Suggested Lodging and Camping Locations

Ricker Pond State Park and New Discover State Park in Groton State forest offer tent camping, lean-to locations, and cabins: https://vtstateparks.com/camping.html#reservations

Lazy Lions Campground (tent sites, leant-to locations and cabins) in Barre, VT
http://www.lazylions.com/Lazy-Lions-Campground/OverView

Meadowcrest Campground (tent sites and on-site RV rentals) in Marshfield, VT
https://meadowcrestcampground.com/

Hilltop Inn of Vermont, Berlin, VT

Econolodge, Montpelier, VT

Quality Inn, Barre, VT

Events

FRIDAY Icebreaker, Vermont Granite Museum, Barre, VT; 5:00-7:00pm

SATURDAY Banquet, Old Labor Hall, Barre, VT; 5:00-7:00pm

Schedule of trips

FIELD TRIPS FOR FRIDAY, October 11th

A1) A Transect Through Vermont's Most Famous Volcano – Mount Ascutney

Trip Leader: Greg Walsh, US Geological Survey, (gwalsh@usgs.gov)

Meeting time: 8:15am
Meeting point: Commuter parking lot at I-91 at Exit 8, on Vermont Route 131 in Ascutney, Vermont.
Coordinates: 43.401405, -72.415496 *(all coordinates are in WGS84 datum)*
The parking lot is on the west side of the Interstate, on the south side of Vermont Route 131. There are two gas stations with convenience stores on the on east side of I-91. There are no restrooms at the commuter parking lot.

The Cretaceous Ascutney Mountain igneous complex affords a classic exposure of the White Mountain Igneous Suite. Often called Vermont's most famous volcano, Mount Ascutney (elev. 3,144 feet, 958 m) stands as a prominent, and often inspirational, monadnock in the Connecticut River Valley. The Ascutney Mountain igneous complex consists of several mafic to felsic nested plutons including gabbro-diorite exposed at Little Ascutney to the west, and the Ascutney Mountain stock composed of syenite, granite, and related volcanic rocks underlying the main summit to the east. The field trip will present the results of new bedrock geologic mapping, discuss the history of classic emplacement mechanisms, and participants will visit the main rocks types of the Ascutney Mountain stock exposed near the summit and on the east side of the mountain.

A2) DEPOSITIONAL ENVIRONMENTS OF CENTRAL VERMONT UPLAND LAKES AND WETLANDS: CLIMATE AND ECOSYSTEM CHANGE SINCE DEGLACIATION

Trip Leader: Laurie D. Grigg, Norwich University, Northfield, VT, (lgrigg@norwich.edu)

Meeting time: 8:15am
Meeting point: Berlin, VT Park and Ride just off of Exit 7 on I-89 (335 Paine Turnpike N, Berlin). We will organize the group and consolidate vehicles. This location is across from a Shaw's supermarket, gas station/convenience store, and Applebees, so plenty of bathrooms, morning coffee, and lunch supply opportunities, but please be ready to leave at 8:30 sharp. From here we will head south of I-89 to the Northfield-Williamstown Exit 5.

Lakes and wetlands within the uplands of the carbonate-rich Waits River Formation contain several unique depositional environments. Come explore the shallow and deep, the oxic and anoxic, the autochothonous and allocthonous, the phytoplankton- and macrophyte-dominated and learn how evidence for these settings through time are used to reconstruct climate and ecosystem change in central Vermont. We will begin at the world famous floating bridge on Sunset Lake where we will get a first-hand view of stratification and deposition in a 40-ft deep mesotrophic lake. Then we will move northward on strike to Twin Ponds, where we will take a wetland core and learn about the production of marl and its links to water depth, water temperature, and productivity. A Holocene reconstruction of aquatic productivity and an independent climatic reconstruction from multiple proxies (pollen, oxygen isotopes, compound-specific hydrogen isotopes, and branched GDGTs) will be presented in order to assess the impacts of past climate change on productivity. We will cross the divide from the White River to the Winooski River drainage in the afternoon to take a short (0.5 mile) hike to the Pecks Pond wetland. Pecks Pond will provide the setting to explore multiple types of wetland vegetation, marvel at more marl, and discuss evidence for late-glacial climate change.

