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

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Basin Map

Modified after Steven Schimmrich, hudsonvalleygeologist.blogspot.com

Marcellus Subgroup outcrop belt

Sample localities

Upper Hamilton and younger bedrock

Ontario

New York

Pennsylvania

New Jersey
sample localities

Parkville, NY
East Guilford, NY
Mastens Lake, NY
Hamilton, NY (Chenango Mbr.)
Bridgewater, NY (Solsville Mbr.)
Wurtsboro, NY
Mamakating, NY

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

Chenango Member, Skaneateles Fm., Hamilton Gp.

20 μm spot

Slide Mountain Formation
Concordia

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)
Zircon plots

Shawangunk Formation (depositional age ~ 420 Ma)

n=95
Grenville Orogenic Cycle

Shawangunk Formation (depositional age ~ 420 Ma) n=87

Elsevirian

Ottawan

Rigolet

Dysert-Mt. Holly (DMH)
Mesoproterozoic zircons (likely, in part, recycled from C-O passive margin strata)
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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.
Taconic Ashokan Formation (depositional age ~ 370 Ma) n=17

Acadian

Taconic

Iapetus Rifting
Paleozoic zircons:

- Taconic (~440 Ma) zircons dominate
- Minor early Acadian (410-380 Ma) zircons (volcanic?) in slightly younger strata
- Minor contributions from Neopro. 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
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.