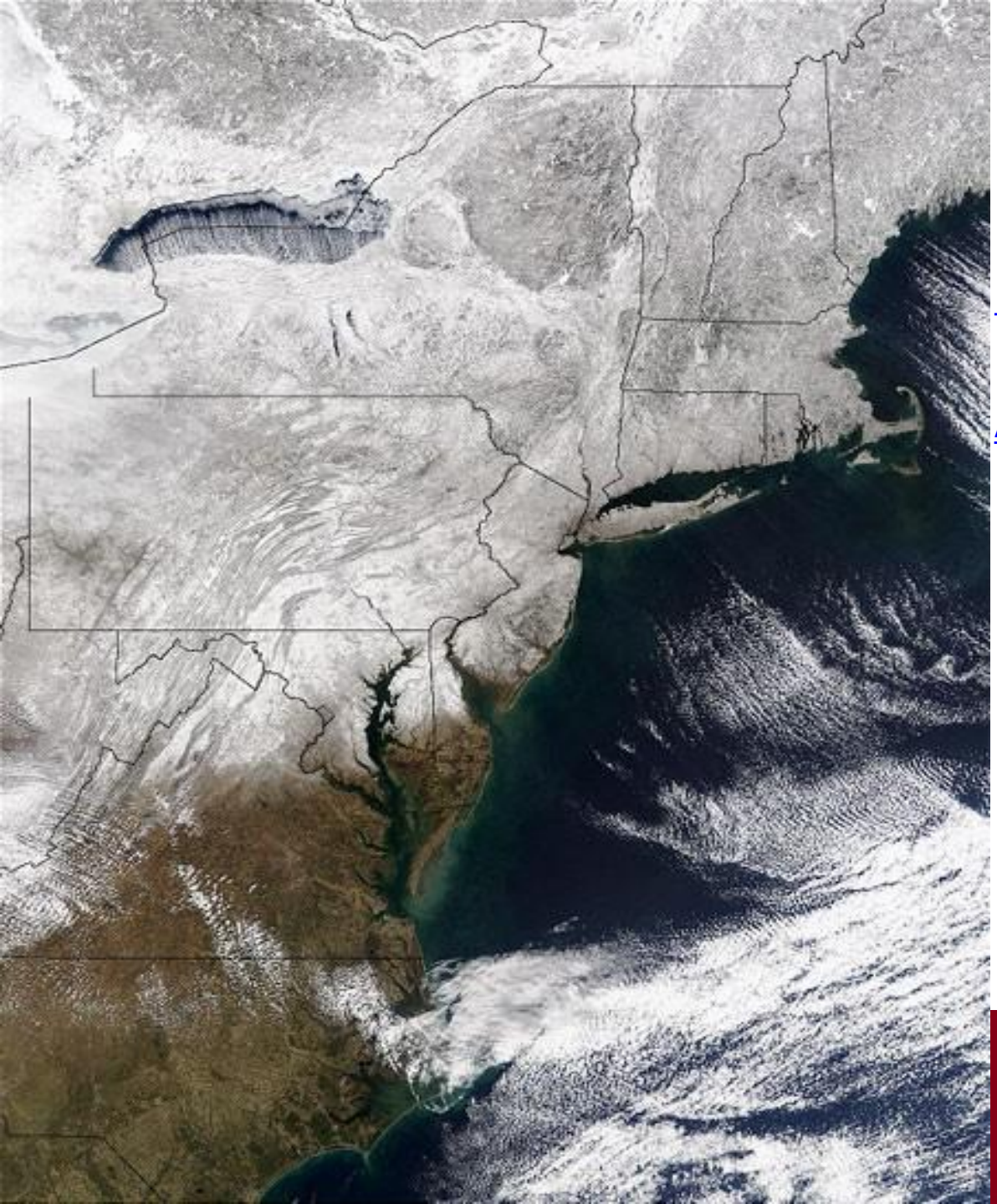

DETRITAL ZIRCON GEOCHRONOLOGY AND PROVENANCE OF MIDDLE AND UPPER DEVONIAN STRATA, NORTHERN APPALACHIAN BASIN OF NEW YORK STATE

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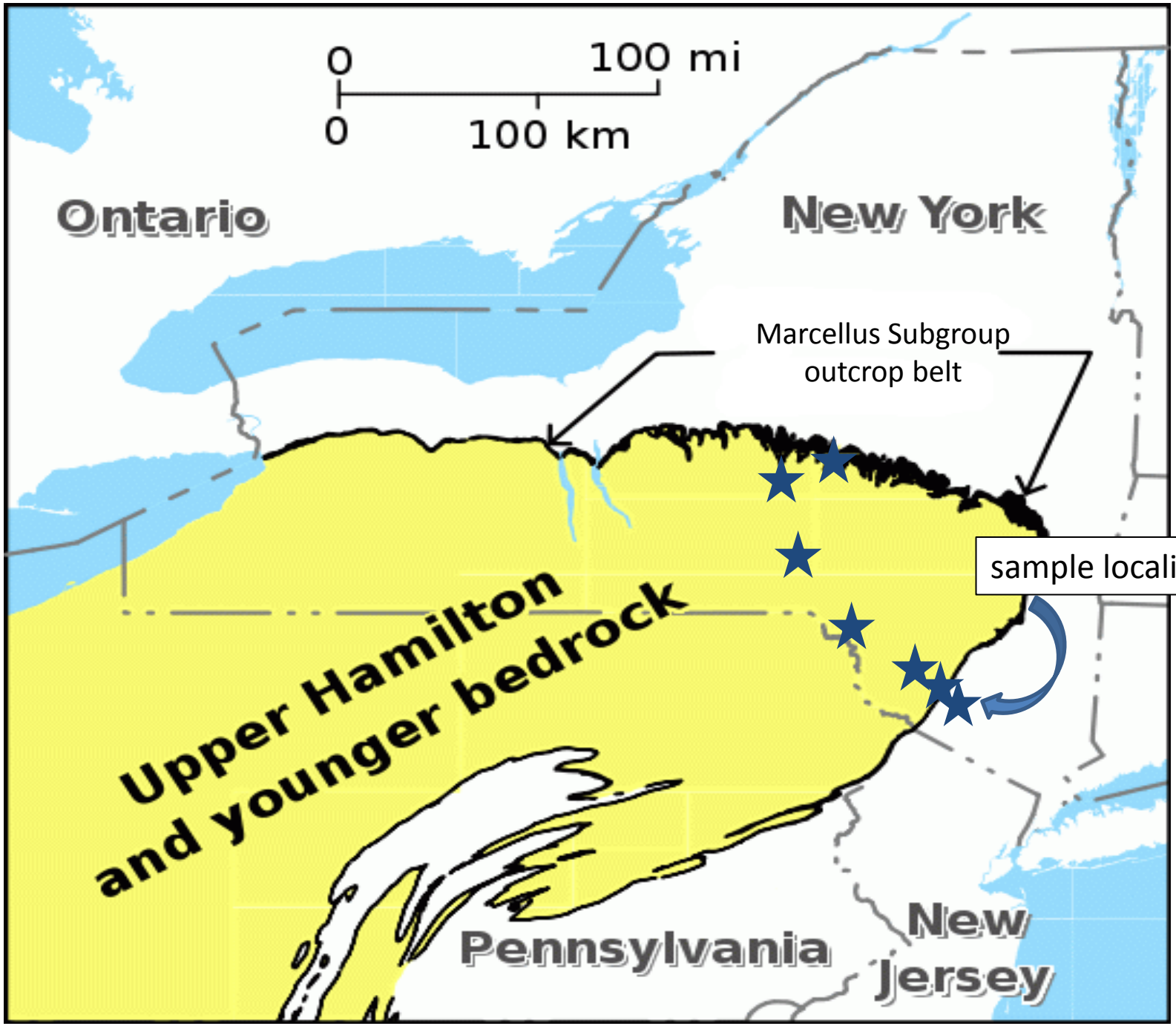
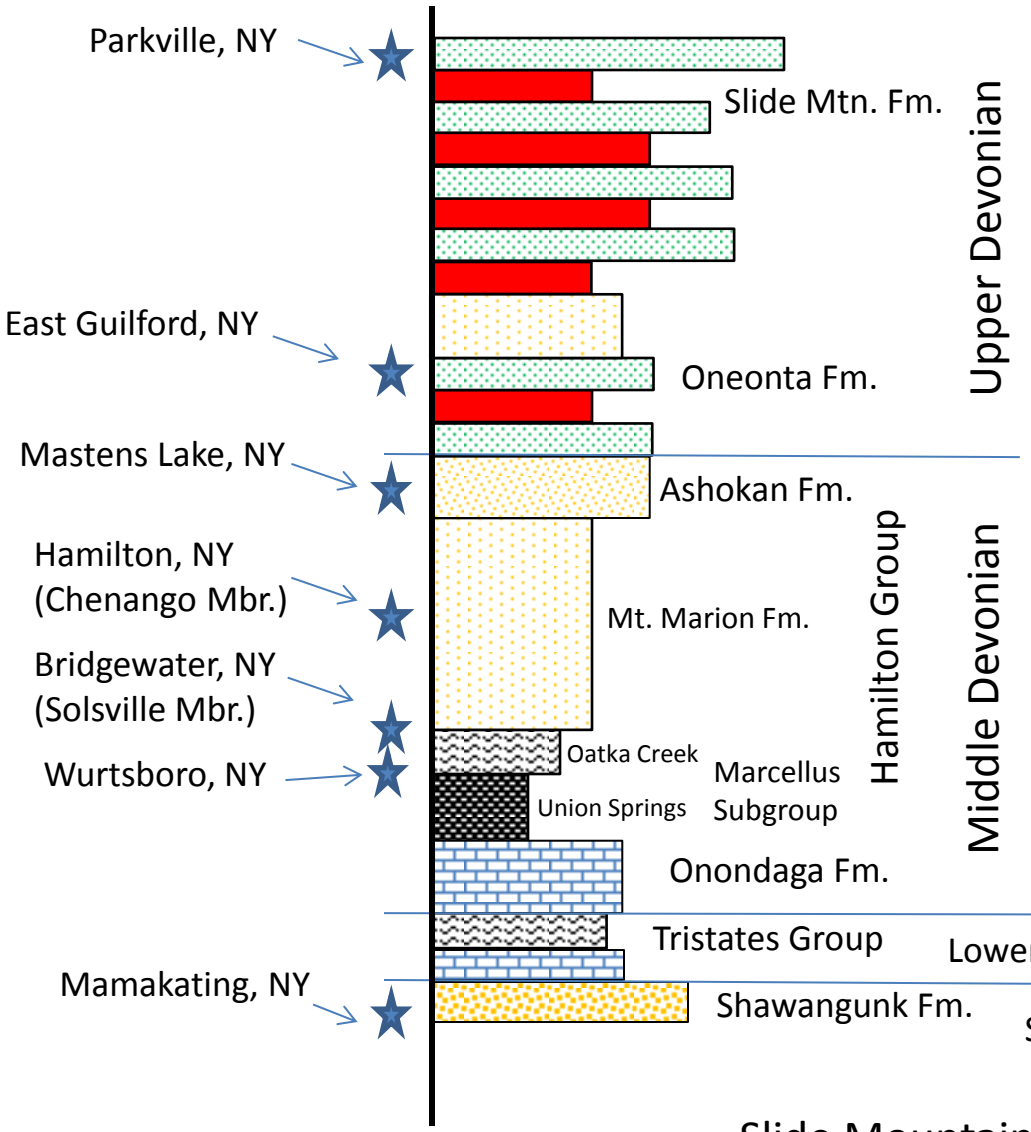
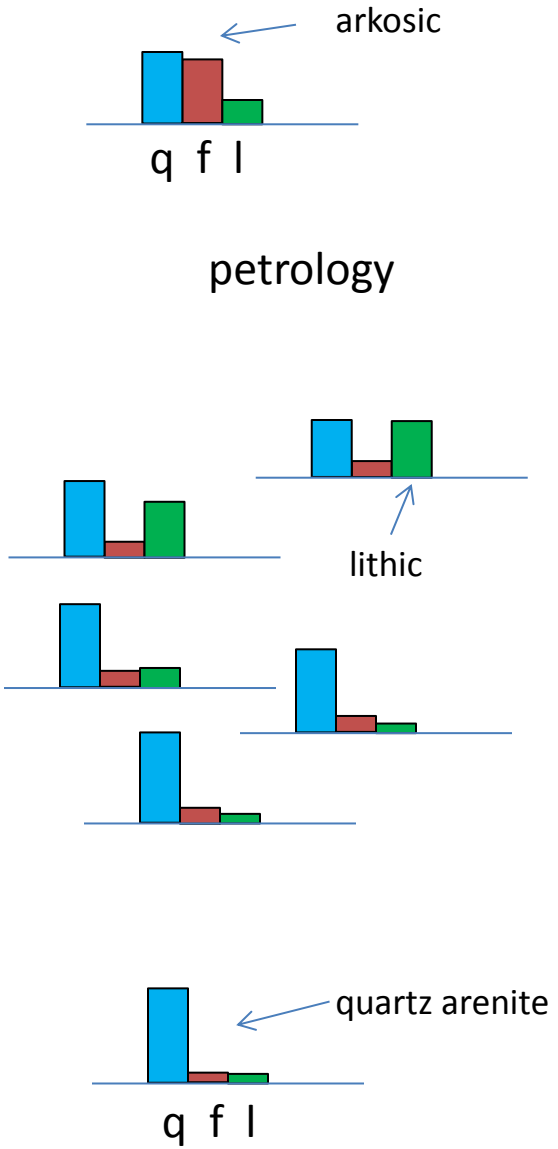
Colgate UNIVERSITY



