

NEIGC 2011

September 30 – October 2, 2011

The 103rd meeting of the
New England Intercollegiate Geological Conference
hosted by Middlebury College, Middlebury, Vermont

Schedule

Friday, Sept. 30th: Field Trips A1 – A4

See field trip descriptions for time and place

4:00 – 7:00 pm Onsite Registration

Middlebury College, Kirk Alumni Center

5:30 – 7:00 pm Welcoming Reception

Middlebury College Kirk Alumni Center

Saturday, Oct. 1st: Field Trips B1 – B5

See field trip descriptions for time and place

6:00 pm NEIGC Banquet Reception

Middlebury College, Atwater Dining Commons

6:30 – 8:00 pm NEIGC Banquet

Middlebury College, Atwater Dining Commons

Sunday, Oct. 2nd: Field Trips C1 – C5

See field trip descriptions for time and place

Some Middlebury Area Accommodations

- Courtyard by Marriott, 802-388-7600
- Greystone Motel, 802-388-4935
- Blue Spruce Motel, 802-388-4091
- Sugarhouse Motor Inn, 802-2770
- Rivers Bend Campground, 802-388-9092
- Lake Dunmore Kampersville Campground, 802-352-4316
- Branbury State Park Campground, 802-247-5925
- Middlebury Visitors Center: <http://www.addisoncounty.com/>, 802-388-7951

For more information contact: Dave West dwest@middlebury.edu, 802-443-3476

For up-to-date field trip descriptions and meeting information see:

<http://www.salemstate.edu/~lhanson/NEIGC/>

Field Trip Schedule

Friday, September 30th

- A1: Transect across the north-central Green Mountains from the carbonate shelf to ultramafic slivers in the Taconian subduction zone**
Peter Thompson, Marjorie Gale, Jo Laird and Ian Honsberger
- A-2: Ice retreat across the Green Mountain foothills, Jericho and Bolton Vermont**
Stephen Wright
- A-3: Traverse of the major fault systems of the Taconian deformational front, the Vermont Valley and the core of Green Mountain massif, southern Vermont**
Nicholas Ratcliffe, Greg Walsh, Bill Burton, and Mick Kunk
- A-4: Comparison of the Day Point, Crown Point and Valcour Formation (Middle Ordovician Chazy Group) reef horizons, northern Champlain Valley, Vermont**
Char Mehrtens, David Griffing, and Lauren Chrapowitzky

Saturday, October 1st

- B-1: A Bedrock transect across the Champlain and Hinesburg Thrusts in west-central Vermont: Integration of tectonics with hydrogeology and groundwater chemistry**
Jon Kim, Keith Klepeis, Peter Ryan, Marjorie Gale, Christine McNiff, Abigail Ruksznis, and Jeffrey Webber
- B-2: Geology and geochronology of the easternmost Adirondacks**
James McLelland, Martin Wong, Tim Grover, Mike Williams, and Mike Jercinovic
- B-3: A transect across the basement massifs of the central Green Mountains, Vermont**
Gregory J. Walsh, Nicholas M. Ratcliffe, and Michael J. Kunk
- B-4: Repeated contraction and extension: Structural history of the central Champlain Valley, Vermont**
Paul Washington
- B-5: Fluvial geomorphology of the Middlebury River watershed: geologic controls, assessment of stream channel stability, and river corridor restoration.**
George Springston, Richard Dunn, Kristen Underwood, Roy Schiff, Amy Sheldon, Dan McKinley, Nathan Donahue, and Shannon Pytlik

Sunday, October 2nd

- C-1: Tectonic thinning in the mantling sequence around the Chester Dome, Vermont: Implications for mechanical decoupling between basement and cover rocks**
Paul Karabinos
- C-2: The record of early Paleozoic collisional tectonics and Mesozoic extension in the Taconic slate belt of Vermont and New York**
Jean Crespi, Art Goldstein, David Mirakian, Ray Underwood, Phaedra Upton
- C-3: Quaternary geology of the central Winooski River watershed with focus on glacial lake history of tributary valleys (Thatcher Brook and Mad River)**
Rick Dunn, George Springston, Stephen Wright
- C-4: The timing and sequence of fluid alteration and magnetite-apatite mineralization in the Lyon Mountain granite: Adirondack Mountains, New York**
Peter Valley and John M. Hanchar
- C-5: Classic bedrock teaching localities in the Champlain Valley between Middlebury and Burlington, Vermont**
Dave West, Keith Klepeis, Jon Kim, and Jeff Webber

