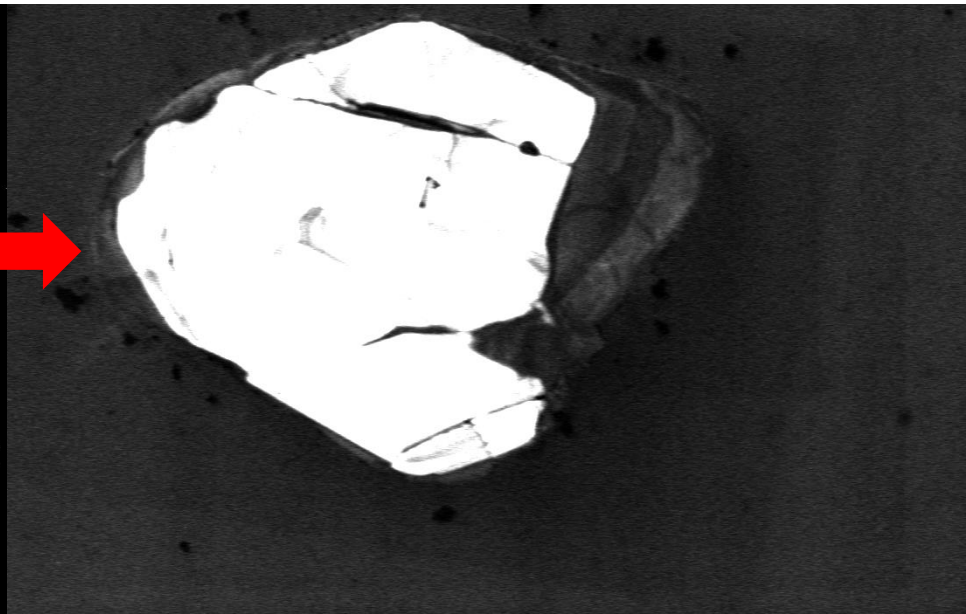
The CL problem

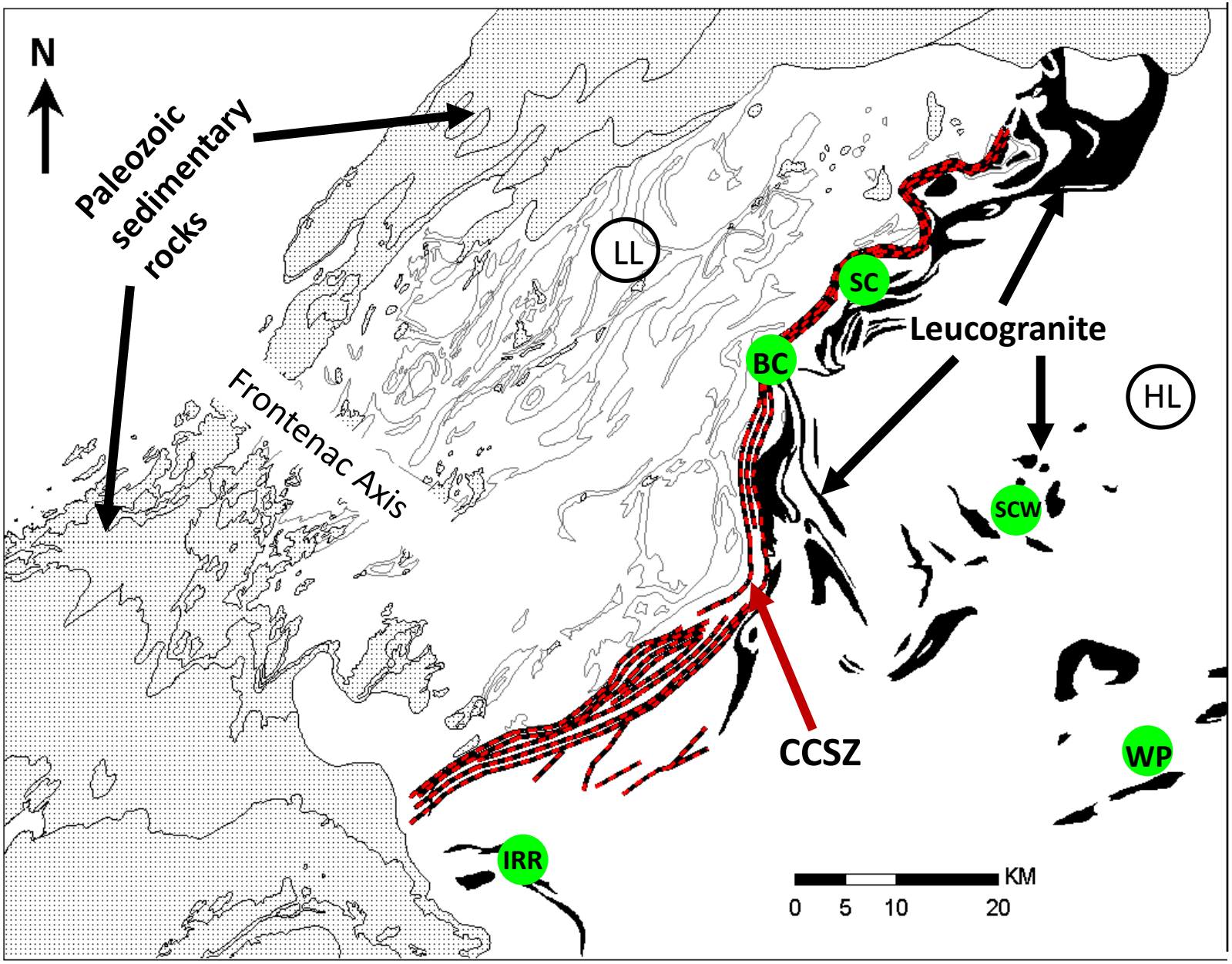




BSE vs. CL – CL in igneous overgrowths damped by bright xenocrystic cores. Oscillatory zoning is present, but faint, in overgrowth – in BSE, and in CL. Sellecks Corners







