The 101st Meeting of the New England Intercollegiate Geological Conference

The 2009 New England Intercollegiate Geological Conference
Northeast Kingdom, Vermont and Surrounding Regions

September 25-27, 2009

Hosted by

Department of Natural Science, Lyndon State College
Department of Geology and Environmental Science, Norwich University
Vermont Geological Survey

Organized by:

David Westerman (westy@norwich.edu)
Alison Lathrop (Alison.Lathrop@lsc.vsc.edu)

Conference Program

The 101st meeting of the NEIGC will be held September 25-27, 2009, at Lyndon State College in Lyndonville, Vermont. The organization of this year’s field conference is similar to those in the past. The tentative program is as follows:

Friday, September 25, 2009

Daytime field trips: A-Trips (see trip descriptions for starting times, departure location and specific trip information – updated periodically)

Onsite Registration and Welcoming Party, Lyndon State College (location details to follow)

Saturday, September 26, 2009

Daytime field trips: B-Trips (see trip descriptions for starting times, departure location and specific trip information - updated periodically)

5:30 – 6:30 pm: Reception – Lyndon State College (location details to follow)

6:30 – 8:30 pm: Annual Banquet – Lyndon State College (Sept. 4th registration deadline; location details to follow)
Sunday, September 27, 2009

Daytime field trips: C-Trips (see trip descriptions for starting times, departure location and specific trip information - updated periodically)

Registration (form located at the end of this document)

Useful links:
Lyndon Area Chamber of Commerce
http://www.lyndonvermont.com/

Lyndon State College Campus map
http://www.lyndonstate.edu/Files/LSCCampusMap.pdf

Driving directions to campus: (please be careful using "MapQuest" as they take you via back roads)
http://lyndonstate.edu/Default.aspx?tabid=528

Ticket information for the Vermont Symphony Orchestra - concert Saturday, September 26, 2009 @ Lyndon State College 7:30pm
http://www.vso.org/

List of Field Trips:

Friday trips, September 25, 2009

A1. Stratigraphy, Structure, and U/Pb Zircon Geochronology of the Southern 10% of the Piermont-Frontenac Parautochthon, Vermont-New Hampshire

Trip Leader: Robert H. Moench and J.N Aleinikoff

A2. Evidence Against the Allochthonous Nature of the Stanbridge Nappe at Highgate Gorge, Northwestern Vermont

Trip leaders: Adam Schoonmaker and W.S.F. Kidd

A3. The Ordovician to Carboniferous Bedrock Geology and Cooling History of the Bronson Hill and Central Maine Belts, Presidential Range, NH

Trip Leaders: Dykstra Eusden, Maura Foley and Mary Roden-Tice
A4. Ice Flow, Subglacial Hydrology, and Glacial Lake History, Northern Vermont

Trip Leader: Stephen Wright

A5. Folds and Sedimentary Environments of the Gile Mountain Formation North of Gallup Mills, Vermont

Trip Leaders: Ballard Ebbett and Alison Lathrop

Saturday trips, September 26, 2009

B1. Environmental Geology of Belvidere Mt., Vermont.

Trip leaders: Mark Van Baalen, Brooke T. Mossman and Mickey E. Gunter

B2. Road to the Kingdom: A Bedrock Transect Across the Pre-Silurian Rowe-Hawley Belt in Central Vermont

Trip Leaders: Jonathan Kim, Marjorie Gale, Ray Coish, Greg Walsh and Jo Laird

B3. A “Homoclinal” Stratigraphy Across the Ammonoosuc Valley, Lisbon and Littleton Quadrangles, NH: Where Are the Foster Hill Fault and the Lisbon Syncline?

Trip Leader: Douglas W. Rankin

B4. Glacial Geology, Climate History, and Late-Glacial Archaeology of the Northern White Mountains, New Hampshire (Part 1)

Trip Leaders: Woodrow B. Thompson, Greg Balco, Christopher C. Dorion, and Brian K. Fowler

B5. Emplacement History of the Maidstone Pluton, Northeast Kingdom, Vermont

Trip Leader: Dave Westerman and Johnathon Miller

B6. Landscape Evolution for K-12

Trip Leader: Alison S. Lathrop
Sunday trips, September 27, 2009.