2011 Field Trip Descriptions

Friday, Sept. 30th Trips

A1: Transect across the north-central Green Mountains from the carbonate shelf to ultramafic slivers in the Taconian subduction zone

Leaders: Peter Thompson, Marjorie Gale, Jo Laird, and Ian Honsberger

The main objective of this field trip is to compare the intensity of deformation and metamorphism within each fault-bounded lithotectonic package at the latitude of cross section D-D' of the new Vermont bedrock map (Ratcliffe et al., in production), just north of Middlebury, Vermont. The cross-section, originally constructed by Stanley et al. (NEIGC, 1987) for the Lincoln Massif area, was further developed by Gale and Thompson and spans the orogen from the shores of Lake Champlain to the Silurian unconformity. Laird and Honsberger will present data on pressure, temperature, and timing of metamorphism, some Taconian and some Acadian, which complement the structural interpretations.

The trip starts in fossiliferous, barely metamorphosed autochthonous Ordovician rocks below the Champlain thrust and ends at intensely deformed late Proterozoic to Cambrian schists, ultramafics and mafic rocks with chemically zoned amphiboles in Stockbridge. (We will not go all the way east to the Silurian unconformity.) Among the stops in between we will see a textbook example of an open, upright fold in the Cheshire Quartzite, a sheared unconformity (late Proterozoic boulder conglomerate on the Grenvillian Lincoln massif), the mylonitic root zone for thrusts west of the Green Mountains, multiply deformed rocks in the allochthonous rocks at Lincoln Gap, and evidence for increasingly pervasive Acadian deformation toward the east.

Meeting time and place: 8:00 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall. Assemble to consolidate vehicles and leave by 8:10 AM. The dirt road over Lincoln Gap is very steep; check brakes and radiator fluid! Trip will loop back to Middlebury in the late afternoon. *Note that this trip is limited to the first 45 registrants*

Contact: Peter Thompson at peter.j.thompson@unh.edu

A-2: Ice Retreat across the Green Mountain foothills, Jericho and Bolton Vermont

Leader: Stephen Wright

This field trip takes place along the western slope of the Green Mountains in the towns of Jericho and Bolton, Vermont and highlights landforms and sediments used to interpret interactions between the retreating Laurentide ice sheet, drainage within and along the margins of that ice sheet, and both small- and large-scale glacial lakes. Field stops include a large landslide along the Lee River revealing a well-exposed Glacial Lake Vermont delta, a sequence of ice-contact through lacustrine sediments in West Bolton, and a series of outwash channels in Bolton Notch. This field trip includes several short hikes including the ascent of a moderately steep landslide scarp.

Meeting time and place: 9:00 AM: “On the Rise” Bakery, Bridge Street, Richmond Vermont. From the Interstate (I-89), use the Richmond Exit (Exit 11) and travel east on Route 2 to the Village of Richmond (~1 mile). At the stoplight (the only one) turn right (south) on Bridge street and the bakery is ~0.25 miles along this road on the right, just before the bridge over the Winooski River. There is a Park and Ride at the Richmond exit, but it’s almost always full by 9 AM. At least one UVM van will be available. Note: If you plan on leaving your car, please park in the south end of the parking lot, close to the river, away from the bakery. Lunch, baked goods, and coffee are available at the bakery, but please leave extra time to secure these goods as the bakery is often busy.