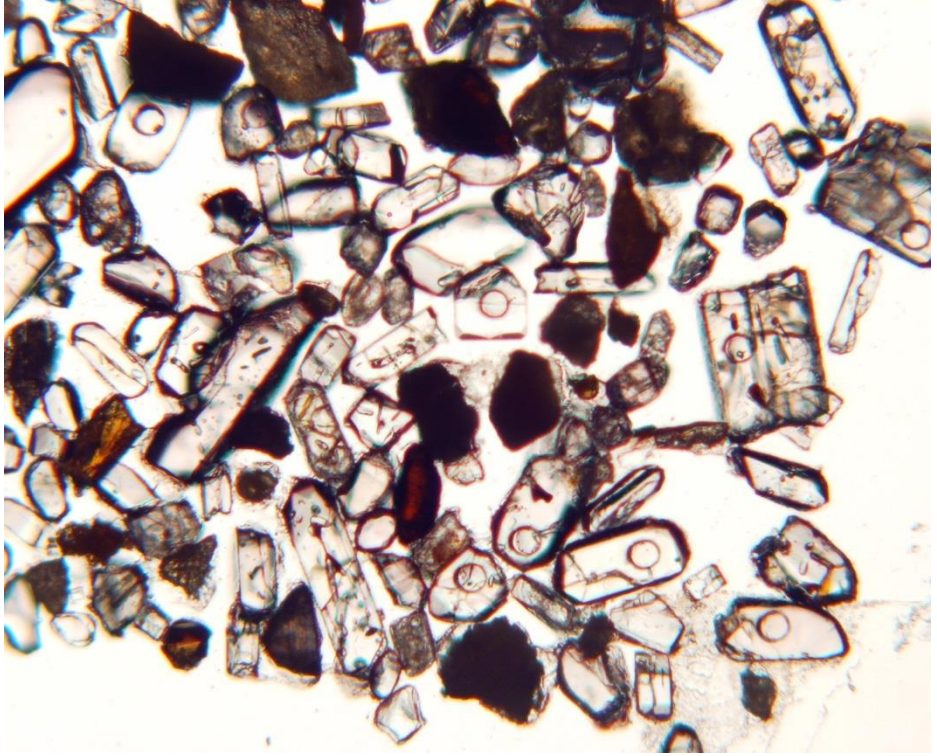
modified after Steven Schimmrich hudsonvalleygeologist.blogspot.com

sample localities

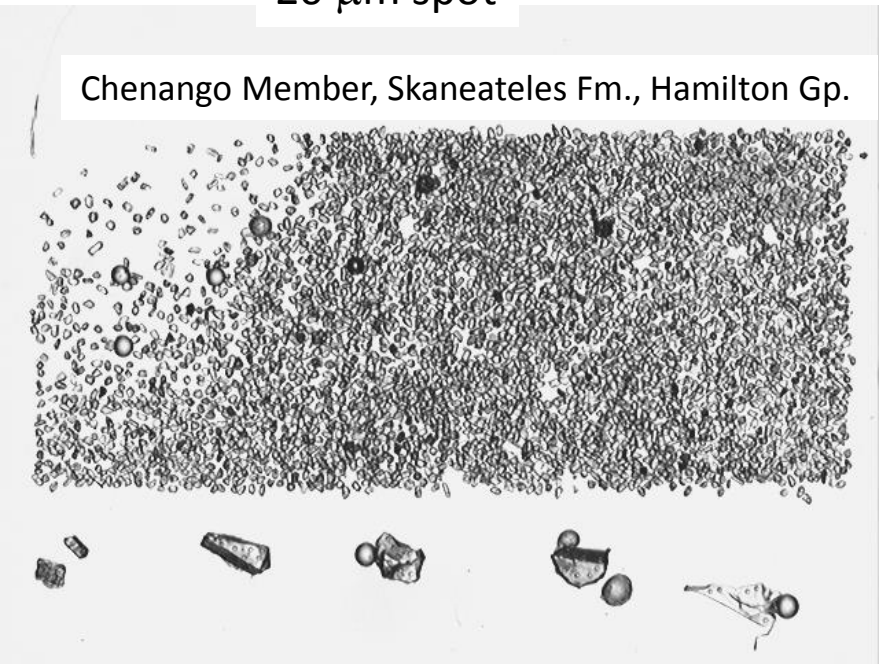




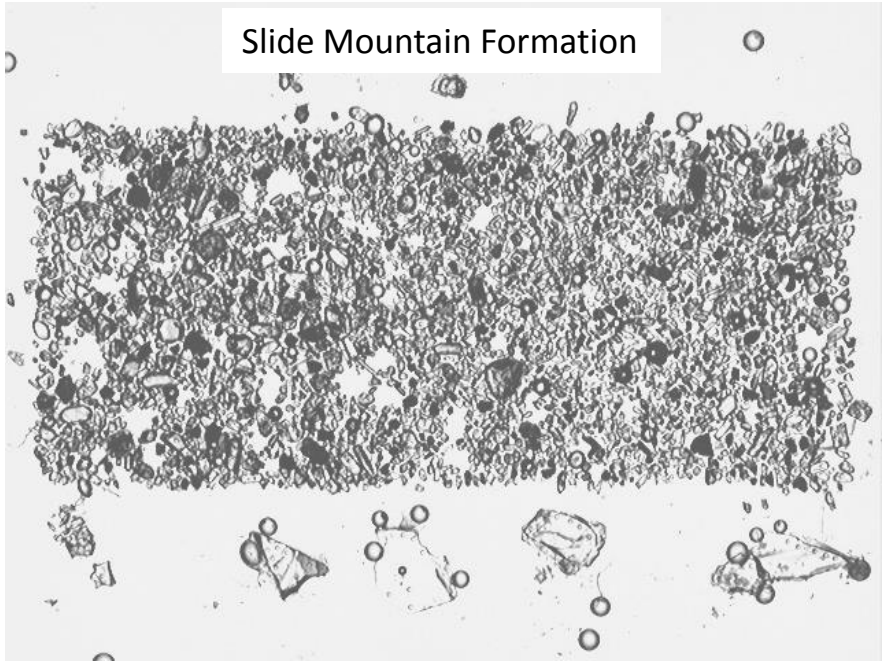
Slide Mountain – feldspathic
Upper Hamilton Group, Oneonta – lithic
Marcellus Subgroup – quartz-rich



Chenango Member, Skaneateles Fm., Hamilton Gp.