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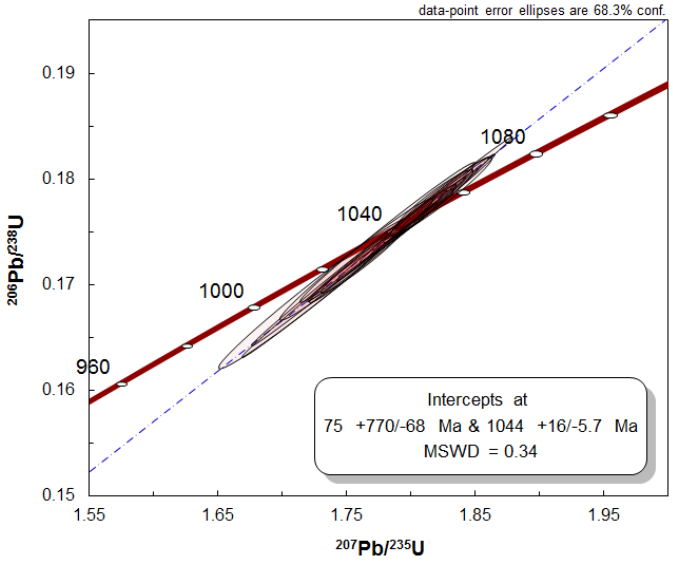
WP – Whitney Portal,

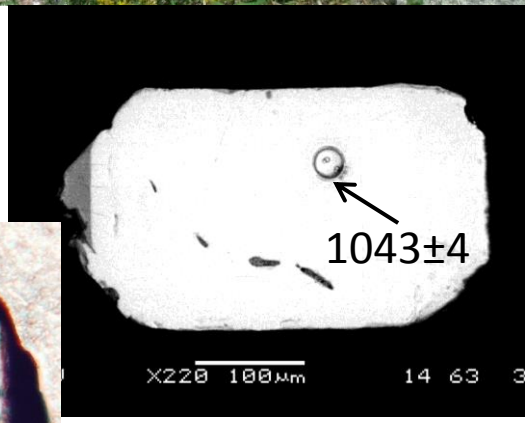
Seveys Corners West

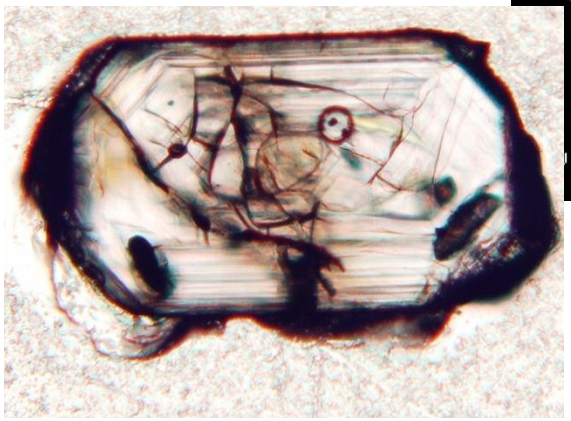
Pegmatite
Final Age = 1044.2 ± 8.6 Ma
Mean = 1044.2±1.9 [0.18%] 2σ
Wtd by data-pt errs only, 0 of 20 rej.
MSWD = 0.34, probability = 0.996

Pegmatite cross-cuts anatectic banding and foliation in leucosome-bearing amphibolite



SCW



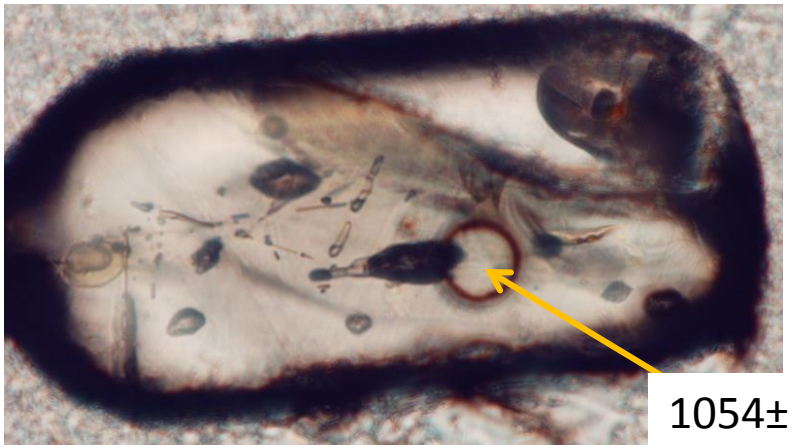


LA-ICPMS (Laserchron) data from here on

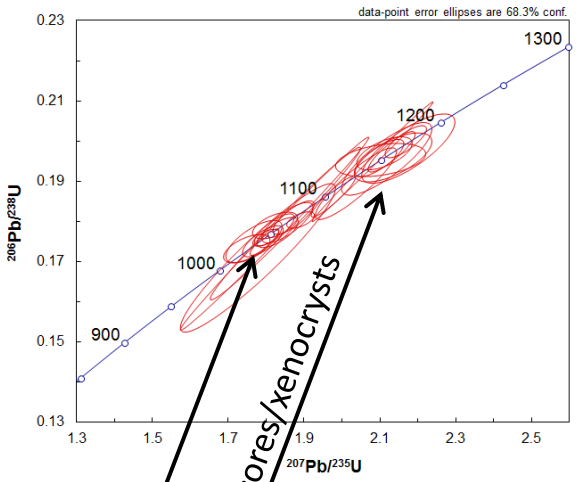
elevated U damps CL; limited BSE contrast