Contact: Stephen Wright at Stephen.Wright@uvm.edu

A-3: Traverse of the major fault systems of the Taconian deformational front, the Vermont Valley and the core of Green Mountain massif, southern Vermont

Leaders: Nicholas Ratcliffe, Greg Walsh, Bill Burton, and Mick Kunk

This field trip will involve an across strike traverse from West Rutland, Vt. to the east edge of the Green Mountain massif near Ludlow, Vt. The traverse will highlight new geologic (paleontologic, structural, geochronologic) interpretations to be shown as part of the new Bedrock Geologic Map of Vermont (1:100,000) based on 15 years of field studies by the U.S. Geological Survey.

Primary emplacement slices of the Taconic allochthons are distinct from a regional system of late Taconian F2 (D2) imbricate thrust faults such as the Taconic frontal faults, Hubbardton River thrust, Pine Hill thrust, and a family of thrusts along the west side and east sides of the Green Mountain massif. $^{40}\text{Ar}/^{39}\text{Ar}$ data help to define the age the thrusts, internal deformation and re-metamorphism (retrogression) of the 1.39-0.955 Ga basement of the massif and of the major imbricate thrusts and suggest that these F2 (D2) features are Taconian. It is possible however that some retrogression and injection of widespread muscovite pegmatite was late Ottawan and related to eastward extensional collapse of the roof the Adirondack core. It could be that the mylonites now exposed along of the Pine Hill as well as some internal to the massif may have enjoyed late Mesoproterozoic activity. We will examine which mylonites might be related or not to this older event although the body of evidence suggests that most of the mylonitization is Taconian. Serial cross sections of the massif and the location of regional fault systems suggest that retrogression and rehydration of the basement rocks is determined by the structural position of basement rocks in slices above Taconian prograde late Proterozoic to Ordovician chlorite to garnet (and higher?) grade rocks in the footwalls. Buckling of the imbricate slices and of basement could be Acadian or Taconian.

The trip will begin on very complex, highly retrograded Mesoproterozoic rocks of the Pine Hill thrust complex, previously interpreted as Ordovician metavolcanics which we will follow south to near Danby near the Dorset Mountain. U-Pb zircon data indicate an Ottawan age for pegmatites deformed in the mylonites. We then will penetrate to the core of the Green Mountain massif near Devils Den and examine retrograde gneisses of the core and progress to the eastern margin where unconformable cover rocks rest on the basement near Ludlow, Vt. Return will be via Rt 140 and across northern end of the Pine Hill thrust complex as it merges with other faults to form the west tectonic front of the massif. The trip will end north of Rutland in mylonitic rocks typical of the

Taconian thrust fault system that forms the northward tapering highly thrust faulted termination of the massif. Emphasis will be on the nature and age of retrogression and mylonitization of basement rocks and their thermal history based on a regional grid of hornblende, biotite and muscovite $^{40}\text{Ar}/^{39}\text{Ar}$ data collected over the past 20 years.

This will complement a similar trip by Walsh, Ratcliffe and Kunk that will traverse the Taconian/Acadian tectonic-metamorphic belt farther to the north.

Meeting time and place: 8:00 AM in Rutland, Vermont. Meet in the front parking lot of the Holiday Inn at the intersection of Routes 7 and 4 – just SOUTH of Rutland (note there is a similar intersection to the north in central Rutland but there is no Holiday Inn there). Participants may wish to spend Thursday night in the Rutland area where there are numerous motels and campgrounds. Please bring your lunch.

Contact: Nick Ratcliffe at nratclif@usgs.gov

A-4: Comparison of the Day Point, Crown Point and Valcour Formation (Middle Ordovician Chazy Group) reef horizons, northern Champlain Valley, Vermont

Leaders: Charlotte Mehrtens, David Griffing, Lauren Chrapowitzky

This field trip will visit at least three localities in the Champlain Islands of northwestern Vermont (Grand Isle and Isle la Motte) to view reef-bearing intervals in the three formations that comprise the Middle Ordovician Chazy Group. The focus will be on examining the general morphology, framebuilder composition, and internal structure of the reefs, as well as the relationship of reefs with non-reef flanking facies.