Slide Mountain Formation



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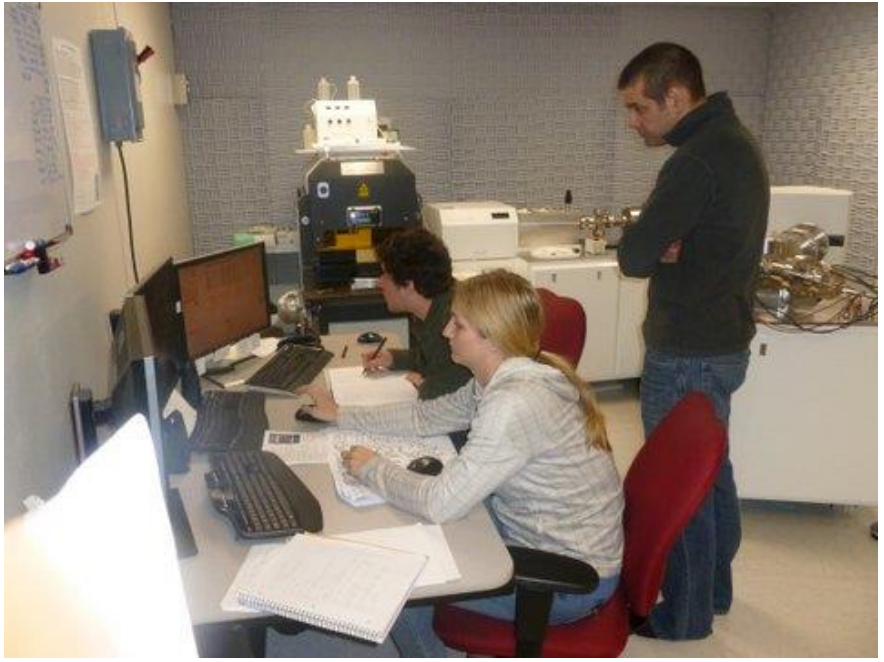
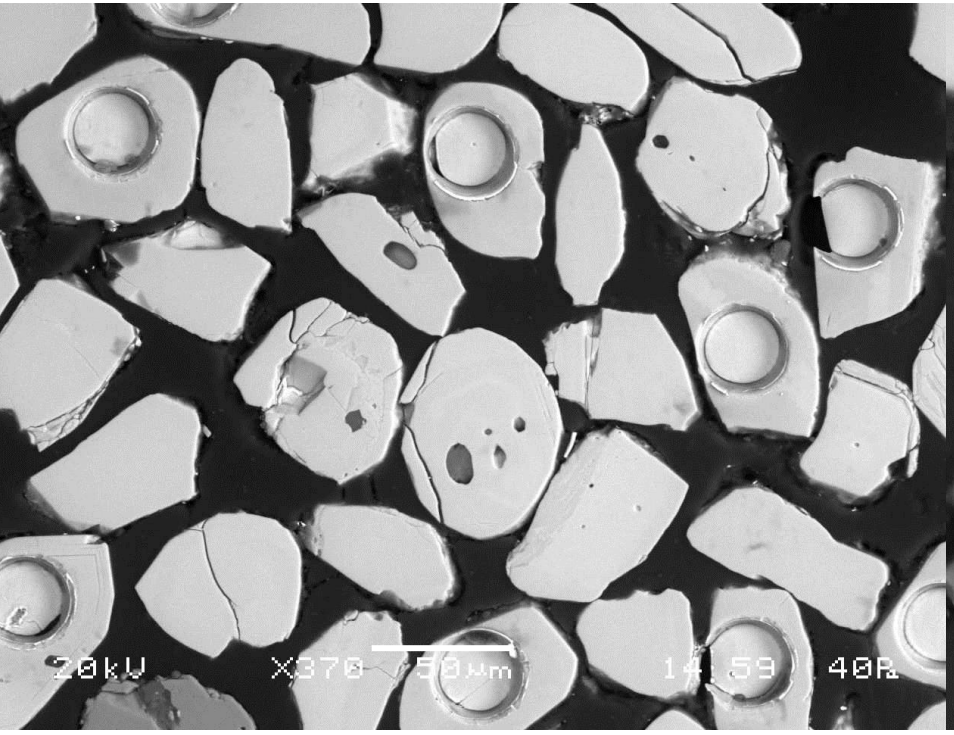
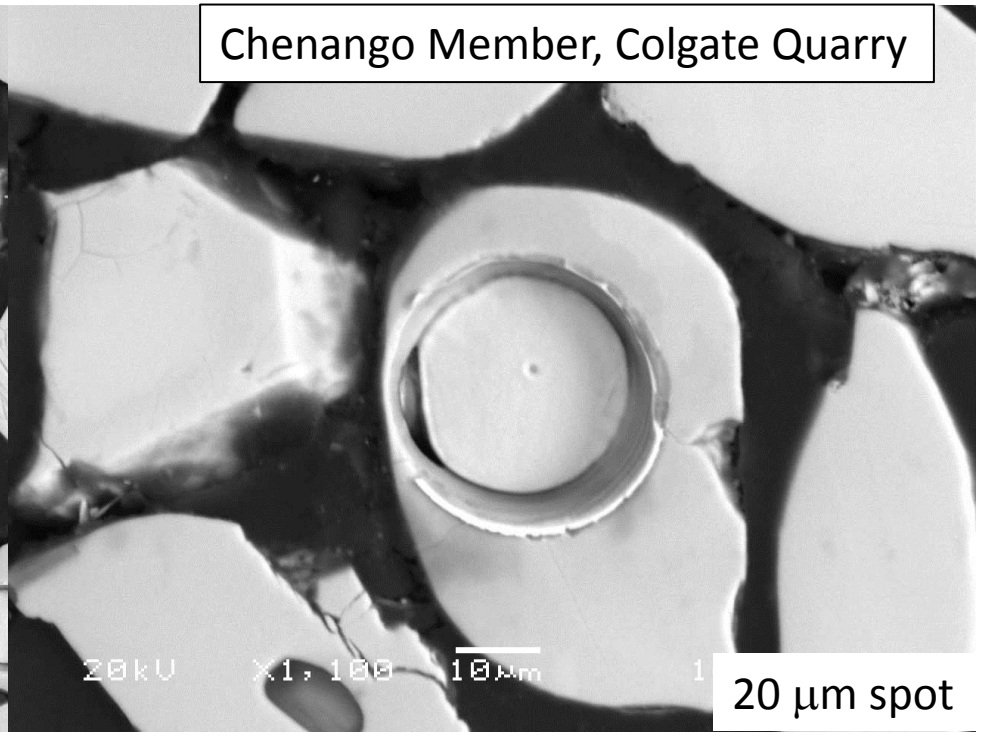
University of Arizona