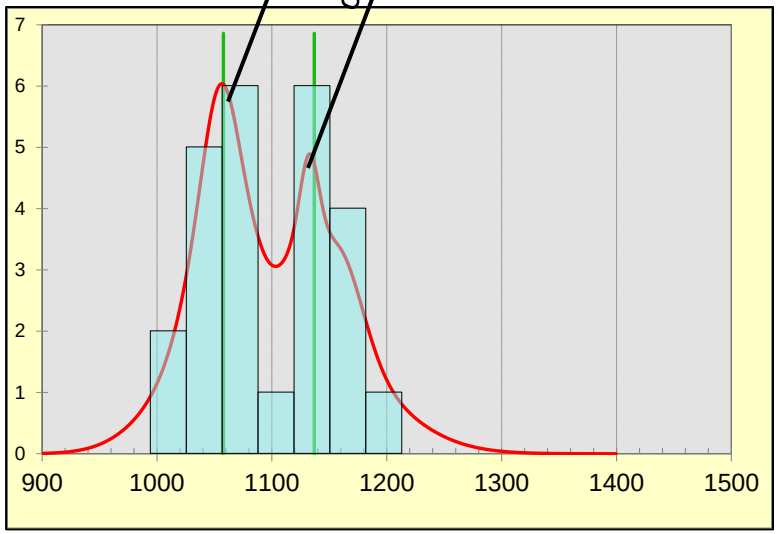
Seveys Corners West

Pink granite
Final Age = 1058 ± 15 Ma
Mean = 1058±13 [1.2%] 2σ
Wtd by data-pt errs only, 0 of 14 rej.
MSWD = 0.53, probability = 0.91

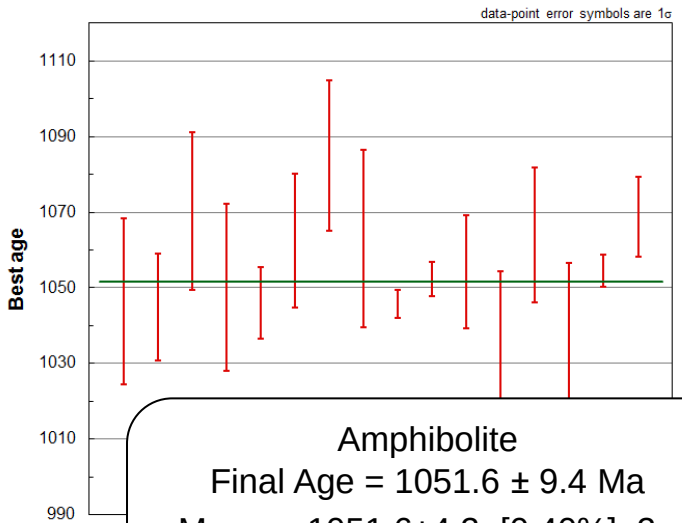


SCW



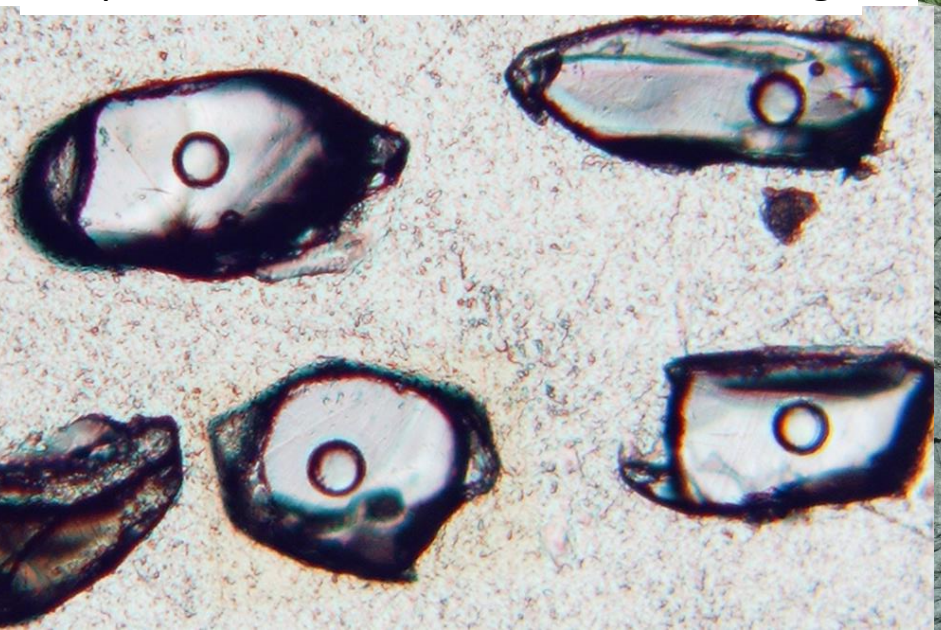


zircon in leucogranite – oscillatory zoning, melt inclusions (?); older cores/xenocrysts