Meeting time and place: 9:00 AM: Delehanty Hall, University of Vermont Campus, 180 Colchester Ave Burlington, Vermont. Delehanty Hall (Geology Department) is located on the old Trinity College Campus adjacent to the University of Vermont. From I-89, take exit 14 (Main Street-Route 2 exit), and go west (towards the lake) to East Avenue. Turn right on East Avenue and go to the end of East Avenue and proceed straight across Colchester Avenue and into the driveway. Delehanty Hall has a slate exterior and large granite blocks in front of it. Once on the driveway, bear around to the left and the parking lot is in the rear.

Contact: Char Mehrtens at cmehrten@uvm.edu

Saturday, Oct. 1st Trips

B-1: A Bedrock transect across the Champlain and Hinesburg thrusts in west-central Vermont: Integration of tectonics with hydrogeology and groundwater chemistry

Leaders: Jon Kim, Keith Klepeis, Peter Ryan, Marjorie Gale, Christine McNiff, Abigail Ruksznis, and Jeffrey Webber

The purpose of this trip is to traverse the three major tectonic zones in the west-central foreland of Vermont looking at the lithologies and structures within each and to discuss the synergistic role that hydrogeology and groundwater chemistry studies have played in current thinking about this foreland thrust system. The trip will take place entirely in the towns of Williston, Hinesburg, and

Charlotte. From west to east and from structurally lowest to highest, these zones are the A) Parautochthon, B) Upper Plate of the Champlain Thrust, and C) Upper Plate of the Hinesburg Thrust. These zones were juxtaposed by the Champlain and Hinesburg thrusts during the Ordovician Taconic Orogeny and later deformed by presumed Acadian (Devonian) folding events.

We will start on the shore of Lake Champlain in the parautochthon and work our way westward to successively higher structural levels. The following stops are planned:

- 1) Unconformity between the Upper Cambrian Little Falls and Lower Ordovician Tribes Hill formations on Thompson's Point, Charlotte.
- 2) Strongly deformed shales of the Middle Ordovician Stony Point Formation across from the Charlotte Flea Market.
- 3) Overview from Mt. Philo State Park, Charlotte.
- 4) Large- scale folds in the Middle Cambrian Monkton Quartzite in Charlotte.
- 5) Hinesburg Thrust zone at Mechanicsville.
- 6) Integration of water well logs through the Hinesburg Thrust with cross sections, Oak Knoll Road, Williston.
- 7) Structures in the Late Proterozoic Fairfield Pond Formation at 5-Tree Hill Park, Williston.
- 8) Ledgewood Road, Williston: A) Hinesburg Thrust overview and B) structures in a footwall anticline below the Hinesburg Thrust (Lower Cambrian Cheshire Quartzite).

Meeting time and place: 8:30 AM at the Town of Charlotte Park and Ride lot on Ferry Street. From Middlebury, follow Route 7 north to Charlotte, make a left (heading west) at the stoplight onto Ferry Street (look for signs for the ferry), follow Ferry Street through the 4 way stop at Greenbush Road for approximately 0.8 miles to the Park and Ride lot on the right (north) side. A train station is also found at this location.

Contact: Jon Kim at jon.kim@state.vt.us

B-2: Geology and geochronology of the easternmost Adirondacks

Leaders: James McLelland, Martin Wong, Tim Grover, Mike Williams, and Mike Jercinovic

This trip, which begins in Ticonderoga, New York, consists of 8 stops, several of which are lengthy. All stops are at roadcuts and no hikes are involved. Parking should not be a problem, but it would be most helpful if as many as possible would **share rides**. Due to rebuilding of the Champlain Bridge, we shall have to take the Ticonderoga Ferry at the beginning of the day. The cost is \$9/car one way or \$16/car roundtrip.

The trip focuses on the late, ca. 1050 Ma, history of the Adirondacks that was marked by extensional orogen collapse, emplacement of Lyon Mountain Granite (LMG), and widespread hydrothermal activity. These issues are not pursued at every stop, and rocks as old as ca. 1350 Ma and 1155 Ma will be examined.