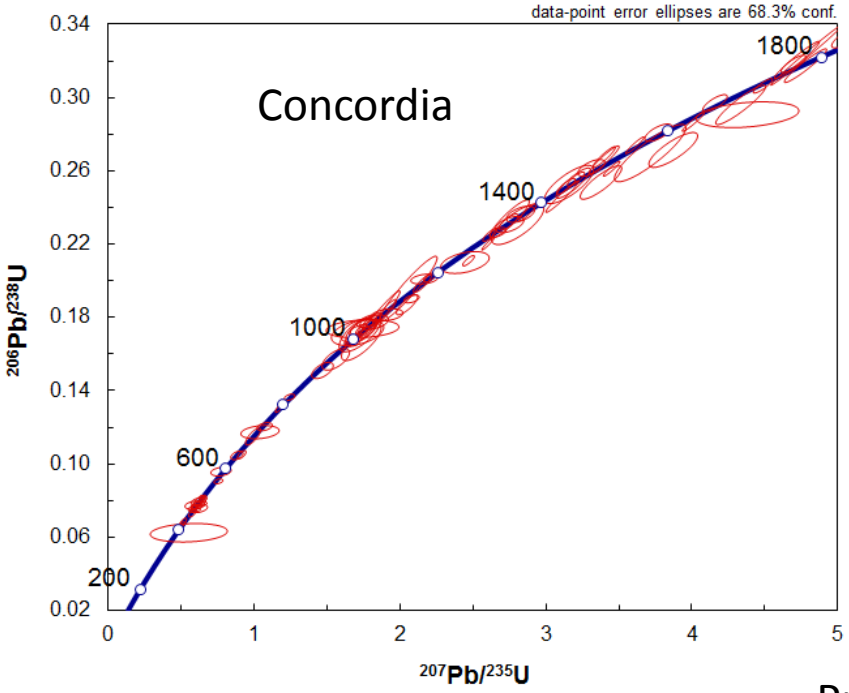






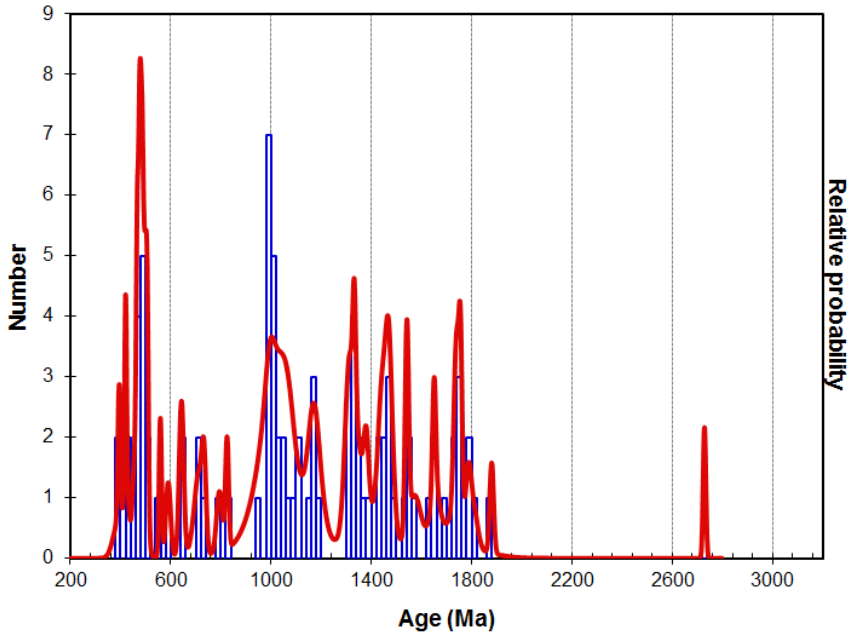
Chenango Member, Colgate Quarry

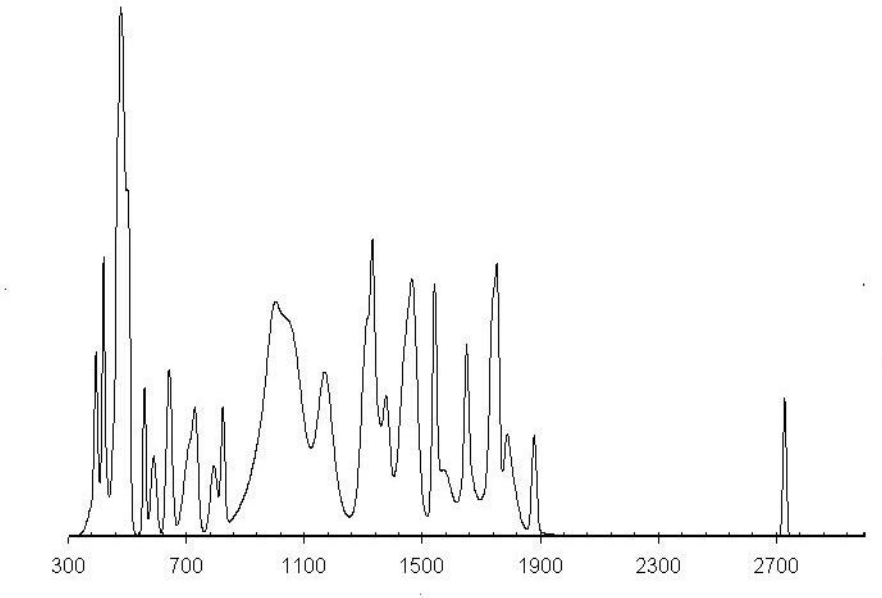
20 µm spot



Chenango Member, Skaneateles Formation,
Hamilton Group, Colgate Quarry

Probability-density





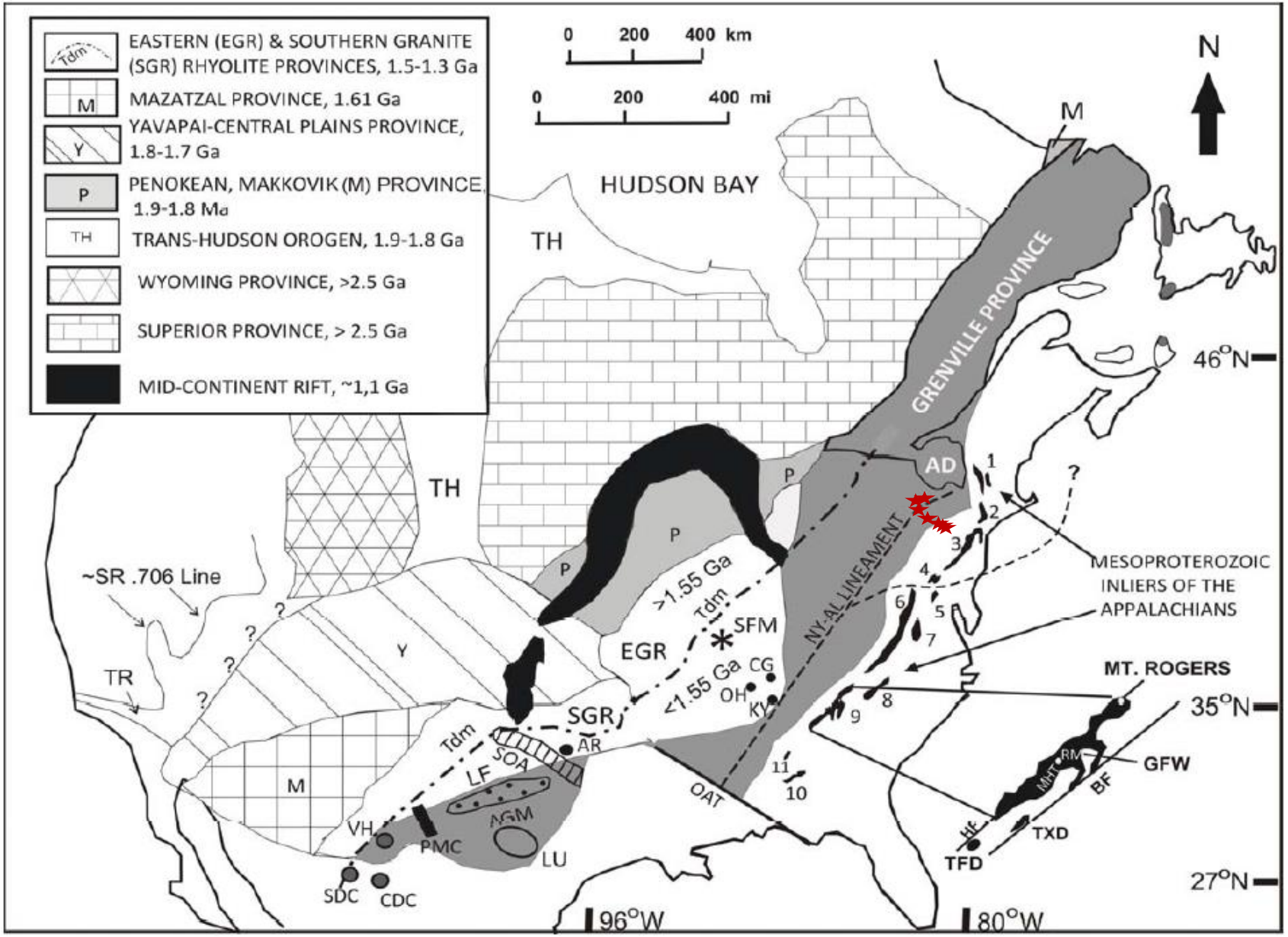
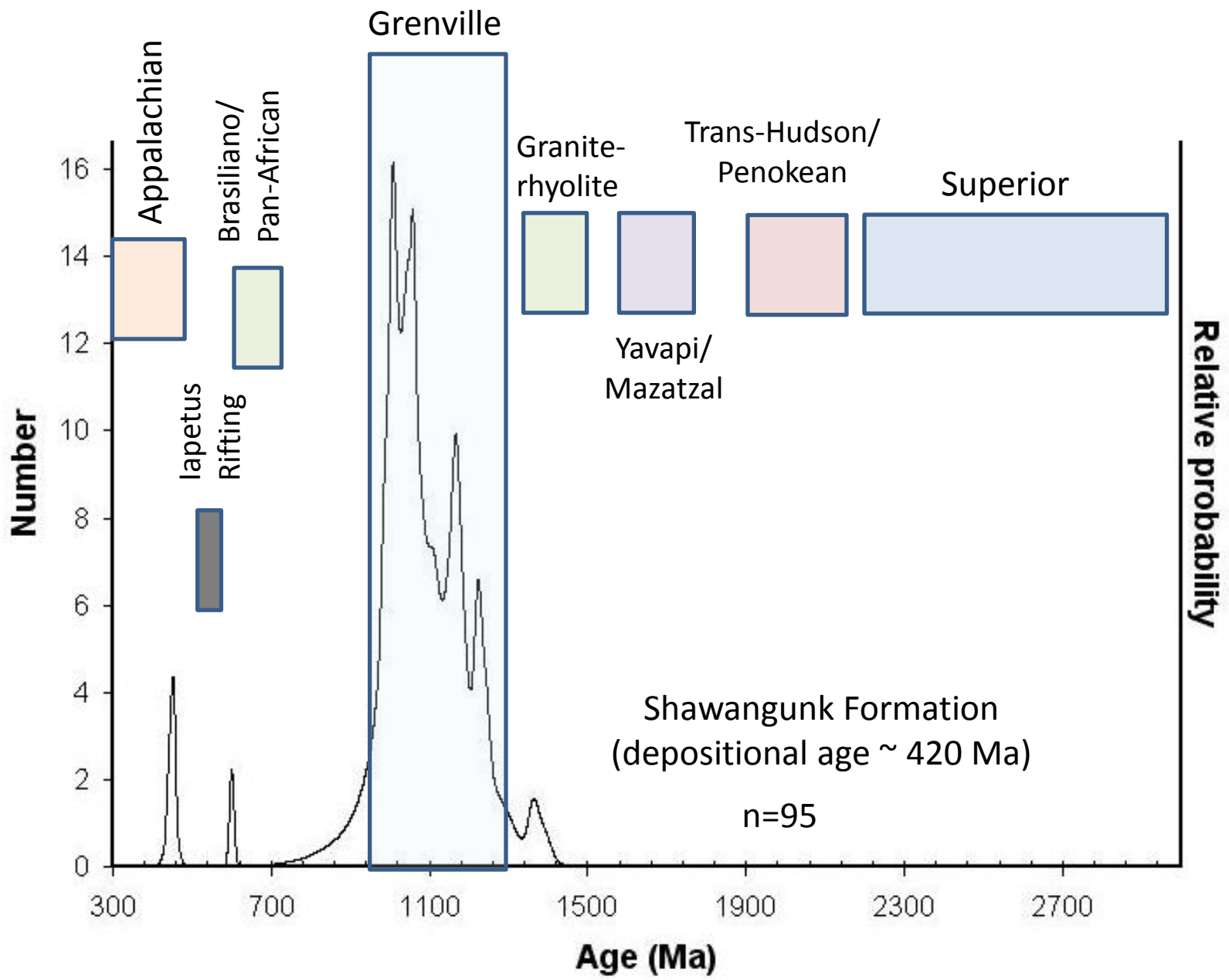
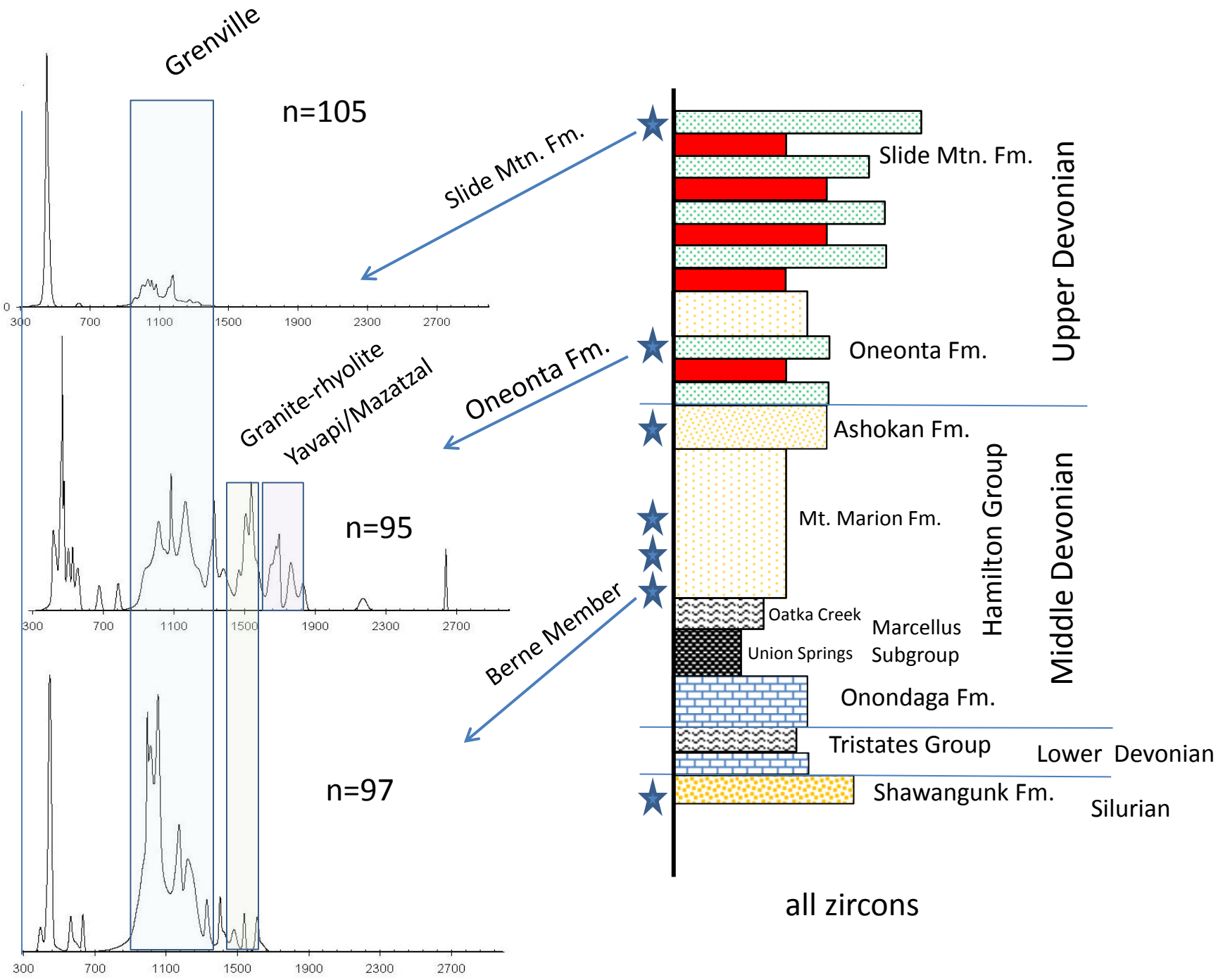
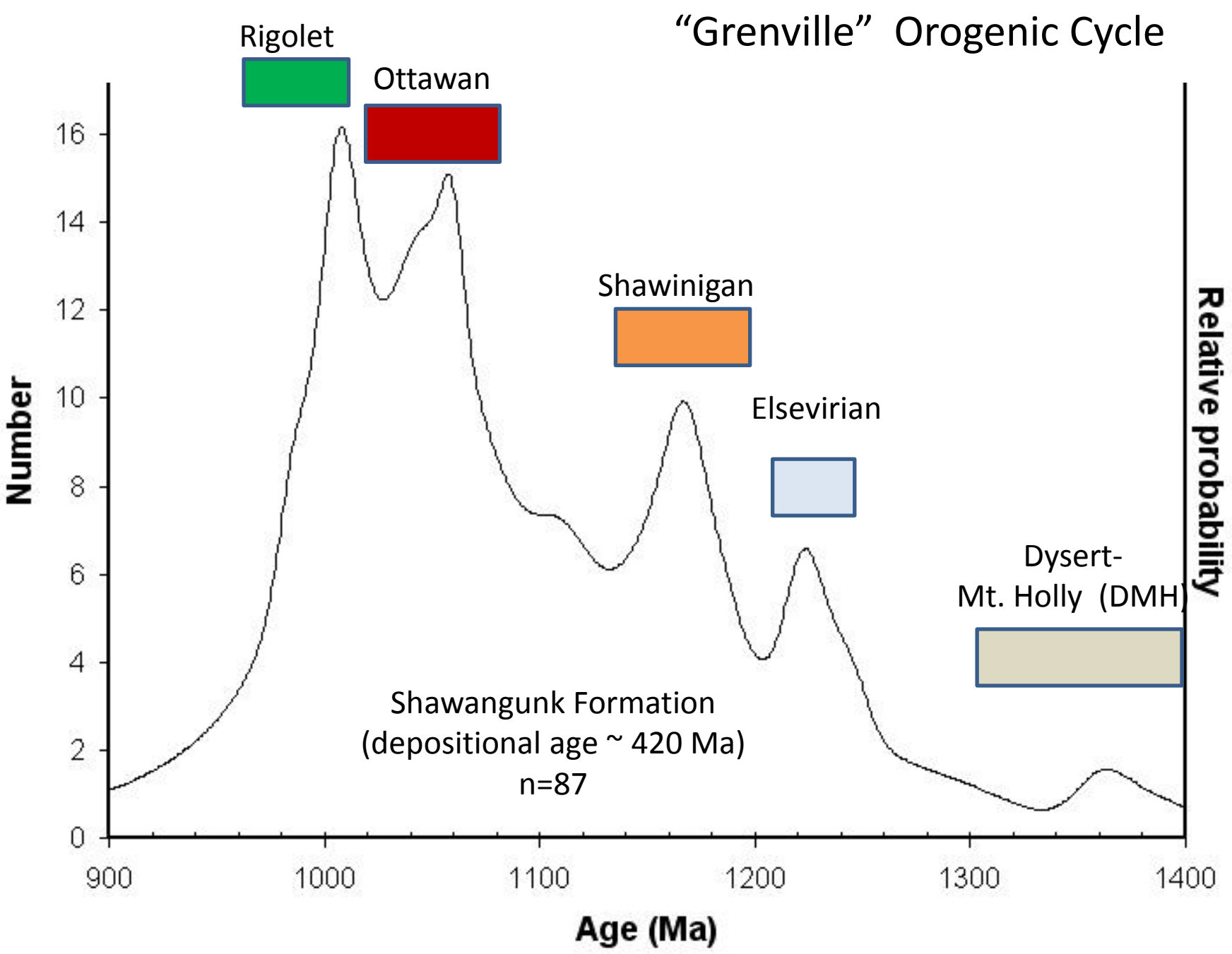