Amphibolite
Final Age = 1051.6 ± 9.4 Ma
Mean = 1051.6±4.2 [0.40%] 2σ
Wtd by data-pt errs only, 0 of 16 rej.
MSWD = 0.82, probability = 0.66

amphibolite zircons– no cores, no zoning

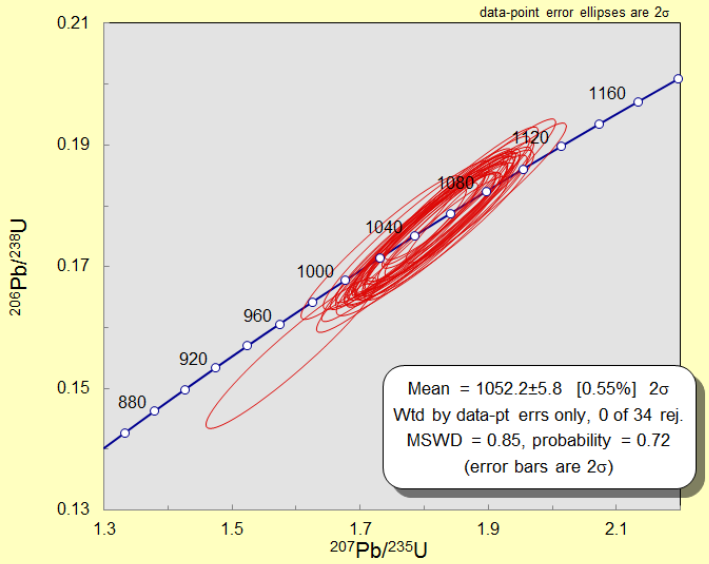


Sevey's Corners

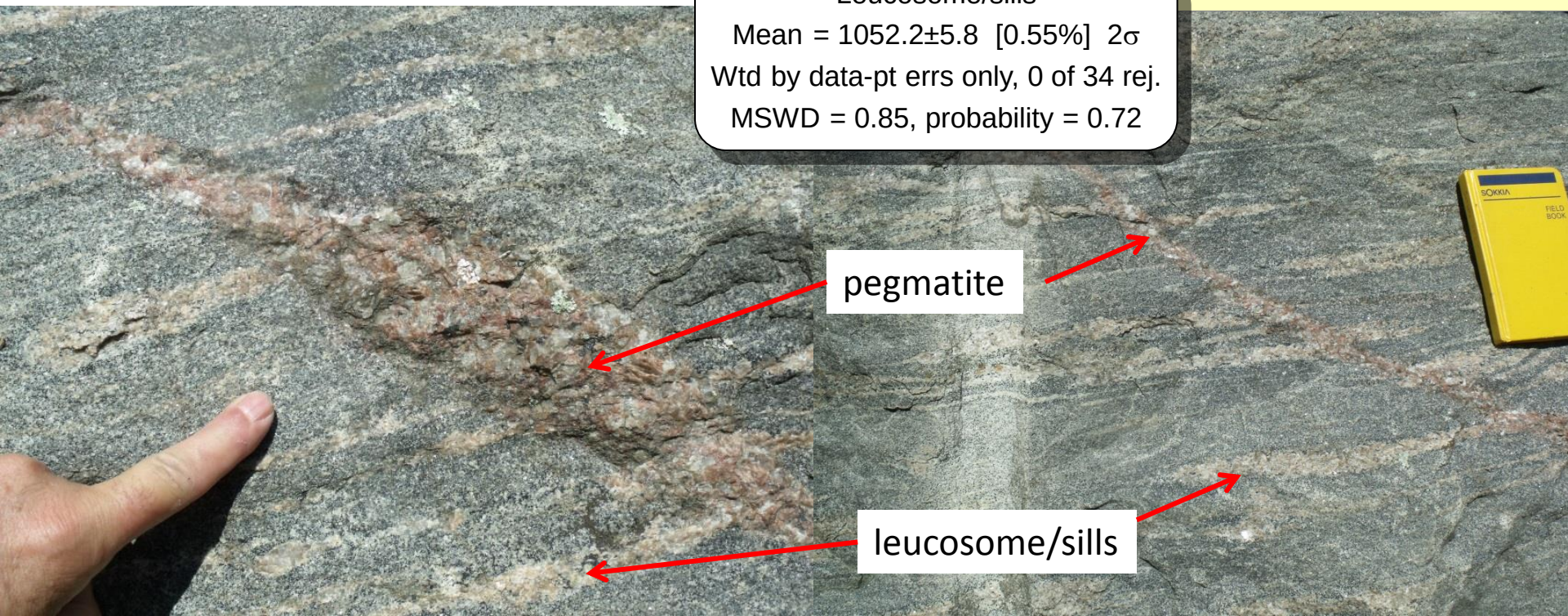
anatectite? sills parallel to foliation/banding in amphibolite
pegmatite cross-cuts leucosome