C1. Bronson Hill Sequence, Connecticut Valley Sequence, and the Monroe Fault in the Stone Mountain and Adjacent Quadrangles, Northeast Kingdom, Vermont

Trip Leaders: Douglas W. Rankin and Robert D. Tucker

C2. Post-glacial Mass Wasting in Franconia Notch, White Mountains, New Hampshire

Trip Leaders: Joseph N. Rogers, Brian K. Fowler, William D. McCoy and P. Thompson Davis

C3. Glacial Geology, Climate History, and Late-Glacial Archaeology of the Northern White Mountains, New Hampshire (Part 2)

Trip Leaders: Woodrow B. Thompson, Richard A. Boisvert, Christopher C. Dorion, Gregory A. Kirby and Stephen G. Pollock

C4. Bedrock Geology of the Montpelier Area, Central Vermont

Trip Leaders: Gregory J. Walsh, Jonathan Kim and Marjorie Gale

C5. Geochemistry and Emplacement Style in Acadian Plutons Between Woodbury and Northfield, Vermont

Trip Leaders: Dave Westerman and Ray Coish

Trip Descriptions (updated periodically)

Friday trips, September 25, 2009

A1. Stratigraphy, Structure, and U/Pb Zircon Geochronology of the Southern 10% of the Piermont-Frontenac Parautochthon, Vermont-New Hampshire

Trip Leaders: Robert H. Moench and J.N. Aleinikoff

This trip continues an argument, ongoing since the early 1990s, between R.H. Moench and D.W. Rankin (and before then with M.P. Billings) about RHM's west-dipping Foster Hill-Thrasher Peaks detachment, now mapped ~200 km from near Piermont, N.H, to just north of the Chain Lakes massif, Quebec-Maine. South of Lat. 44 degrees, 45', the
argument mainly concerns the validity of the type Ordovician? Albee Formation: Whether (DWR) it exists as M.P. Billings defined it, or (RHM) Albee is divisible into several younger units correlated to the Rangeley sequence of western Maine plus the Late Silurian to Early Devonian Frontenac Formation.

The route of this trip winds through several of the units in question, plus two dating localities--one near Piermont, NH, the other a mile north of Bradford, Vt. Both localities expose uppermost beds of the Silurian Rangeley Formation. The youngest detrital zircon grains from each suite, both dated at ~425 Ma, indicate that uppermost beds of Rangeley Formation can be no older than Wenlockian or latest Llandoverian. A structural focus of the trip is the west-dipping, Triassic Ammonoosuc fault. Restorations to pre-Ammonoosuc positions consistently show that the low grade terrane on the west is lifted ~4 km up and over the higher grade terrane to the east. This exercise yields a normal metamorphic depth zoning as a 3-D view of structure and stratigraphy.

Starting time and location: This trip will start at the Newbury, Vermont village center on at 9 am.

Contact: Robert H. Moench, USGS, MS 905, DFC Denver, CO 80225; bsmoench@indra.com

Limit on participants: None

A2. Evidence Against the Allochthonous Nature of the Stanbridge Nappe at Highgate Gorge, Northwestern Vermont

Trip Leaders: Adam Schoonmaker and W.S.F. Kidd

This trip will feature the spectacular exposure of upper Cambrian and Lower Ordovician carbonate shelf edge strata and overlying transgressive shale in the Highgate Falls Gorge. There, the continuously exposed sequence consists of sandy dolomitic breccias of the Gorge Formation conformably overlain by slaty limestones and limestone breccias of the Highgate Formation and black slates of the Morses Line Formation. In Quebec, the equivalent contact is inferred to be a major tectonic (thrust fault) boundary between allochthonous slaty limestones and slates of the Stanbridge Nappe (Highgate and Stanbridge formations) and underlying dolomites of the Laurentian shelf sequence (Dunham Dolomite). Also, beautifully exposed in the gorge, the Highgate Falls Thrust emplaces upper Cambrian dolomite breccias of the Gorge Formation over lower to mid-Ordovician black slates of the Morses Lines Formation. This out-of-sequence thrust fault is likely part of the larger Champlain Thrust system. Additionally, diachronously evolved en echelon fractures sets (many showing various stages of rotation) and associated minor thrusts are well displayed in the slates beneath this thrust. Older (pre-cleavage, pre-thrusting) extensional small displacements of beds in the Morses Line Fm. we attribute to downslope passive continental margin processes.
Starting time and location: Assemble at 8:00 am at the Highgate Falls Village Green on Vermont Route 207, on the south bank of the Mississquoi River.