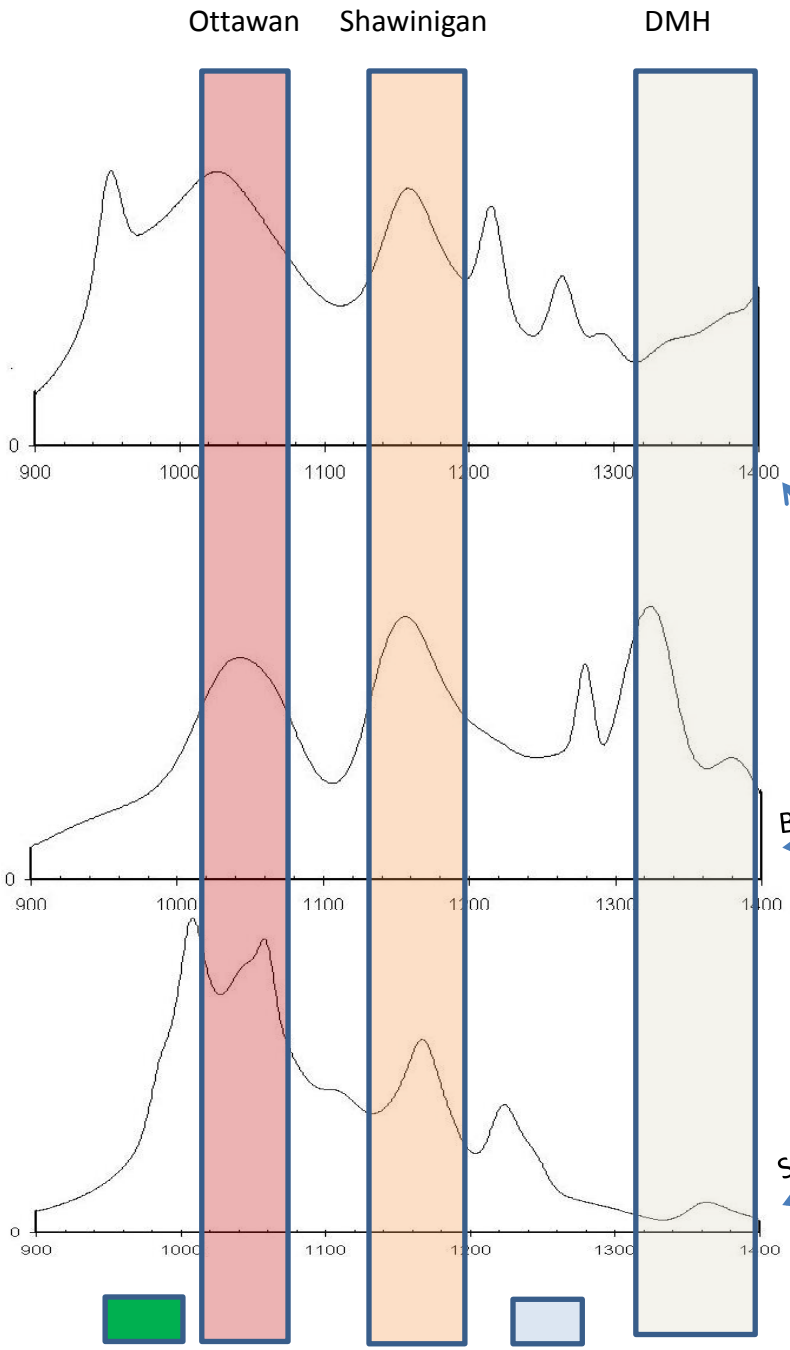
Figure 1. Generalized map depicting major tectonic and geochronological subdivisions in the USA. The Grenville Province is shown in medium gray and its exposed portions are indicated by heavy outlines. **Abbreviations**: AD = Adirondack Mountains,