The first stop examines a typical ca 1050 Ma andesine-rich pegmatite which provided hydrothermal fluid responsible for the growth of megacrystic Gore Mt.-type garnets with black hornblende rims during late orogenic collapse. Next, we visit the Proterozoic-Cambrian unconformity exposed in roadcuts along Rt. 22. This is followed by a long stop at exposures of an intrusion breccia consisting of amphibolite blocks within intrusive LMG. We then proceed south to examine another roadcut of LMG that has been shown to be a repetition of the LMG just visited. The two lie along the limbs of a late, upright F3 antiform that must be slightly younger than LMG. A short distance to the south, we have another long stop at a series of exposures in one of the best roadcuts in the Adirondacks. We will see evidence of Shawinigan (ca 1210-1160 Ma) structures preserved in a garnet-sillimanite xenolith preserved in a metagabbro. Marble solid-state

intrusion breccias are also present, as is graphitic Dixon schist. Following this, we will stop at a good example of ca. 1350 Ma tonalite. Continuing south, we have a long stop at roadcuts where zircon and monazite geochronology help clarify extensional orogenic collapse in the Adirondacks and link it to collapse of the entire Grenvillian orogen. Our last stop is just south of the junction of Rts. 22 and 4 at Comstock. Here will examine garnetiferous gabbroic anorthosite, ultramafic pods, wollastonite skarn, and exceptional mylonite of migmatitic metapelites.

Meeting time and place: 8:00 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall. Assemble to consolidate vehicles and leave by 8:10 AM. Alternatively, for those traveling from New York state, you may meet us at 8:45 AM in Ticonderoga on north side of Rt. 74 approximately 0.3 miles west of junction of Rts. 74, 22, and 9N. This location is at north end of Ticonderoga and within view of a MacDonald's.

Contact: Jim McLelland at jmcllland@citlink.net

B-3: A transect across the basement massifs of the central Green Mountains, Vermont

Leaders: Gregory J. Walsh, Nicholas M. Ratcliffe, and Michael J. Kunk

In the core of the northern Appalachians, in the Green Mountains east of Middlebury, the Lincoln massif marks the northernmost extent of exposed Precambrian Laurentian basement. Historically, the basement rocks were divided into the northern Lincoln massif and the much larger southern Green Mountain massif. New bedrock geologic mapping in support of the forthcoming Bedrock Geologic Map of Vermont (Ratcliffe and others, in press) now demonstrates that the Lincoln massif is in fact contiguous with, and part of, the larger Green Mountain massif. Newly identified smaller massifs occur on the eastern side of the main Green Mountain massif as inliers within the Neoproterozoic to Cambrian cover sequence rocks, locally in fault-bounded thrust slices. This trip will highlight these new findings in an eastward transect along Route 125 through Middlebury Gap with a return transect along Route 73 through Brandon Gap.

Meeting time and place: 9:00 AM at the Hannaford's Shopping Center on Route 7, one mile south of downtown Middlebury. Latitude and Longitude: 44°00'07"N, 73°09'17"W (WGS84 datum). Please bring your lunch.

Contact: Greg Walsh at gwalsh@usgs.gov

B-4: Repeated contraction and extension: Structural history of the central Champlain Valley, Vermont

Leader: Paul Washington

This trip will look at evidence for several generations of contractional and extensional deformation within the central Champlain Valley, from Middlebury north to Charlotte. Special attention will be given to evidence for the mostly overlooked normal fault systems and how they help us work out the deformational history. At present, we can distinguish at least five generations

of regional contractional events and five (possibly six) generations of regional extensional events that have affected this area during Phanerozoic time.

Meeting time and place: 8:30 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall. **Special Instructions:** If you have a hard hat please bring it (we will have a few extras available if you don't have one). We will be visiting a working limestone quarry and hard hats will be required for access; a hold-harmless agreement will be also necessary, but that will be taken care of at the quarry office at the time of entry.