A3) A LACUSTRINE RECORD OF LATE PLEISTOCENE ICE RE-ADVANCE IN THE WINOOSKI BASIN OF CENTRAL VERMONT

Trip Leaders: Richard K. Dunn and George E. Springston, Department of Earth and Environmental Sciences, Norwich University, 158 Harmon Drive, Northfield, VT 05663, (rdunn@norwich.edu, gsprings@norwich.edu)

Meeting time: 8:00am
Meeting point: Vermont Granite Museum in Barre, VT. There are no facilities or markets along the route, so please come prepared for lunch in the field.

Our trip will explore the glaciolacustrine stratigraphic and sedimentological record of a Late Pleistocene ice re-advance into the Winooski River basin in central Vermont, locally known as the Middlesex Re-advance. We will explore deposits in three tributary valleys that contain a wide variety of sediment gravity flow deposits that appear to record the approach of the re-advancing ice margin and the destabilization of basin deposits in front of the ice margin. These lacustrine deposits are overlain by several meters of dense silt-matrix till. In some locations this till is overlain by glaciolacustrine silt and sand that represents the final lake in the area as the ice fully retreated. Stops will be few in number and will provide participants with time to study the sections. We will focus on details of sediment gravity flows, including stratified diamicts that we interpret to have formed in a grounding zone wedge.

A4) Variation in intrusive styles of granitic plutons on the western margin of the New Hampshire plutonic suite in central Vermont

Trip Leader: Christopher Koteas, Norwich University, Northfield, Vermont, (gkoteas@norwich.edu)

This trip will review the different types of intrusive mechanisms preserved along a north-to-south transect adjacent to the interface between Siluro-Devonian units and Cambro-Ordovician units between Barre and Hardwick, Vermont. Outcrop-scale features will be discussed in the context of geochemistry and geochronology and estimates of pressure-temperature conditions during pluton growth suggesting different paleodepths along this interface. Chemical and isotopic variation suggest different degrees of assimilation as well as different influences of stress along this temporal interface to create unique intrusive features based on the proximity of intrusions to zones of high-strain along this temporal interface. Stops will include outcrops that require moderate hiking as well as inactive quarries.

Meeting time: 8:30am
Meeting point: Vermont Granite Museum, Barre, VT

FIELD TRIPS FOR SATURDAY, October 12th

B1) New Insights on the Ordovician - Neogene Tectonic History of the Champlain Valley Belt from Drone Surveys, Photogrammetry, and Geochronology, West-Central Vermont

Trip Leaders: Jon Kim- Vermont Geological Survey, Montpelier, VT; Keith Klepeis and Laura Webb- Dept. of Geology, University of Vermont, Burlington, VT; Will Amidon- Dept. of Geology, Middlebury College, Middlebury, VT

Meeting time: 8:30am
Meeting Point: Richmond Park and Ride at Exit 10 on Interstate 89. The Park and Ride is on Route 2.
-If coming from the north (Burlington end) on I-89 South, take Exit 11, proceed to the light at the end of the exit ramp, and go straight across Route 2 into the Park and Ride lot.
-If coming from the south (Montpelier end), proceed to the stop sign at the end of the exit ramp, make a left onto Route 2, and make a left at the first light in the Park and Ride lot.
Meeting Point Coordinates: X = 658550, Y= 4920804; UTM NAD83 meters

The field area for this trip encompasses the western part of the Green Mountain Belt and the Champlain Valley Belt. These two belts represent the foreland and western hinterland of the Ordovician Taconian Orogen of west-central Vermont, respectively. The region can be divided into three lithotectonic slices which are, from west to east and from structurally lowest to highest: A) the Parauthochthon, B) the Hanging Wall of the Champlain Thrust, and C) the Hanging Wall of the Hinesburg Thrust. The Champlain Thrust forms the tectonic boundary between slices A and B, whereas the Hinesburg Thrust separates slices B and C. Although all of these slices were originally juxtaposed during the Ordovician; each experienced further deformation during the Devonian Acadian Orogeny, during Cretaceous extension and magmatism, and during Neogene extension. For this trip, we will focus on field sites where drone and photogrammetry surveys were completed and/or where new geochronology

(40Ar/39Ar ages or U/Pb ages on calcite veins) reveals new elements of this complex tectonic history.