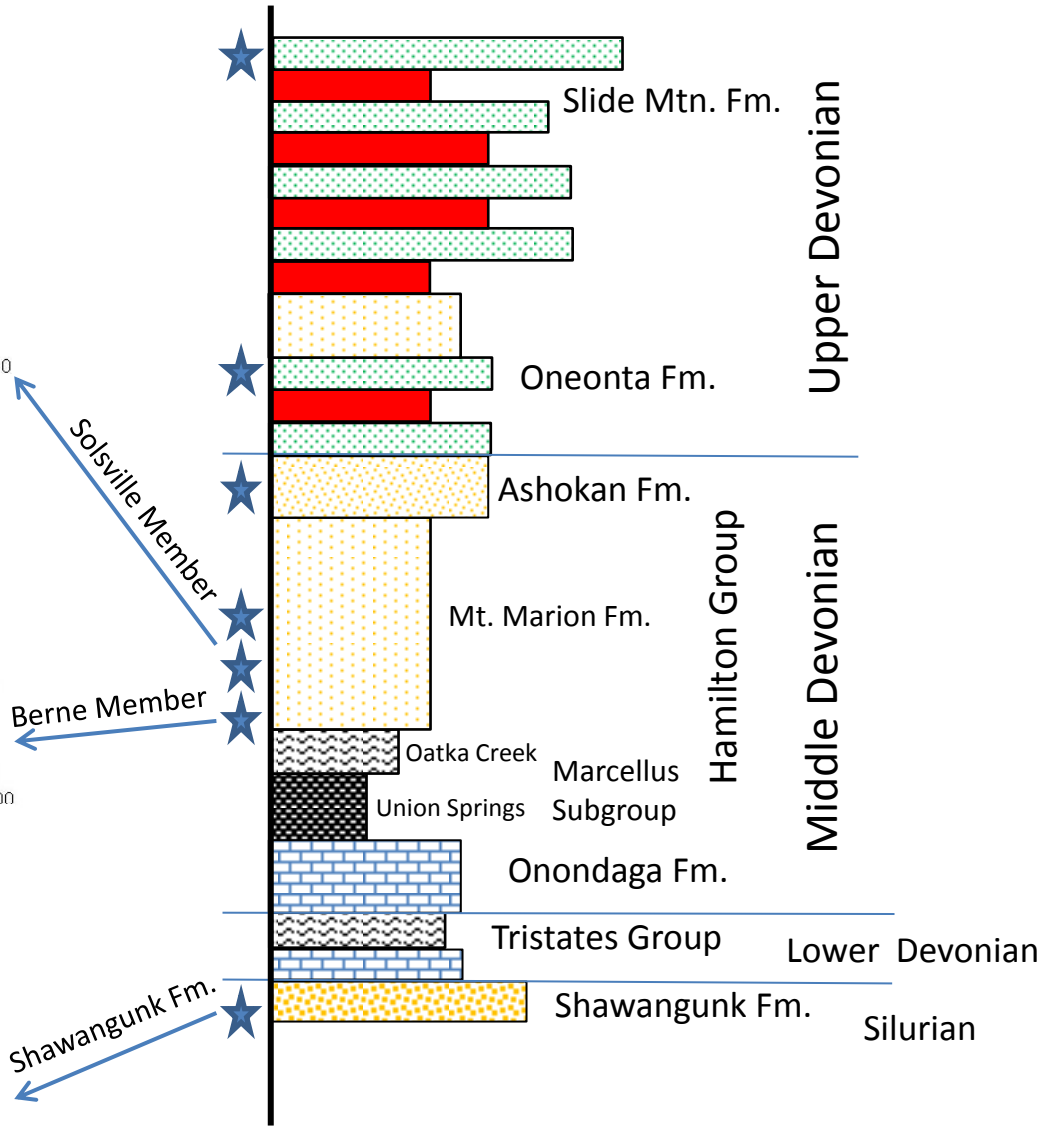
(from Tectonic Evolution of the Adirondack Mountains and Grenville Orogen Inliers within the USA, McLelland, et al, 2013)


Grenville
Appalachian
Brasiliano/
Pan-African
Granite-
rhyolite
Trans-Hudson/
Penokean
Superior
Yavapi/
Mazatzal
Iapetus
Rifting
Number
Relative probability
16
14
12
10
8
6
4
2
0
300
700
1100
1500
1900
2300
2700
Age (Ma)
Shawangunk Formation
(depositional age ~ 420 Ma)
n=95

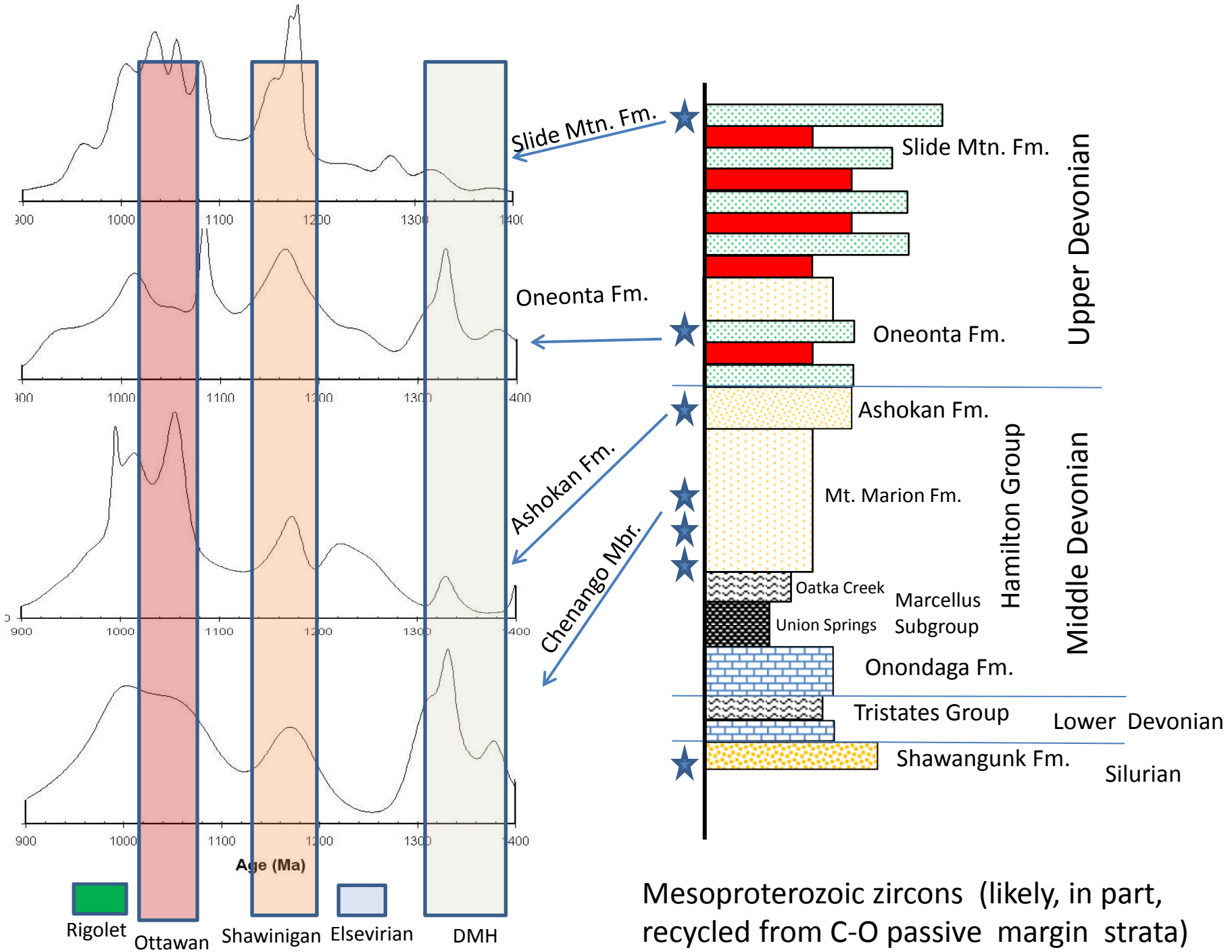

Grenville
n=105
Slide Mtn. Fm.
Granite-rhyolite
Yavapi/Mazatzal
Oneonta Fm.
n=95
Berne Member
n=97
300
700
1100
1500
1900
2300
2700
Slide Mtn. Fm.
Oneonta Fm.
Ashokan Fm.
Mt. Marion Fm.
Oatka Creek
Union Springs
Marcellus
Subgroup
Onondaga Fm.
Tristates Group
Shawangunk Fm.
Hamilton Group
Upper Devonian
Middle Devonian
Lower Devonian
Silurian
all zircons