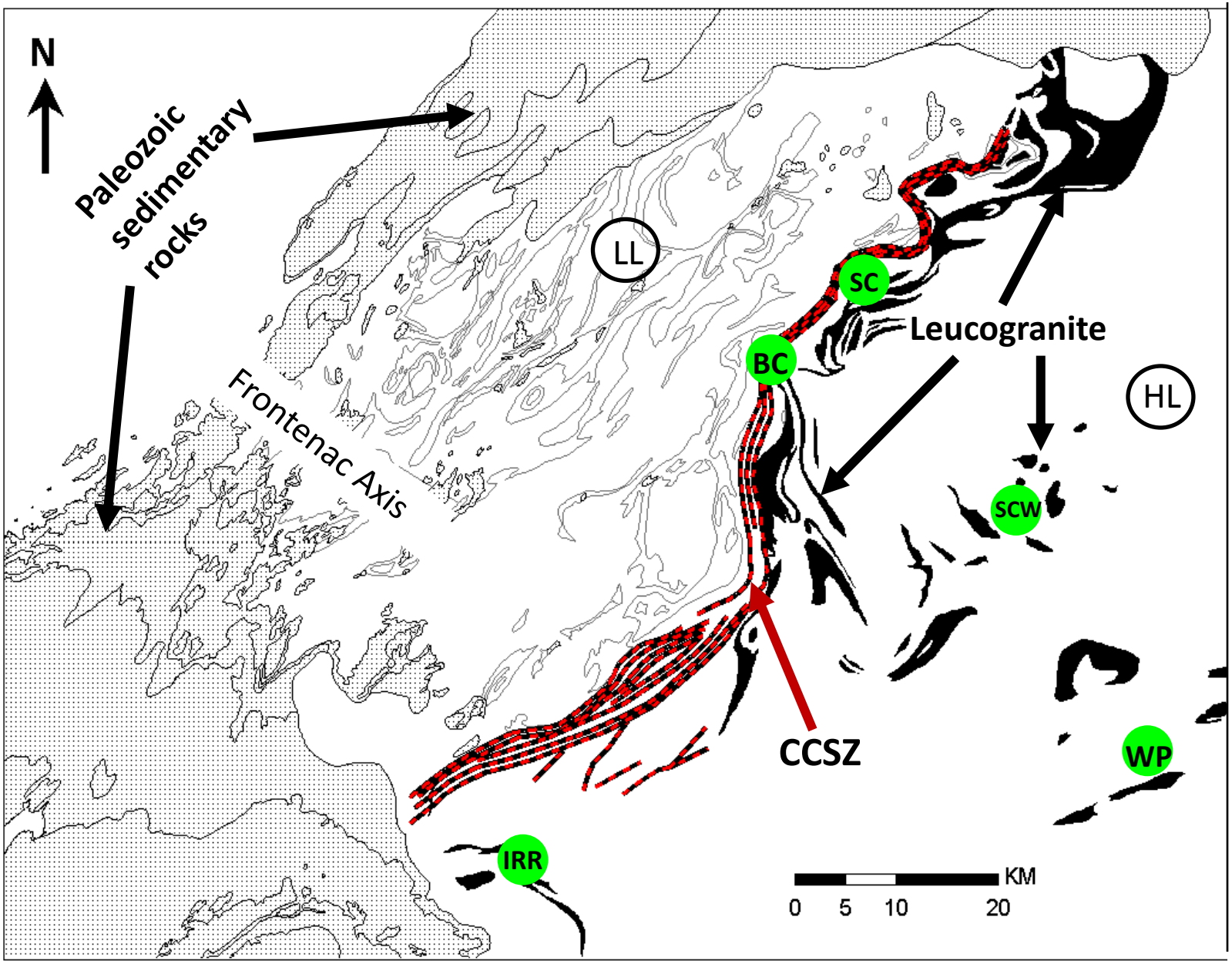
leucosome (1052±6) ≈
pink granite (1058 ± 15) ≈
amphibolite (1052 ± 9)

pegmatite (1044 ± 9) - cross-cuts all



Leucosome/sills
Mean = 1052.2±5.8 [0.55%] 2σ
Wtd by data-pt errs only, 0 of 34 rej.
MSWD = 0.85, probability = 0.72





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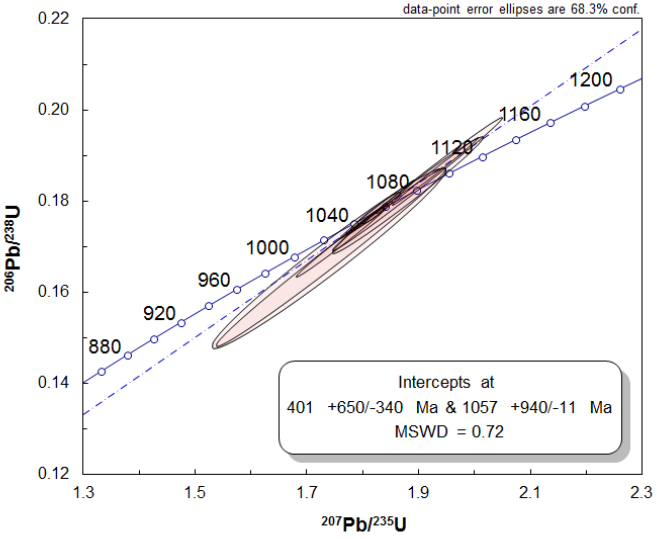
SCW – Seveys Corners, Colton, NY
WP – Whitney Portal,

Whitney Portal:

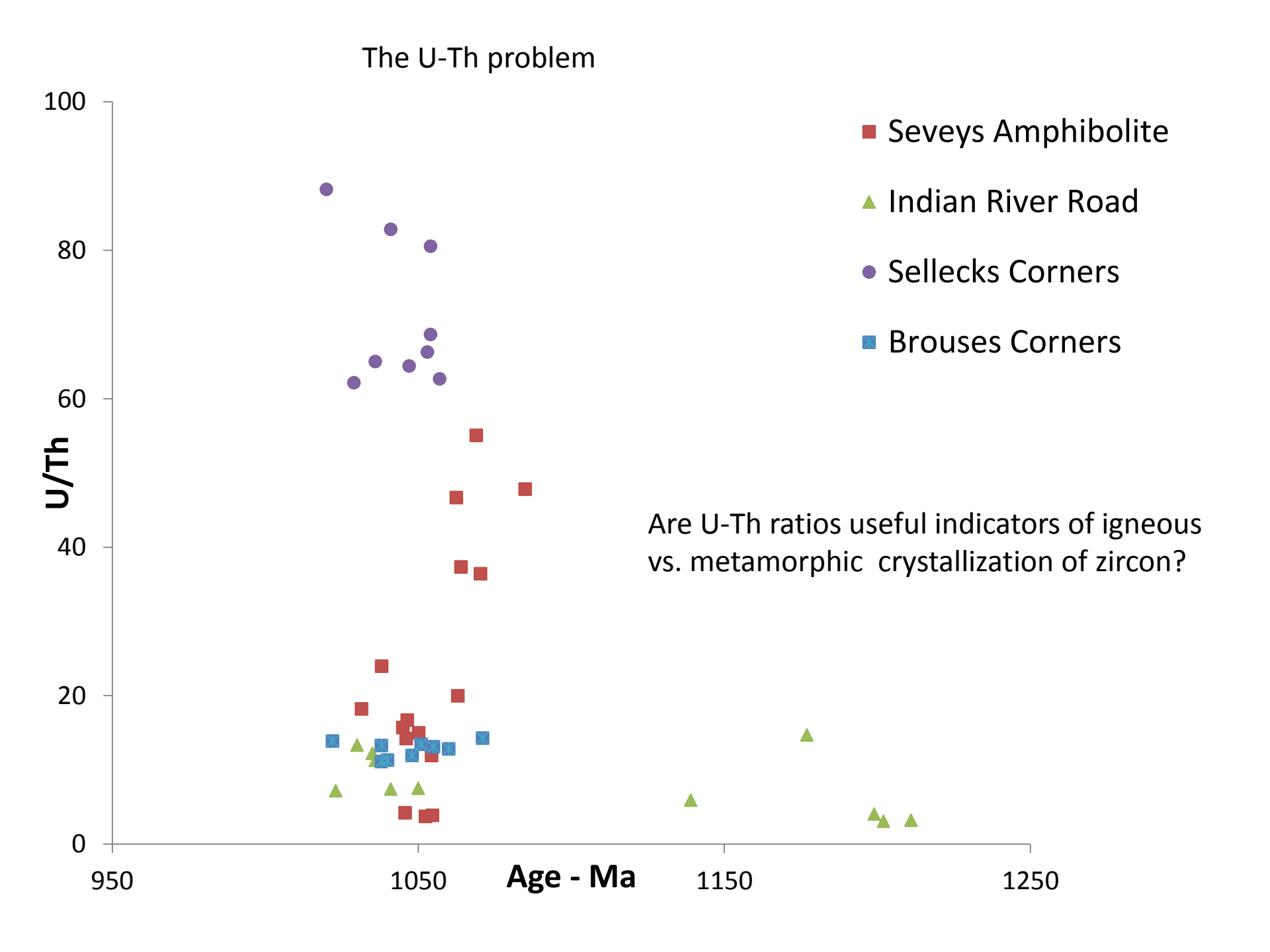
equigranular quartz mesoperthite granite intrudes anorthosite gneiss

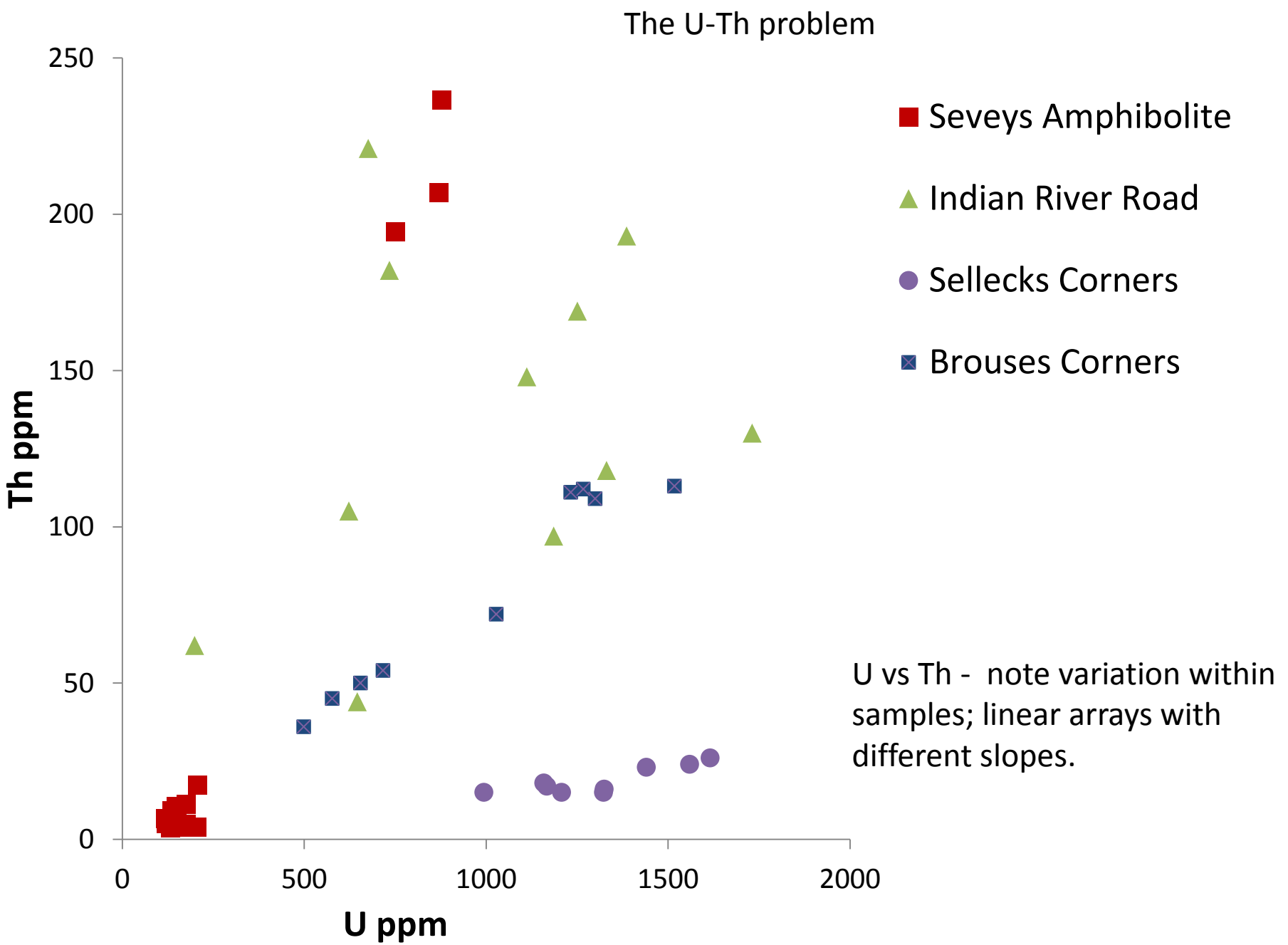
(megagarnets – see McLelland and Selleck, 2011)