Contact: Adam Schoonmaker, Utica College, Utica, NY 13346 adschoonmaker@utica.edu

Limit on participants: None

A3. The Ordovician to Carboniferous Bedrock Geology and Cooling History of the Bronson Hill and Central Maine Belts, Presidential Range, NH

Trip Leaders: Dykstra Eusden, Maura Foley and Mary Roden-Tice

This trip will examine the rocks of the Acadian Orogeny in the transition between the Silurian and Devonian turbidites of the Central Maine Belt and the Ordovician volcanics and dome rocks of the Bronson Hill Belt. The field trip will begin with a traverse down the West Branch of the Peabody River in Pinkham Notch where wonderful exposures of the Littleton, Madrid, Smalls Falls and Rangeley Formations are found. Aspects of the stratigraphy, structure and metamorphism will be presented. The trip will then cross over the Pinkham B Road (Dolly Copp Road) and, en route, stop at exposures of the Carboniferous two-mica Peabody granite. Along the Route 2 valley in Randolph, NH, the trip will finish with a traverse across the Oliverian Jefferson Dome and Ammonoosuc Volcanics. Newly discovered mylonites, constrained by new microprobe monazite ages, will be shown and discussed. New apatite fission track cooling ages will be discussed at key outcrops on the entire trip. Expect about 4 miles of some rugged walking with stream traverses. Bring a huge lunch and water!

Starting time and location: The trip will start at 9:00 am at the base of the Mount Washington Auto Road at Great Glens; park in the dirt lot on the west side of Rte 16 just south of the entrance to the Auto Road.

Contact: Dykstra Eusden, Bates College Geology Department, Lewiston, Maine 04240; 207 786 6152, deusden@bates.edu

Limit on participants: None

A4. Ice Flow, Subglacial Hydrology, and Glacial Lake History, Northern Vermont

Trip Leader: Stephen Wright

The objective of this field trip is to introduce participants to several key elements of northern Vermont’s glacial geology. All of the areas visited occur along the upper reaches of two tributaries to the Lamoille River: the North Branch and the Gihon River. Field stops will include the spectacular bedrock channels and potholes occurring on the
eastern side of Shattuck Mountain, a variety of high-elevation ice-contact sediments deposited in and around Belvidere Bog, the outlet to the western arm of Glacial Lake Memphremagog just below the Belvidere asbestos mine, large-scale fluvial landforms produced downstream from that outlet, and a visit to Ritterbush Pond to investigate both it’s glacial and Holocene history.

This field trip includes several short hikes. Specifically, to reach Stop 1, the Shattuck Mountain Channels, we will hike ~1 km each way with a modest elevation gain. The hike includes bushwhacking and some short, but steep slopes. Several other planned stops also require moderate hikes over woods roads and trails.

**Starting location and time:** The trip will start at the Grand Union parking lot (Route 15), Johnson, VT at 9 am.

**Contact:** Stephen Wright, Department of Geology, University of Vermont, Burlington, VT 05405; 802-656-4479, Stephen.Wright@uvm.edu

**Limit on participants:** None

### A5. Folds and Sedimentary Environments of the Gile Mountain Formation North of Gallup Mills, Vermont

**Trip Leaders:** Ballard Ebbett and Alison Lathrop

The Silurian/Early Devonian Gile Mountain Formation is well-exposed on stream-washed surfaces and glacial pavements in the bed of the Moose River north of Gallup Mills, Vermont. Sedimentary structures in these rocks suggest sediments deposited by turbidity currents, liquefied flows and “bottom” currents that generate rare crossbeds. Schistosity and interference patterns of folded beds on bedrock surfaces indicate that an earlier period of tight to isoclinal folding was followed by a later period of more open to tight folding. Most folds are passive, but some earlier folds are associated with parasitic folds that suggest flexural slip. One early fold has two horizons of mesoscopic parasitic folds associated with duplex-like structures. These “duplexes” occur within a 400 square meter exposure that has been mapped at a scale of 1:50. The nearly-continuous exposure allows unusually clear comparison of early and late fold generations and encourages speculation about how these structures are related to the Willoughby Arch.