B2) Trondhjemitic Extensional Magmatism of the Northfield Intrusive Complex and Its Association with Opening of the Siluro-Devonian Basin of Central Vermont
Trip Leader: David S. Westerman, Norwich University, Northfield, VT

Meeting time: 8:30
Meeting point: Montpelier I-89 Park and Ride (18T 692005 E; 9403023 N)

On this field trip we will examine a swarm of trondhjemitic dikes and associated tonalitic plutons of the Northfield intrusive complex (NIC) located along the eastern margin of the Moretown Formation immediately west of the Dog River fault zone (RMC) which marks the western margin of the Siluro-Devonian basin in central Vermont. The belt of dikes is typically 20m wide with up to 10 dikes across strike, has been traced more than 20km along strike, with has three associated small tonalitic plutons. We will specifically explore and discuss the unique petrological character of these leucocratic, peraluminous rocks, and the structural and tectonic controls on the timing and conditions of their post-Taconian and pre-Acadian emplacement. Discussion will include the significance of their late-Silurian – early Devonian ages (428.2 ± 4.8, 412.7 ± 4, and 409.7 ± 8 Ma), as well as the extensive presence of inherited zircons with age populations of 1.8-2.0 Ga, 1.0-1.5 Ga and 650 Ma, the latter suggesting a Pan-African affinity.

B3) Glacial Geology of the Miller Brook Valley, Stowe, Vermont: A Head to Toe Hike
Trip Leader: Stephen Wright, University Vermont, Burlington, VT

Meeting time: 8:30am
Meeting Point: This field trip road log begins at the Cold Hollow Cider Mill in Waterbury Center, Vermont. The Cider Mill has a large parking lot, but this can fill on busy holiday weekends. Both food and bathrooms are available in the Mill. This field trip is designed as a two-part trip. The first part is a hiking trip in the upper Miller Brook valley that will take the majority of the day. The second part of the trip is accessed via a short drive down the valley which leads to the final two closely-spaced stops.

The Miller Brook valley hosts a wonderful suite of glacial sediments and landforms that shed light on many aspects of the glacial geology of the northern Green Mountains as well as its post-glacial history. Most stops will be accessed via an ~6-mile-long hike (~800 ft of elevation gain) along trails through the colorful fall woods. We'll begin by hiking along and up the north side of the valley to Nebraska Notch, the headwaters of Miller Brook, to view both cirque-like landforms and evidence for subglacial water flow. We'll then descend down the south side of the valley along a landform originally interpreted to be a moraine, but now known to be an esker. We'll follow this esker to a Glacial Lake Winooski delta and a complex network of channels incised in that delta following the draining of the lake. If time permits we will drive farther down the valley to visit a gravel pit that exposes sediments deposited in the esker, a subaqueous fan, and Glacial Lake Winooski. This trip will emphasize the results of recent mapping and will update interpretations presented in 1997, the last time an NEIGC field trip visited this site.