Contact: Paul Washington at paul.washington@gmail.com

B-5: Fluvial geomorphology of the Middlebury River watershed: geologic controls, assessment of stream channel stability, and river corridor restoration

Leaders: George Springston, Kristen Underwood, Rick Dunn, Nathan Donahue, Shannon Pytlik, Amy Sheldon, Roy Schiff

This trip will highlight recent surficial geologic mapping, fluvial geomorphic assessment, riparian corridor management, and related conservation activity in the Middlebury River watershed. The principal tributaries to the river flow westward from the crest of the Green Mountains to come together at the village of Ripton (a site of recurring flash flood events). The mainstem then flows steeply west through a bedrock gorge and exits the mountains at East Middlebury, where the gradient lessens and the modern river is channelized through a formerly active alluvial fan deposit. Once out on the floor of the Champlain Valley the river empties into Otter Creek, a tributary of Lake Champlain.

This trip will examine the range of Pleistocene and Holocene surficial geologic materials and landforms in the watershed. Field trip stops will illustrate some of the geomorphic techniques used in assessing the stability of the stream channel and the condition of the riparian corridor. We will also visit a river corridor restoration site where an effort is being made to reconcile the conflicts that arise from the juxtaposition of houses, roads, and other structures with a flashy, steep-gradient stream.

Meeting time and place: 8:30 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall.

Contact: George Springston at gsprings@norwich.edu

Sunday, Oct. 2nd Trips

C-1: Tectonic thinning in the mantling sequence around the Chester Dome, Vermont: Implications for mechanical decoupling between basement and cover rocks

Leader: Paul Karabinos

The Chester dome is a classic example of a mantled gneiss dome. Mesoproterozoic basement rocks are located in the core of the dome. The core is mantled by Neoproterozoic to Ordovician rocks that are structurally attenuated when compared to equivalent rocks on the east flank of the Green Mountain massif. These highly deformed mantling rocks are structurally overlain by Silurian and Devonian schist and metavolcanic units of the Connecticut Valley trough. Doll and others (1961) interpreted the succession of rocks as stratigraphically continuous except for unconformities at the base of the Neoproterozoic and Silurian units. Ratcliffe (2000) explained the attenuation of mantling units as the result of Taconic thrusting. This field trip will examine evidence for an Acadian normal-sense ductile shear zone around the Chester dome. This trip will include several extended traverses along well exposed sections from Cavendish to Townsend, Vermont.

Meeting time and place: 9:00 AM in Proctorsville, Vermont. Please note that this is an approximately 90 minute drive south of Middlebury. Meet at the intersection of Route 131 and Depot Street in Proctorsville.

Contact: Paul Karabinos at Paul.M.Karabinos@williams.edu

C-2: The record of early Paleozoic collisional tectonics and Mesozoic extension in the Taconic slate belt of Vermont and New York

Leaders: Jean Crespi, Art Goldstein, David Mirakian, Ray Underwood, Phaedra Upton

On this field trip, we will visit classic outcrops that highlight the results of recent research on the tectonic history and structural development of the Taconic slate belt. We will look at excellent examples of ductile and brittle structures that record the effects of early Paleozoic arc-continent collision and Mesozoic rifting of Pangea. Discussion topics will center around (1) shear zone development in slates; (2) evidence for transpression and the role of preexisting continental-margin architecture on collisional tectonics; (3) volume change in slates; and (4) the effect of well-developed preexisting structural anisotropies on brittle fault development. In addition to results of field and microstructural studies of the slates, we will present results of mechanical modeling of along-strike variations in the structural geometry of the Taconic slate belt and results of forward modeling of post-cleavage faults. The field trip will take place in the Granville, New York, to Bomoseen, Vermont, area.

Meeting time and place: 8:00 AM in Fair Haven, Vermont (“Slate Center of the Nation”). Meet in the parking lot of the Shaw’s supermarket located on the west side of VT 22A approximately 3/4 mile north-northwest of the town green in Fair Haven. GPS coordinates of the meeting point are 43° 36.135’N, 73° 16.540’W.