The field trip will move along the river examining outcrops as time and river-level permit. The access road parallels the river so there will be no appreciable hiking. We plan to construct a model onsite to demonstrate the interference patterns seen on the bedrock surfaces.

**Starting time and location:** This trip will start at “Library/Academic Center parking” located between the Theater/gymnasium complex and the Alumni house (see campus map link above; follow signs to Trip A5) at Lyndon State College at 11 am.
B1. Environmental Geology of Belvidere Mt., Vermont.

Trip Leaders: Mark Van Baalen, Brooke T. Mossman and Mickey E. Gunter

Chrysotile asbestos was quarried on Belvidere Mt. for a century prior to closure of the mine in 1993. A century of hard rock mining has left enormous tailings piles on the mine property. Since 2004, concerns have been expressed about the slow erosion and transport of these tailings, downstream into nearby wetlands. For this reason, the Vt. Agency of Natural Resources (ANR) and the U.S. Environmental Protection Agency (EPA) have initiated a process of creating drainage controls to prevent tailings from leaving the mine property. Additionally, in November 2008, the Vermont Dept. of Health (VDH) released a public health study that seemed to show an increased incidence of respiratory disease including lung cancer in the population of 10 towns surrounding Belvidere Mt. This study, since largely retracted by VDH, raised an uproar in the local community and in the scientific community beyond. Belvidere Mt. has now become a case study for students of environmental geology, with many lessons learned and yet to be learned. This field trip will explore some of these issues, as well as reviewing the bedrock geology and mineralogy, mining history, and the nature of public communications on environmental risk at Belvidere Mt.

Notes: Moderate hiking is required. On account of ongoing legal disputes over the status of the quarries, participants will be asked to sign a release of liability, and the Vermont Geological Survey sponsorship of NEIGC 2009 will not extend to this field trip.

Starting location and time: This trip will start at “Library/Academic Center parking” located between the Theater/gymnasium complex and the Alumni house (see campus map link above; follow signs to Trip B1) at Lyndon State College, Lyndonville, VT at 8:30 am. Bring a lunch.

Contact: Mark Van Baalen, Harvard University mvb@harvard.edu

Limit on participants: Limited to 20 participants.
B2. Road to the Kingdom: A Bedrock Transect Across the Pre-Silurian Rowe-Hawley Belt in Central Vermont

Trip Leaders: Jonathan Kim, Marjorie Gale, Ray Coish, Greg Walsh and Jo Laird

This trip will focus on the Pre-Silurian bedrock section along Route 2/ Interstate 89 between Waterbury and Montpelier will integrate igneous geochemistry, petrology, and structure with recently completed maps and cross sections. The trip will start in the Worcester Complex (garnet-kyanite schists and amphibolites) and proceed through the metasedimentary and metaigneous rocks of the Ottauquechee, Stowe, and Moretown Formations. We will finish the trip in Hubbard Park in Montpelier at the Richardson Memorial Contact (RMC).

Starting time and location: The trip will leave from the Montpelier Park and Ride at 9 am. Take Exit 8 off I-89 and proceed northeast for 1/3 mile towards Montpelier. Make your first left onto Dog River Road towards Montpelier Junction and the railroad station. The parking lot is on the left. Latitude and Longitude: 44°15'19"N, 72°35'41"W (WGS84 datum).

Contact: Jonathan Kim, Vermont Geological Survey, 103 South Main Street, Logue Cottage, Waterbury, VT 05671; jon.kim@state.vt.us

Limit on participants: None

B3. A “Homoclinal” Stratigraphy Across the Ammonoosuc Valley, Lisbon and Littleton Quadrangles, NH: Where Are the Foster Hill Fault and the Lisbon Syncline?

Trip Leader: Douglas W. Rankin and Robert D. Tucker

The trip will examine evidence for a coherent stratigraphy eastward across the Ammonoosuc Valley from the pre-Silurian Albee Formation to the Devonian Littleton Formation of the Salmon Hole Brook syncline, all east of the Ammonoosuc fault. Much of the trip will focus on the complex internal stratigraphy of the Ammonoosuc Volcanics, the age range of the Partridge Formation, and the importance of both stratigraphy and lithology in distinguishing one sulfidic black pelite from another. What has been mapped as the Foster Hill fault is a stratigraphic contact between the Albee Formation and the Ammonoosuc Volcanics. Current mapping does not support the presence of a Lisbon syncline and suggests significant changes in Billings’s interpretation of the southern termination of the Salmon Hole Brook-Garnet Hill syncline.