B4) The White River Watershed – a Natural Laboratory for Basic and Applied Studies on River Processes.
Trip Leader: John Gartner, Norwich University, Northfield, VT

The White River watershed is one of the largest river systems without flow regulation in the northeast, making a wonderful laboratory to study river processes. This region was also struck by an extreme flood during Tropical Storm Irene in 2011. In this field trip, we explore sites used for basic and applied research on geomorphic processes. After an overview of the bedrock and glacial history of the watershed, we visit sites where fallout radionuclides were used to determine residence times of stream bed sediment. We next examine the impacts of Tropical Storm Irene, paying particular attention to how GIS maps of stream power derived from pre-storm data can to predict the movement of sediment into and out of the river channel, as well as the natural hazards of landslides and thick floodplain deposits. We further examine the dramatic landslides, looking at their continued input of sediment even 8 years after the flood, and placing this in the context of the long-term denudation of the Green Mountains. Finally, we examine the human dimension of the flood, how misguided recovery efforts threatened stream habitat, and how innovative delineations of river corridors are being used to protect river systems and reduce future human impacts. We close our field trip by investigating this broad question: Do floods—large and/or small—ruin or restore rivers?

B5) Overview of quarrying operations and petrogenetic history in the Barre area

Trip Leader: Chris Koteas, Norwich University, Northfield, VT

Meeting time: 8:30am
Meeting point: Rock of Ages visitor center, 558 Graniteville Rd, Graniteville, VT

This trip will begin with a tour of the Rock of Ages museum and factory followed by a guided tour of the active quarries in the immediate area. This will be followed by a hike on established trails in gentle to moderate terrane to look at some of the inactive quarries in the immediate area of Barre/Graniteville. Quarry and outcrop exposures along the hike will be used to discuss regional petrogenetic processes and the magmatic history within this portion of the Connecticut Valley/ Gaspe Synclinorium. Most of the locations discussed are sites used for freshman- and sophomore-level introductory courses offered by the Department of Earth and Environmental Sciences at Norwich University.

FIELD TRIPS FOR SUNDAY, October 13th

C1) Stratigraphic and Structural Evidence for a Fault Contact Between Ordovician Arc Rocks and the Connecticut Valley - Gaspé Basin Sequence in Vermont
Trip Leaders: Paul Karabinos, Williams College, Williamstown, MA; David S. Westerman, Norwich University, Northfield, VT; James L. Crowley, Boise State University, Boise, ID; Francis A. Macdonald, University of California, Santa Barbara, Santa Barbara, CA

Meeting time: 8:30am
Meeting point: Starting point is Shaws Market parking lot, 160 Paine Turnpike North, Berlin, VT

On this trip we explore the evidence for the depositional environment and age of units in the Connecticut Valley - Gaspé basin (CVGB) in central Vermont, and the nature of the contact between these units and the structurally underlying Ordovician arc rocks. The Shaw Mountain Formation occurs discontinuously as fault-bound slivers along the western margin of the CVGB, whereas the Northfield Formation unfailingly overlies the slivers of Shaw Mountain or the Ordovician rocks. The Shaw Mountain and Northfield Formations formed in radically different depositional environments and geochronological evidence suggests that they represent the oldest and youngest units, respectively, in the CVGB. Mylonites and lenticular blocks of various lithologies occur between the Ordovician arc rocks and the Shaw Mountain and Northfield Formations in Northfield, Vermont, and Westerman (1987) identified this contact as the Dog River fault zone. We suggest that it extends southward through Vermont and Massachusetts into Connecticut. We will visit outcrops in Northfield, Bethel, and Randolph, Vermont, and if time permits examine the high-strain, normal-sense shear zone between Ordovician arc rocks and Devonian units on the northeast flank of the Chester dome.

C2) THE NEW HAMPSHIRE PLUTONIC SUITE: MINERALOGICAL AND GEOCHEMICAL EVIDENCE FOR SOURCE ROCK COMPOSITIONS, PARTIAL MELTING REACTIONS, AND PERITECTIC/RESTITIC PHASE ENTRAINMENT

Trip Leader: Michael J. Dorais, Department of Geological Sciences, Brigham Young University, Provo, UT

Meeting time: 8:00am
Meeting Point: Meet at Sunapee Ski Resort, Lot #2, off Route 103 at the south end of Lake Sunapee.