"Grenville" Orogenic Cycle
Rigolet
Ottawan
Shawinigan
Elsevirian
Dysert-
Mt. Holly (DMH)
Shawangunk Formation
(depositional age ~ 420 Ma)
n=87
Number
Relative probability
Age (Ma)
0
2
4
6
8
10
12
14
16
900
1000
1100
1200
1300
1400





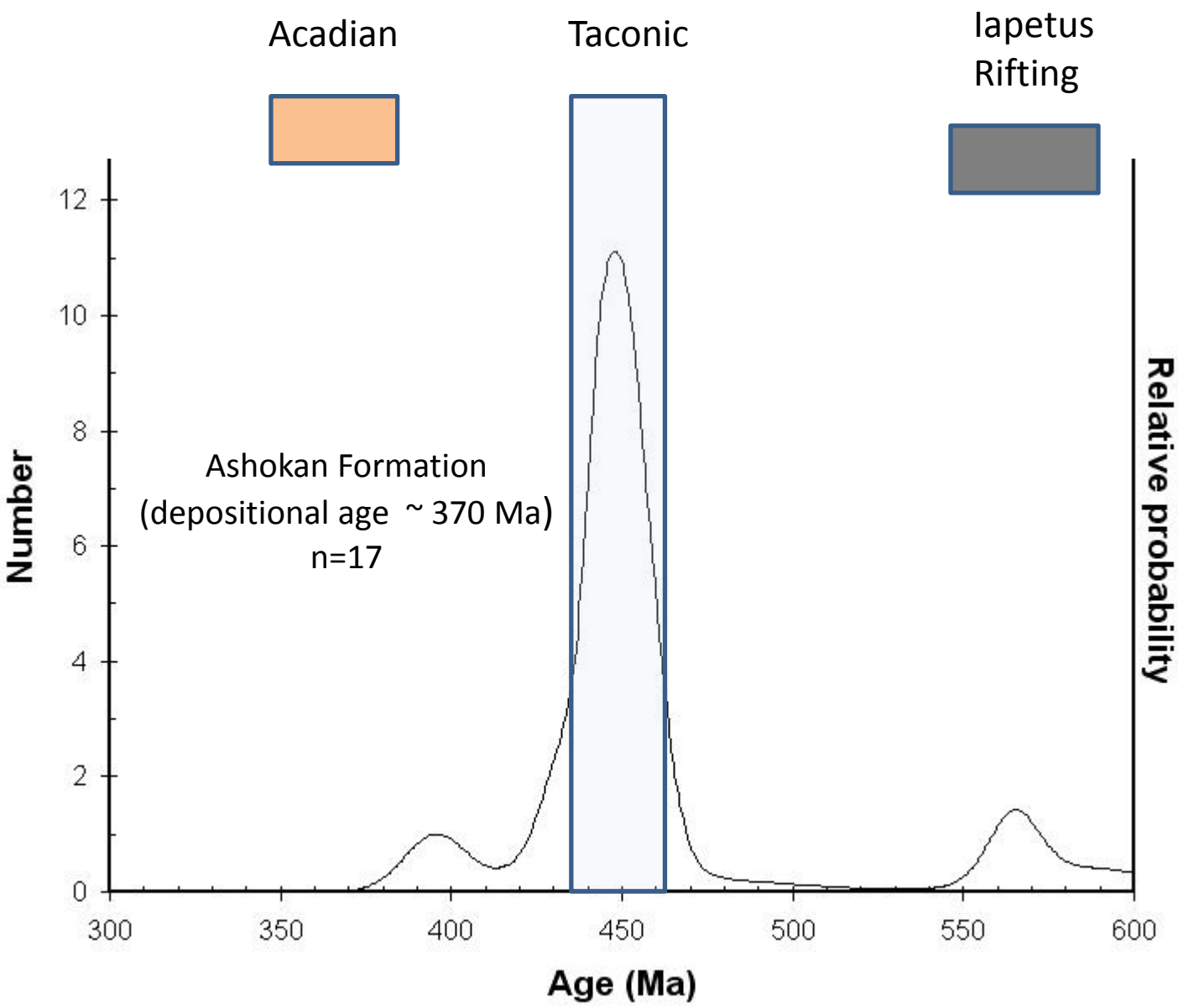
Mesoproterozoic zircons (likely, in part, recycled from C-O passive margin strata)

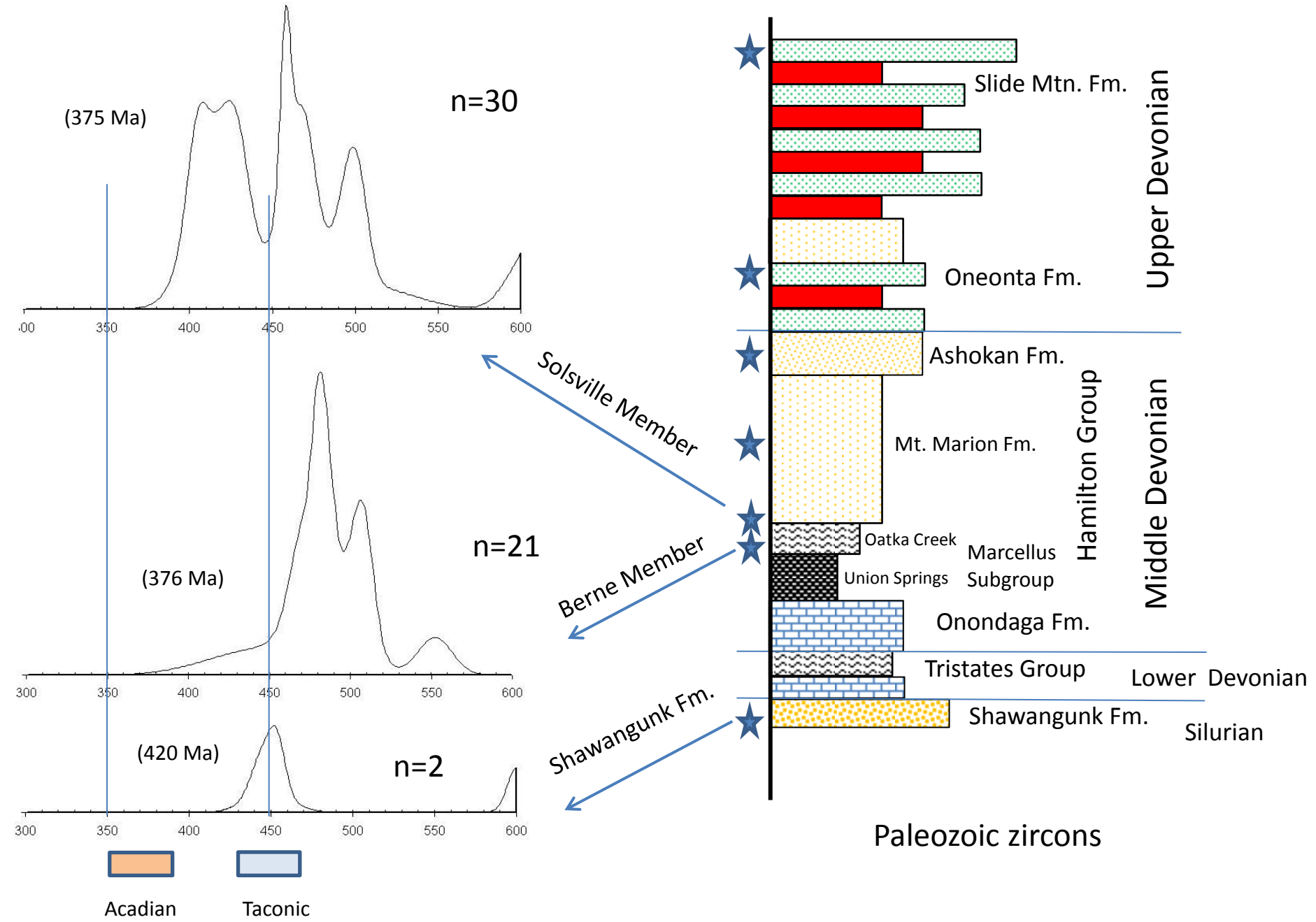


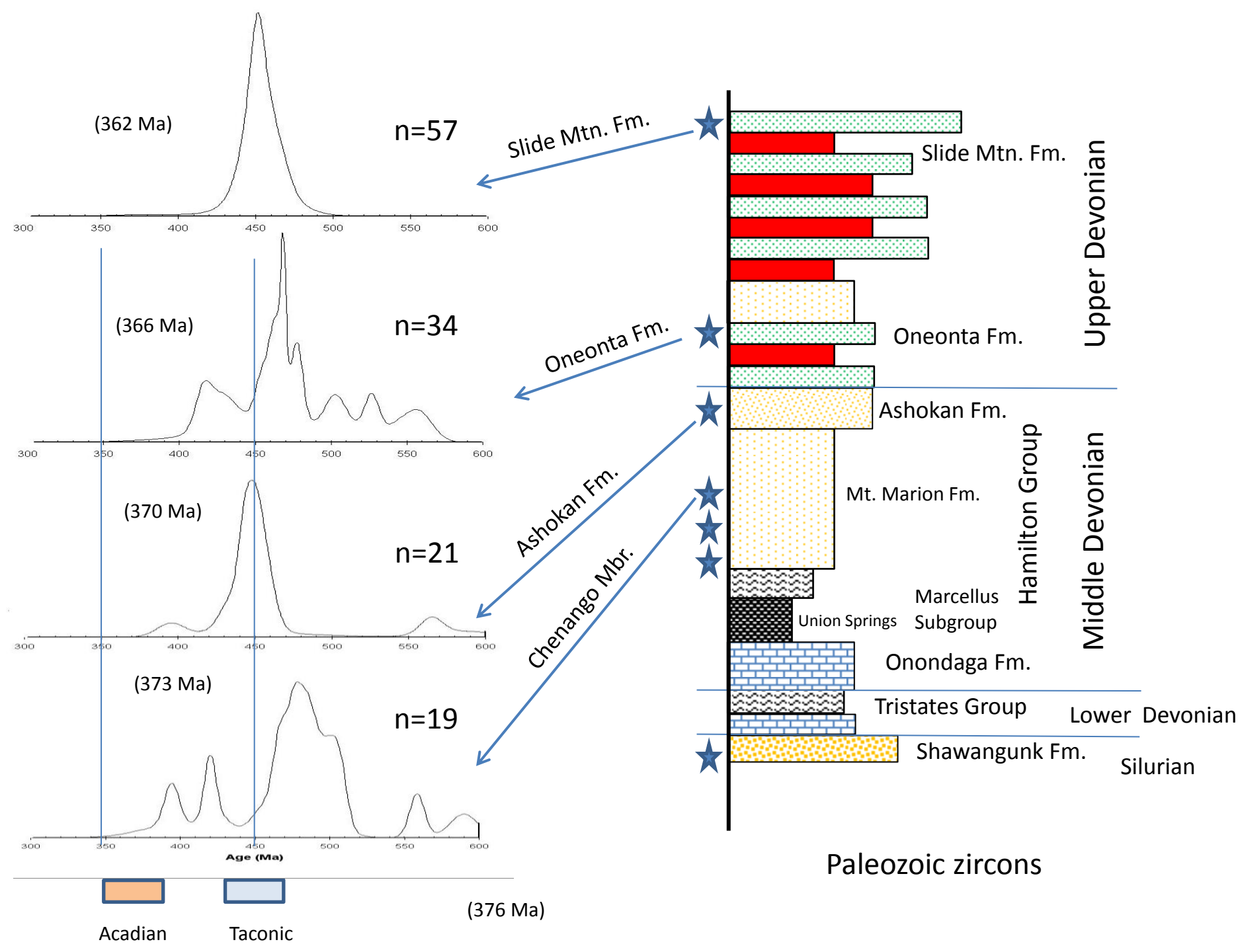
Mesoproterozoic zircons (likely, in part, recycled from C-O passive margin strata)