Starting time and location: This trip will start at 8:15 am in the Wal-Mart parking lot, Littleton, NH. Wal-Mart is on the west side of Littleton on US-302 just south of Exit 42 on I-93, about 26 miles southeast of Lyndon, VT.
**B4. Glacial Geology, Climate History, and Late-Glacial Archaeology of the Northern White Mountains, New Hampshire (Part 1)**

**Trip Leaders:** Woodrow Thompson, Greg Balco, Christopher Dorion and Brian Fowler

This two-part trip will discuss recent research on the glacial history and early human settlement of the northern White Mountains between Littleton and Berlin, New Hampshire. The first day will emphasize the record of glacial events and related climate change. We will examine moraine systems and fan/delta deposits formed in ice-dammed glacial lakes, indicators of glacial readvance, a large proglacial outwash fan, and the stratigraphic and climate record from pond sediment cores. These features will be tied to a deglaciation chronology based on radiocarbon and cosmogenic exposure dating, together with correlations to the New England Varve Chronology in northern glacial Lake Hitchcock. Evidence that the White Mountain moraines formed during the Older Dryas climate cooling ca. 14,000 cal yr BP will also be presented.

**Starting time and location:** The trip will start at 8:00 am on Saturday, September 26th in the Elks Lodge parking lot on south side of Route 302, just east of Littleton village and close to exit 41 on I-93. It will end on U. S. Route 2 in Randolph, NH, from which participants can easily return west to Lyndonville via Route 2 and I-91 for the NEIGC dinner.

**Contact:** Woodrow B. Thompson, Maine Geological Survey, 22 State House Station, Augusta, ME 04333-0022; woodrow.b.thompson@maine.gov

**Limit on participants:** None

---

**B5. Emplacement History of the Maidstone Pluton, Northeast Kingdom, Vermont**

**Trip Leader:** Dave Westerman and Johnathon Miller

This trip will visit the Maidstone pluton on the eastern margin of the Northeast Kingdom batholith, a Devonian-aged complex in northeastern Vermont that primarily intruded the regionally metamorphosed and deformed rocks of the Connecticut Valley – Gaspé Trough (CVGT). The Maidston pluton is somewhat unique in that it stitches the Monroe Fault that separates the CVGT rocks (west) from the Cambro-Ordovician Albee formation (east). Rocks of the pluton include hornblende quartz diorite, tonalitic granodiorite, monzogranite, and leucocratic low-Ti monzogranite, each occurring as discrete zones. The composite character of the pluton is well supported by overlapping ranges of silica content accompanied by distinctive abundances of other elements,
producing sharp graphical separation on discrimination diagrams. These relationships suggest assembly of the pluton by sequential emplacement of pulses from an evolving magma sources. Outcrops of igneous breccia characterize the pluton margins for both the tonalite and monzogranite lithotypes, and these breccias will be visited during the trip.

Access to the various outcrops will require vehicles with adequate clearance; four-wheel drive is recommended. Efforts will be made to consolidate vehicles, particularly when using power line maintenance roads.

Starting time and location: The trip will start at 8:30 am at the access road to Maidstone State Park where it leaves VT Route 102 (NAD83 19T 0293985 – 4952010).

Contact: David S. Westerman, Department of Geology and Environmental Science, Norwich University; 802 485-2337, westy@norwich.edu

Limit on participants: None

B6. Landscape Evolution for K-12

Trip Leader: Alison S. Lathrop

This trip will provide practice in using local field sites to present fundamental geological concepts focused on landscape evolution to K-12 students. We will discuss background and equipment needed by the students with regard to State standards and grade level. Locations visited will depend on participants’ needs and interests, but expect to examine a variety of surficial and bedrock sites. Materials will be handed out on site rather than published ahead of time, given the large number of possible stops from which participants will choose.