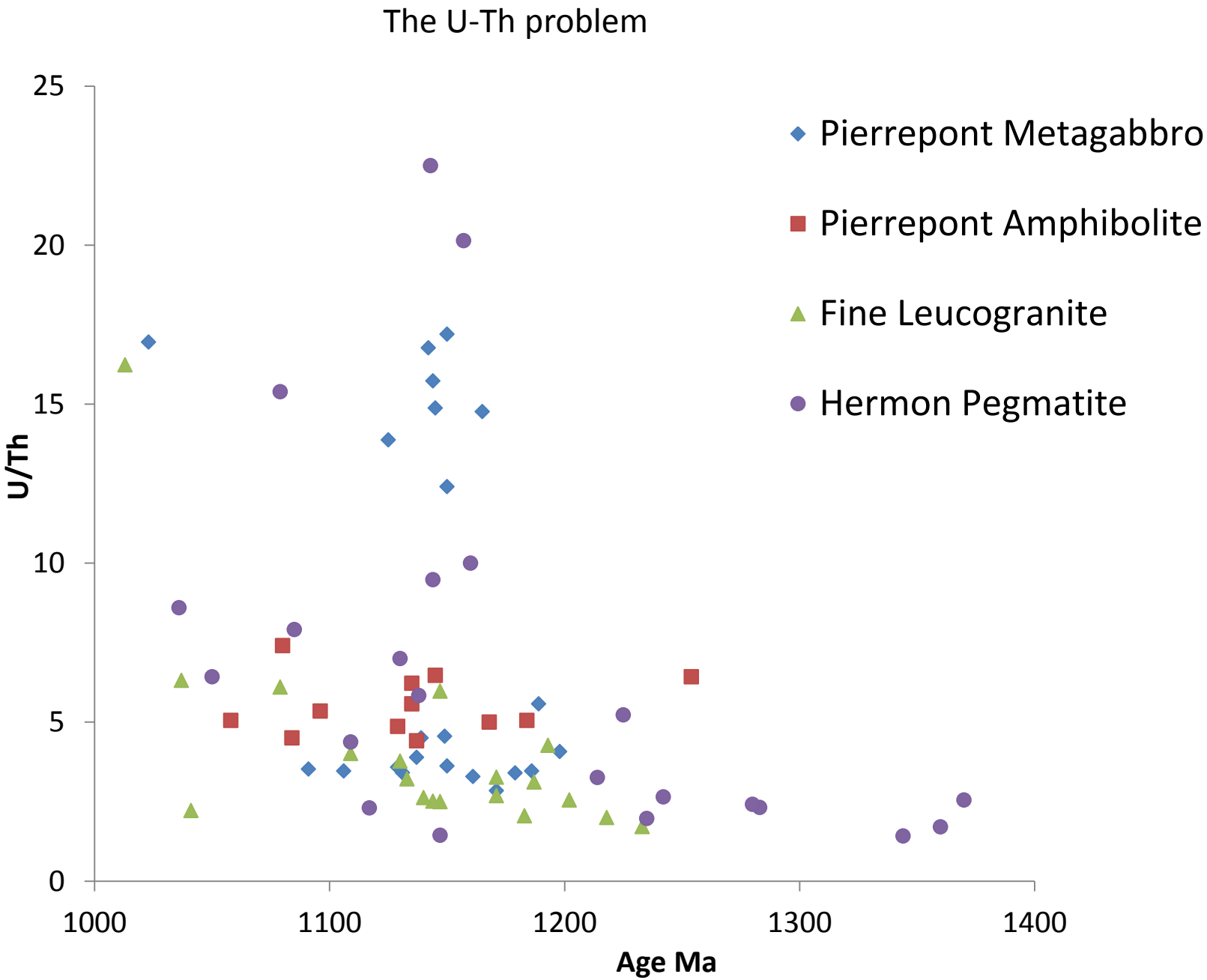
Final Age = 1056.6 ± 9.1 Ma
Mean = 1056.6±3.4 [0.32%] 2σ
Wtd by data-pt errs only, 0 of 11 rej.
MSWD = 1.5, probability = 0.13