Contact: Jean Crespi at Jean.crespi@uconn.edu

C-3: Quaternary geology of the central Winooski River watershed with focus on glacial lake history of tributary valleys (Thatcher Brook and Mad River)

Leaders: Rick Dunn, George Springston, and Stephen Wright

This trip examines the glacial history preserved in the central Winooski River watershed, focusing on glacio-lacustrine materials in a north-south transect through the Thatcher Brook and Mad River valleys. Several glacial lake levels are preserved, ranging from relatively small ice-contact lakes in the tributary valleys up to glacial Lake Winooski, which at its maximum size extended throughout the Winooski valley from Cabot and Marshfield on the east to Richmond on the west. This lake also extended throughout much of the lowlands of the Lamoille River watershed to the north. The trip will start in deposits of the recently identified glacial Lake Thatcher, which drained through a bedrock notch, south into the Winooski valley, and probably onto ice in the valley. The trip will end in the southern part of the Mad River valley at Granville Notch, where glacial Lake Granville drained south through a bedrock outlet. A 20-mile drive will return participants to I-89.

Meeting time and place: 8:30 AM just outside of Waterbury, Vermont. Meet in the Shaws Supermarket parking lot on Rt.100 N out of Waterbury (official address is 820 Waterbury Stowe Rd., also known as Rt. 100N). From I-89 Exit 10, head north on Rt. 100N.

Contact: Rick Dunn at rdunn@norwich.edu

C-4: The timing and sequence of fluid alteration and magnetite-apatite mineralization in the Lyon Mountain granite: Adirondack Mountains, New York

Leaders: Peter Valley and John M. Hanchar

The Lyon Mountain granite (LMG), which crops out extensively in the northeastern Adirondack Highlands is the host to numerous Kiruna type, low-Ti magnetite-apatite deposits. The LMG experienced extreme metasomatic alteration by potassic- and sodic-rich fluids related to at least one stage of Fe mineralization and during which time high field strength elements (HFSE) including Zr, Y, U, and light and middle rare earth elements were mobilized. Uranium-Pb ages from zircon grains in the magnetite-apatite deposits are 20 to 60 m.y. younger than the host granite and contain extremely radiogenic Hf values. These data, as well as field relations, suggest that early formed ore deposits related to granite emplacement were altered by fluids and remobilized to form a second generation of mineralization. Dykes and pegmatite bodies which crosscut the regional fabric are contemporaneous with zircon ages in the ore. This suggests that fluid alteration and second generation mineralization is related to extension of the Adirondack Highlands at the end of the Ottawan orogeny.

Meeting time and place: 9:00 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall.

Contact: Peter Valley at pvvalley@gmail.com

C-5: Classic bedrock teaching localities in the Champlain Valley between Middlebury and Burlington, Vermont

Leaders: David West, Keith Klepeis, Jon Kim, and Jeff Webber

This field trip will visit several spectacular bedrock exposures in the northern Champlain Valley that illustrate both the geologic history of the region and fundamental geologic features/processes (e.g., sediment deposition, dipping beds, folding, faulting, igneous intrusion). At each stop an explanation of the geological processes responsible for the features will be provided as well as an overview of how the exposed rocks fit into the regional geologic history of the region.

The trip will begin in Middlebury, steadily proceed northward along the Rt. 7 and Rt. 116 corridor, and end along the shores of Lake Champlain just north of Burlington, Vermont. Stops will include gently dipping Cheshire quartzites at Bristol Falls, spectacular folds at “The Oven” near North Ferrisburgh, ductile shearing along the Hinesburg thrust fault at Mechanicsville, a panoramic overview of geomorphic features from the top of Mt. Philo, igneous intrusions in carbonate rocks along the shores of Lake Champlain just west of Charlotte, and the trip will culminate with arguably the most dramatic fault exposure in eastern North America: the Champlain thrust fault at Lone Rock Point (shore of Lake Champlain) just north of Burlington.

Meeting time and place: 8:30 AM in the McCardell Bicentennial Hall parking lot on the Middlebury College campus. From the center of Middlebury (Route 7), follow signs for Route 125 west. Proceed up the hill and past the Catholic Church (on the right) through the College. Go over the hill crest, and at the bottom of the hill as the road flattens; immediately turn right (Bicentennial Drive) onto the winding driveway. Parking is available in the large parking lot on the west side of Bicentennial Hall. Please note that the trip will proceed steadily north from Middlebury throughout the day and will end along Lake Champlain just north of Burlington. Please bring your lunch.

Contact: Dave West at dwest@middlebury.edu