Starting time and Location: 9:00 AM; meet in Alexander Twilight Theater Lobby, Lyndon State College

Contact: Alison S. Lathrop, Department of Natural Science, Lyndon State College, alison.lathrop@lsc.vsc.edu, 802-626-6500

Limit on participants: None

Sunday trips, September 27, 2009

C1. Bronson Hill Sequence, Connecticut Valley Sequence, and the Monroe Fault in the Stone Mountain and Adjacent Quadrangles, Northeast Kingdom, Vermont

Trip Leaders: Douglas W. Rankin and Robert D. Tucker
We will present evidence for Taconian deformation of the Albee Formation, Bronson Hill sequence, prior to intrusion of the isotopically dated early Silurian Lost Nation pluton. We will look at sedimentary breccia (formerly mapped as Clough Formation or Devonian fault breccia) separating Albee from volcanogenic chert with coticules and magnetite iron formation (formerly mapped as Littleton Formation) interpreted as distal correlatives of the Ammonoosuc Volcanics preserved in a syncline. The Connecticut Valley sequence includes isotopically dated rhyolite that also contributes clasts to muddy conglomerate interpreted to be at the base of the Early Devonian Compton Formation (Gile Mountain Formation) adjacent to the Monroe fault. If time permits we will visit outcrops of multiply deformed Gile Mountain Formation, a mafic complex of the Comerford Intrusive Suite, and exposures of the Monroe fault mylonite recrystallized at amphibolite grade.

Starting time and location: This trip will start at 8:30 am at Shaws parking lot, Lancaster, NH. Shaws is on the north side of Lancaster on US-2 just south of the junction with US-3, about 40 miles east of Lyndon, VT.

Contact: Douglas W. Rankin, US Geological Survey, Mail Stop 926A, National Center, Reston, VA 20192; 202-648-6903, dwrankin@usgs.gov

Limit on participants: None

C2. Post-glacial Mass Wasting in Franconia Notch, White Mountains, New Hampshire

Trip Leaders: Joseph N. Rogers, Brian K. Fowler, William D. McCoy, and P. Thompson Davis

We will examine post-glacial mass wasting deposits and landforms, including talus slopes, rock falls, debris flows (landslides), and Profile Lake, which archives historic and pre-historic debris flow sediments. The rock formation known as the ‘Old Man of the Mountain’ (north end of Cannon Cliff) collapsed on 5 May 2003. While this event attracted national media attention, few are aware that on 19 June 1997, a much larger rockfall occurred at Cannon cliff. We will examine debris from both the Old Man rockfall event and earlier events that comprise the talus slope below Cannon cliff. Large debris flows from Mount Lafayette (opposite Cannon Cliff) covered old U.S. Rt. 3 with several meters of debris on 23 July 1947, 24 June 1948, and 24 October 1959. These historic slides left diagnostic signatures punctuating Profile Lake’s sediment column, which reveal a nearly complete post-glacial record of both historic and prehistoric landslides from Walker ridge and Eagle cliff on Mount Lafayette.

Starting time and location: This trip will start at 9 am at the Peabody Lodge, Cannon Mountain Ski Area, Rt. 3, Franconia Notch, NH.
C3. Glacial Geology, Climate History, and Late-Glacial Archaeology of the Northern White Mountains, New Hampshire (Part 2)

**Trip Leaders:** Woodrow B. Thompson, Richard A. Boisvert, Christopher C. Dorion, Gregory A. Kirby and Stephen G. Pollock

This trip will extend the themes of late-glacial events in the northern White Mountains that began with the Part 1 trip on Saturday. Today’s excursion will visit the Berlin-Gorham area in the upper Androscoggin River basin. Stops will include newly discovered glacial moraines that are believed to correlate with the moraines to the west, formed during the Older Dryas climate event. We will also take a short hike to the Mt. Jasper archaeological site in Berlin, which was quarried by Native Americans beginning in Paleoindian time, ca. 12,000 years ago. Mt. Jasper will provide the background for discussion of humans arriving in late-glacial time, as well as the bedrock provenance of artifacts from this and other Paleoindian sites in the White Mountains. Other stops will visit a large prehistoric (paraglacial?) landslide on the edge of downtown Gorham, and the York Pond coring site in Berlin. Topographic map coverage of the field trip area is provided by the Berlin, Milan, and West Milan 7.5-minute quads; the Pliny Range 7.5 x 15-minute quad; and the Mount Washington and Groveton 1:100,000 maps. The latter maps provide an excellent overview of the region.