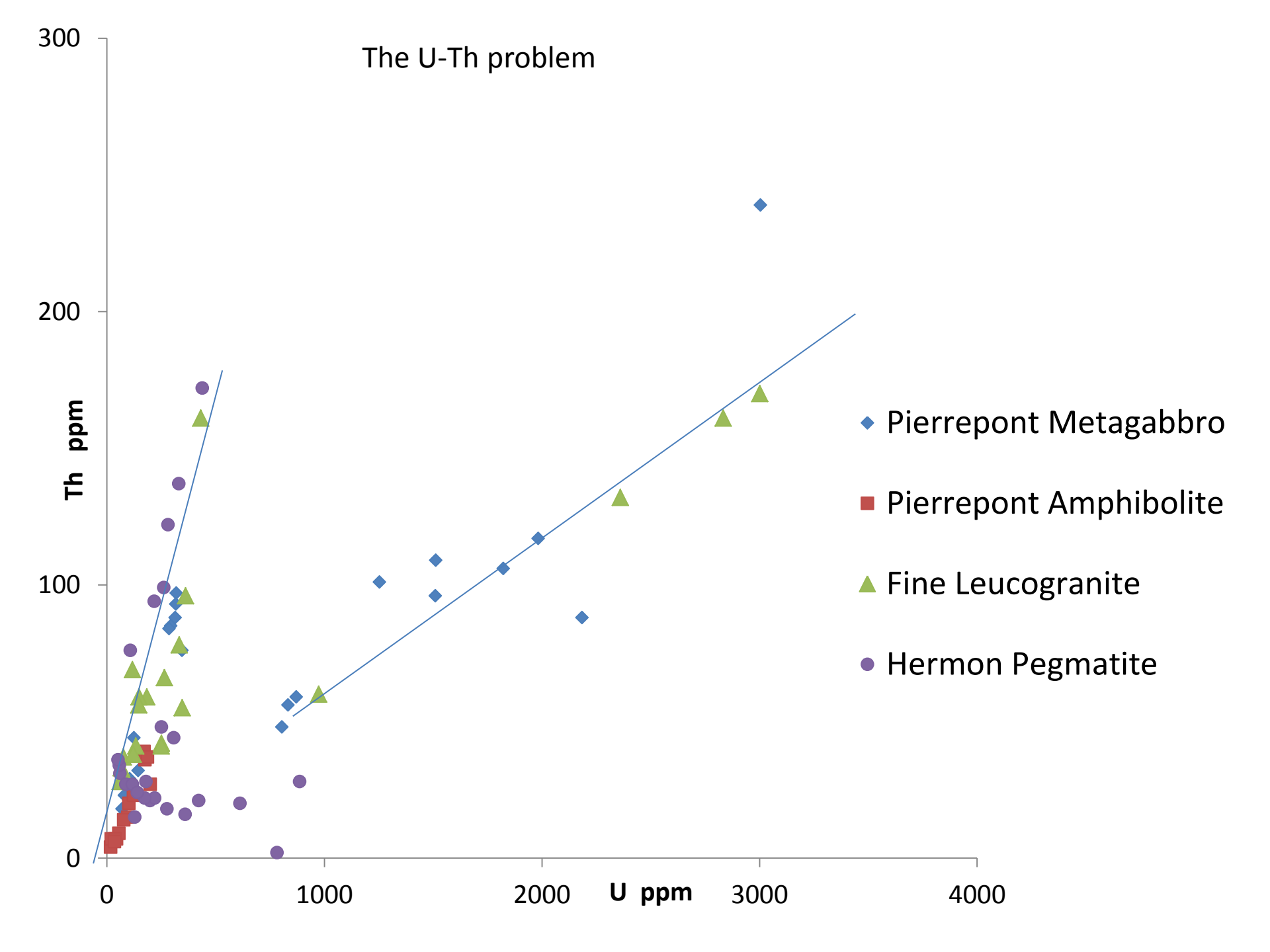


WP


The U-Th problem
100
80
60
40
20
0
U/Th
950
1050
1150
1250
Age - Ma
Seveys Amphibolite
Indian River Road
Sellecks Corners
Brouses Corners
Are U-Th ratios useful indicators of igneous vs. metamorphic crystallization of zircon?


The U-Th problem
250
200
150
100
50
0
Th ppm
0
500
1000
1500
2000
U ppm
Seveys Amphibolite
Indian River Road
Sellecks Corners
Brouses Corners
U vs Th - note variation within samples; linear arrays with different slopes.


The U-Th problem
25
20
15
10
5
0
U/Th
1000
1100
1200
1300
1400
Age Ma
Pierrepont Metagabbro
Pierrepont Amphibolite
Fine Leucogranite
Hermon Pegmatite


The U-Th problem
300
200
100
0
Th ppm
0
1000
2000
U ppm
3000
4000
Pierrepont Metagabbro
Pierrepont Amphibolite
Fine Leucogranite
Hermon Pegmatite