Proterozoic zircons :

- older Proterozoic and Archean zircons may be recycled from ‘Grenville” metasedimentary sources
- additional recycling from early Paleozoic passive margin and foreland basin clastics, plus derivation from exposed basement
- Middle Devonian samples dominated by ‘Grenville’ sources
- Oneonta Formation suite includes mid-continent sources
- “Grenville” zircon component relatively reduced in upper Devonian samples
- Variable Shawinigan vs. Dysert-Mt. Holly “Grenville” suites

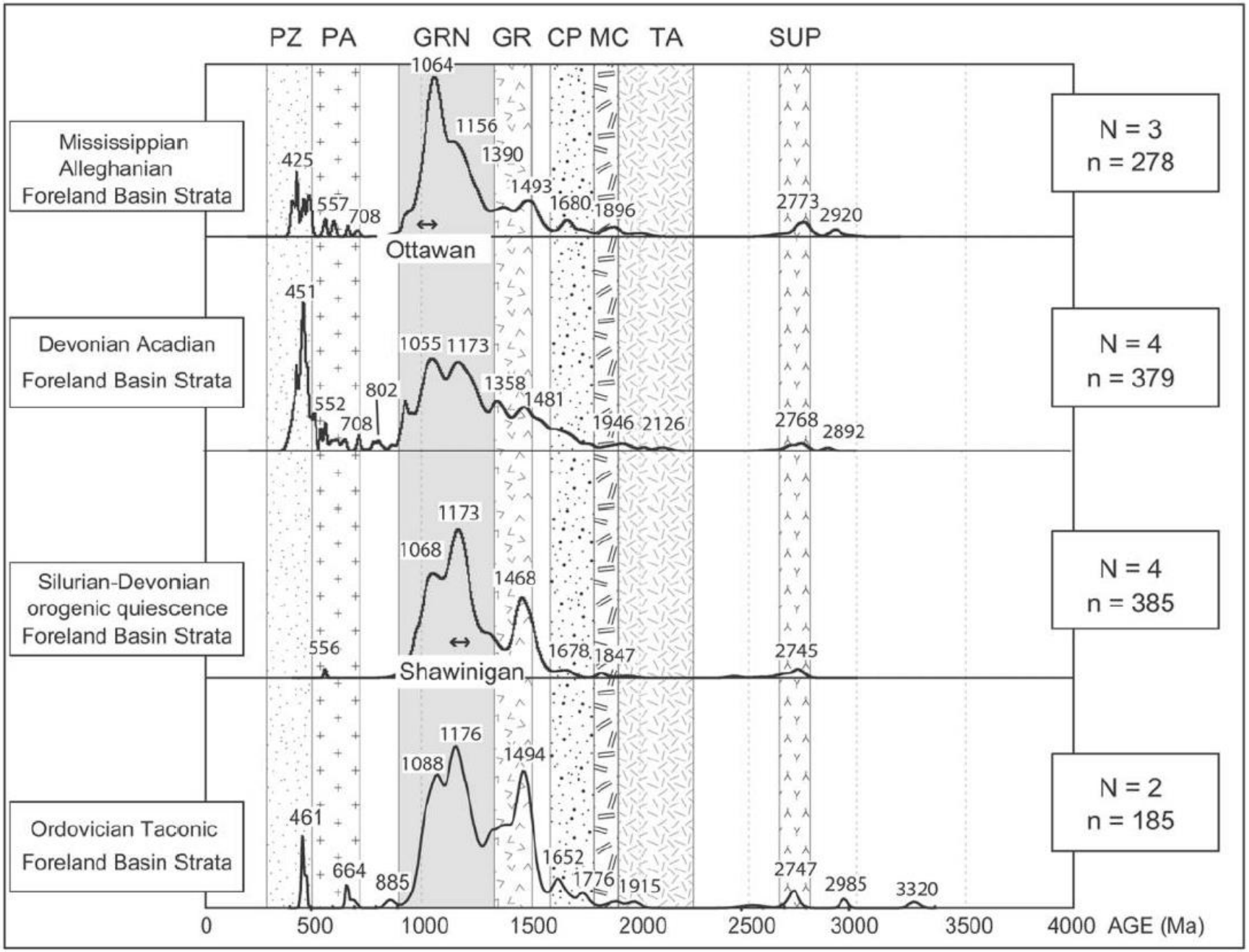

Acadian
Taconic
Iapetus
Rifting
Ashokan Formation
(depositional age ~ 370 Ma)
n=17
Number
Relative probability
Age (Ma)
0
2
4
6
8
10
12
300
350
400
450
500
550
600


(375 Ma)
n=30
(376 Ma)
n=21
(420 Ma)
n=2
300
350
400
450
500
550
600
Acadian
Taconic
Solsville Member
Berne Member
Shawangunk Fm.
Slide Mtn. Fm.
Oneonta Fm.
Ashokan Fm.
Mt. Marion Fm.
Oatka Creek
Union Springs
Marcellus Subgroup
Onondaga Fm.
Tristates Group
Shawangunk Fm.
Hamilton Group
Upper Devonian
Middle Devonian
Lower Devonian
Silurian
Paleozoic zircons


(362 Ma)
n=57
(366 Ma)
n=34
(370 Ma)
n=21
(373 Ma)
n=19
300
350
400
450
500
550
600
Age (Ma)
Acadian
Taconic
(376 Ma)
Slide Mtn. Fm.
Oneonta Fm.
Ashokan Fm.
Chenango Mbr.
Slide Mtn. Fm.
Oneonta Fm.
Ashokan Fm.
Mt. Marion Fm.
Marcellus Subgroup
Union Springs
Onondaga Fm.
Tristates Group
Shawangunk Fm.
Upper Devonian
Middle Devonian
Hamilton Group
Lower Devonian
Silurian
Paleozoic zircons

Paleozoic zircons:

- Taconic (~440 Ma) zircons dominate
- minor early Acadian (410-380 Ma) zircons (volcanic?) in slightly younger strata
- minor contributions from Neoprot. and early Pal. (Iapetan rift, Brasiliano/PanAfrican)
- significant proportional increase in Taconic zircons in Upper Devonian samples correlates with increased coarse feldspar in sandstone
- unroofing of arc plutons and high-grade Taconic arc basement



Park, et al, 2010. Application of Foreland Basin Detrital-Zircon Geochronology to the Reconstruction of the Southern and Central Appalachian Orogen.

Detrital zircons from Middle and Upper Devonian strata in the northern Appalachian Basin of New York State record the increasing importance of hinterland source regions during the Acadian Orogeny. Zircon suites from the Marcellus Subgroup (Mt. Marion and Oatka Creek Formations) and overlying Skaneateles and Ashokan Formations are dominated by Grenville Orogen (950-1350 Ma) with modest Taconic/early Acadian (400-450 Ma) age clusters, plus 550–700 Ma (Brasiliano/Pan-African, per Park, et al, 2010) and 1600–1800 Ma (Yavapi/Mazatzal) populations. Zircons from 1400-1500 Ma (Granite-rhyolite Province) and 1800-1950 Ma (Trans-Hudson/Penokean Provinces) are also present. Superior Province (2500-3000 Ma) zircons are a very minor component in all Devonian samples. Zircon suites from the Upper Devonian Oneonta Formation resemble the Middle Devonian suite, with a substantial Grenville population. The overlying Upper Devonian Slide Mountain Formation zircon suite is dominated by Taconic/Acadian zircons, with minor Grenville contributions. One zircon sample from the Silurian Shawangunk Formation is dominated by Grenville zircons. The age distributions and relative abundances of zircon age clusters from Middle and Upper Devonian strata are consistent with previously reported Nd model ages of 1504-1825 Ma (Caesar, et al, 2010). The zircon data suggest that Marcellus Subgroup sediments accumulated during early phases of basin-filling, when cratonic and reworked passive margin sources were significant. Grenville zircon suites in the older strata are moderately biased toward younger Grenville ages (Ottawan Orogeny), perhaps indicating direct unroofing of Grenville basement during Marcellus deposition. The dominance of Taconic/Acadian zircons in the Upper Devonian Slide Mountain Formation reflects derivation from volcanic and plutonic rocks of the Acadian collisional margin. Coarse clastics of the Slide Mountain contain abundant monocrystalline potash feldspar, documenting exposure of granitic rocks in the source area.