**Starting time and location:** We will assemble at 8:30 AM in the parking lot at the New Hampshire Department of Environmental Services, located on Route 16 about 0.4 mile south of U. S. Route 2 on the east side of Gorham. Participants are encouraged to car pool.

**Contact:** Woodrow B. Thompson, Maine Geological Survey, 22 State House Station, Augusta, ME 04333-0022; woodrow.b.thompson@maine.gov

Limit on participants: None

C4. Bedrock Geology of the Montpelier Area, Central Vermont

**Trip Leaders:** Gregory J. Walsh, Jonathan Kim and Marjorie Gale

The bedrock geology of the Montpelier area consists of Silurian to Devonian metasedimentary rocks of the Connecticut Valley – Gaspé synclinorium (CVGS) and metamorphic rocks of the Cambrian to Ordovician Moretown and Cram Hill Formations. Devonian granite dikes intrude all the rocks, but are more abundant in the Silurian to Devonian rocks. The pre-Silurian rocks to the west are separated from the rocks of the
CVGS to the east by the informally named “Richardson Memorial contact” (RMC), historically interpreted as either an unconformity (Cady, 1956; Doll and others, 1961) or fault (Westerman, 1987; Hatch, 1988). This trip will highlight the results of new bedrock geologic mapping in the Montpelier and Barre West quadrangles (Walsh and others, in press), and address the tectonic evolution of the rocks across the RMC. This trip will follow up on discussions presented in Saturday’s trip across the pre-Silurian rocks by Kim and others (this volume).

Starting time and location: Meet at 09:00 on Sunday September 27th at the Montpelier Park & Ride commuter parking lot. Take Exit 8 off I-89 and proceed northeast for 1/3 mile towards Montpelier. Make your first left onto Dog River Road towards Montpelier Junction and the railroad station. The parking lot is on the left. Latitude and Longitude: 44°15’19”N, 72°35’41”W (WGS84 datum). Please bring your lunch, a hard-hat, and a safety vest.

Contact: Gregory J. Walsh, U.S. Geological Survey, P.O. Box 628, 87 State Street, Room 324, Montpelier, VT 05601; 802-828-4528 or Cell: 802-522-9043, gwalsh@usgs.gov

Limit on participants: None

C5. Geochemistry and Emplacement Style in Acadian Plutons Between Woodbury and Northfield, Vermont

Trip Leaders: Dave Westerman and Ray Coish

This trip will examine a series of quarry exposures of granitic and intermediate intrusions between Northfield and Woodbury, Vermont. We will examine evidence for the magmatic history of these rocks while exploring the hypothesis that the size of a magma batch influences what type and scale of magma trap is exploited during emplacement. More than 100 intrusions in northeastern Vermont, ranging from less than 100 m² to over 1,000 km², make up the Northeast Kingdom batholith. Compositions of the intrusions range from gabbro to granite; however, granodiorite is most common. The bodies exhibit calc-alkaline chemical trends and show negative Nb-Ta anomalies in extended rare-earth element diagrams. The host rocks of the batholith are dominated at the formation scale by broad open structures such as low-angle recumbent nappes and associated thrusts, seen with large wavelength repetition in parallel belts of both the lower Waits River Formation and overlying Gile Mountain Formation. At the outcrop scale however, bedding exhibits tight isoclinal folds with amplitudes measured in 100’s of meters.

Small batches of magma were accommodated by small structures associated with the folding and associated layer-parallel strain, producing dikes with generally NNE trends. These intrusions, such as the Berlin pluton, reach lengths of 1.5 km with aspect ratios as small as 10. At the next scale, larger magma batches have been accommodated by upright structures to produce enlarged linear forms, locally connected to produce complex map patterns. A type example of this emplacement mode is the Barre granite. Large plutons within the batholith are characterized by small aspect ratios, with the limiting case having
a nearly circular shape. This shift from high to low aspect ratios corresponds to a change from magma being trapped in relatively small, upright structures, to magma spreading laterally in association with much larger sub-horizontal structures at the formational scale.

Starting time and location: Meet in town parking lot near the Village Restaurant in Harwick, Vermont. Enter the parking lot from Wolcott Street.

Contact: David S. Westerman, Department of Geology and Environmental Science, Norwich University; 802 485-2337, westy@norwich.edu

Limit on participants: None