The Devonian New Hampshire Plutonic Suite (NHPS) consist of four members, the Bethlehem Granodiorite, Kinsman Granodiorite, Spaulding Tonalite, and the Concord Granite. The first three are synkinematic with Acadian tectonism, whereas the Concord Granite is post-tectonic. On this trip, we will visit outcrops of all four members and discuss the nature of the source rocks, potential heat sources that caused partial melting for each member, and the tectonic setting that produced the NHPS magmatism. We will compare the mineral assemblages and whole-rock compositions of the peraluminous Bethlehem and Kinsman Granodioites and make inferences about their different petrogenetic histories. We will particularly focus on the relationship between restitic garnetites and host granitic rocks of the Cardigan Pluton, a Kinsman Granodiorite pluton. The garnetites allow determination of partial melting reactions and the textural and chemical identification of restitic and peritectic phases. Having identified these phases in the garnetites, we use these same characteristics to identify restitic and peritectic phases in the host granitic rocks, enabling interpretation of the whole-rock geochemical variations of the pluton. In contrast to the older, peraluminous members, the Spaulding Tonalite is metaluminous and requires different source rocks, partial melting reactions, and heat sources. Finally, the mineralogy and whole-rock major, trace element and isotopic geochemisty of the Concord Granite will be discussed and regional variations in these parameters interpreted to make inferences about the compositions of the source rocks and the identity of the basement under this portion of New Hampshire.

C3) Structural variability along and across the Taconic-Acadian margin in central Vermont

Trip Leader: Christopher Koteas, Norwich University, Northfield, VT

Meeting time: 8:30am
Meeting point: Community parking area in downtown Hardwick, VT adjacent to the Village Restaurant on 74 Main Street.

The Taconic-Acadian interface, often considered the Richardson Memorial Contact (RMC) has long been described as being defined as an unconformable surface (i.e. Richardson, 1919). However, this interface has also been described as preserving evidence for faulting and has been called the Dog River Fault Zone in Northfield, VT (Westerman, 1994) and Montpelier, VT (Walsh et al., 2010). Work north of Montpelier, between Woodbury and Craftsbury, has recognized an anastomosing set of upper-greenschist to lower-amphibolite grade shear zones. These zones are sub-parallel with the RMC, but appear to operate independently and are hypothetically a continuation of the Dog River Fault Zone along-strike to the south. Field studies as well as microstructural and microgeochemical work on high-strain rocks associated with these shear zones, suggest subtle localized rheological changes that manifest as marked changes in kinematic conditions. A broad set of high-strain zones suggests that significant shortening normal to the RMC, as well as extensive elongation of minerals parallel to this interface, occurred relatively late in Acadian orogenisis.

C4) Glacial, deglacial, and postglacial history of Franconia Notch, New Hampshire, from constructing a cosmogenic nuclide glacial dipstick to determining a landslide history from lake sediment cores and ground penetrating radar images

Trip Leader: P. Thompson Davis, Bentley University, Waltham, MA

Meeting time: 9:00 AM
Meeting point: At the large parking lot opposite the Peabody Lodge at Cannon Mountain ski area, about 0.7 mi west on Rte. 18 from Exit 34C on Rte. I-93; 44.17884°N, -71.70169°W.

This field trip serves two main purposes: 1) discuss and review the glacial and deglacial history of Franconia Notch based on cosmogenic nuclide exposure ages obtained to develop one of several glacial "dipsticks" funded by NSF to understand the timing and rate of ice thinning of the last continental ice sheet in New England and adjacent areas, and 2) examine the historic and prehistoric postglacial landslide history of Franconia Notch as determined from sediment cores and GPR images from Profile Lake. Other parts of our glacial dipstick project have been presented at the past two NEIGC; Mount Washington, N.H. (Trip C1; Davis et al., 2017), Mount Mansfield (Trip A4; Bierman et al., 2018), and Mount Greylock (Trip C4; Halsted et al., 2018). Our earlier work on the landslide history in Franconia Notch was presented to a small NEIGC group primarily indoors because of inclement weather (Trip C2; Rogers et al., 2009).