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The Geology and Deformation History of the Southern Part of the Matapedia Zone and Its Relationship to the Miramichi Zone and Canterbury Basin

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TRIP B-10

THE GEOLOGY AND DEFORMATION HISTORY OF THE SOUTHERN PART OF THE MATAPEDIA ZONE AND ITS RELATIONSHIP TO THE MIRAMICHI ZONE AND CANTERBURY BASIN

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INTRODUCTION

Western New Brunswick is underlain by parts of two tectonostratigraphic zones: the Matapedia Zone and the Miramichi Zone. Part of the Miramichi Zone is downfaulted forming the Canterbury Basin in the southern part of the area (Figure 1). The purpose of this trip is to examine sections from Florenceville to Canterbury and contrast the structural development of the two zones with the Canterbury Basin.

The Matapedia Zone has been mapped in the Woodstock area by Anderson (1968), and Hamilton-Smith (1972). The regional geology in the southern part of the Matapedia Zone has been demonstrated by Pavlides (1968). Reconnaissance work by us has modified the structural interpretation for this area and an early (Pre-Acadian) period of recumbent folding is recognized. Recent mapping by the Department of Natural Resources has modified previous interpretations of the stratigraphy, structure and metamorphism of the Miramichi Zone. The rocks in the Canterbury Basin have been mapped by Venugopal (1978, 1979) and Lutes (1979) and the general stratigraphy and structure are well known.

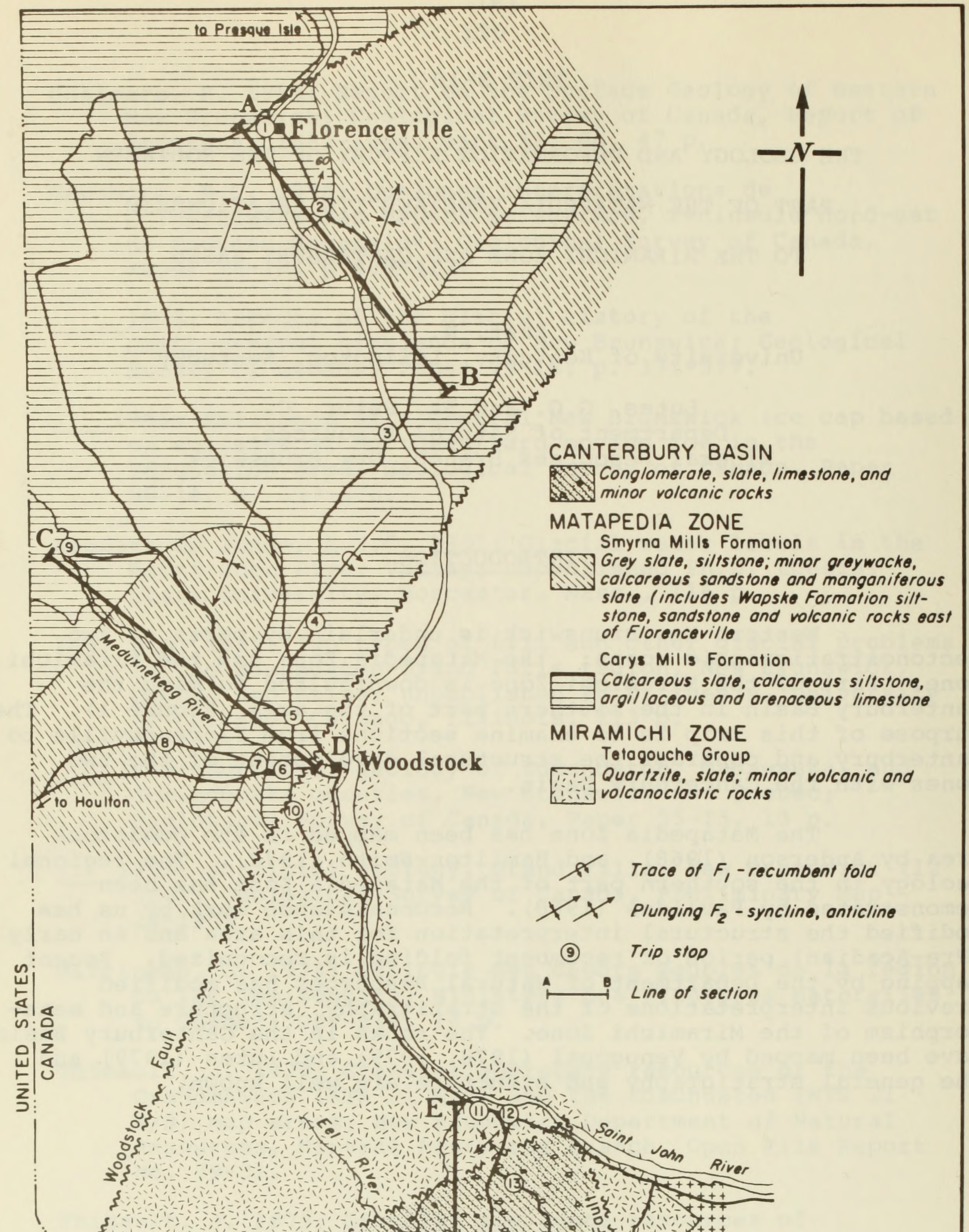

Figure 1. Generalized Geology of Western New Brunswick.

MATAPEDIA ZONE

Stratigraphy

The Matapedia Zone strikes from northeastern Maine across northwestern New Brunswick into the southern part of the Gaspe Peninsula. The zone is composed of limestones, greywackes, siltstones and shales ranging from Middle Ordovician to Late Silurian in age. The rocks in northern New Brunswick have been separated into four rock-stratigraphic units: Grog Brook Group, Matapedia Group, Upsalquitch Formation, and Perham Formation (St. Peter, 1978). In the Woodstock area, the Matapedia Zone is underlain by calcareous slates of the Carys Mills Formation which are stratigraphic equivalents of the Matapedia Group and range in age from Middle Ordovician to Lower Silurian (Pavlides, 1968). Its thickness has been estimated to range from 1500 to 12,000 feet in Maine; the formation thins to the west (Pavlides, 1968). In New Brunswick, it has been estimated to be greater than 2500 feet thick (Hamilton-Smith, 1972) and has been interpreted as a turbiditic sequence of calcareous flysch (Pavlides, 1968). The Smyrna Mills Formation conformably overlies the Carys Mills Formation in Maine (Pavlides, 1968). It is composed of slate, calcareous slate and sandstone with minor manganiferous siltstone. This formation ranges in age from early Llandovery to early Ludlow (Pavlides and Berry, 1966). Parts of the Wapske Formation occur above the Smyrna Mills Formation southeast of Florenceville. The Wapske Formation consists of intercalated clastic sedimentary and mafic volcanic rocks which are interpreted by St. Peter (1978) as an alternating sequence of marine and terrestrial rocks, the marine rocks probably being shelf deposits. The age of the Wapske Formation is established as Lower Devonian, probably Helderbergian (St. Peter, 1978).

Structure

Two periods of folding have been recognized in the Woodstock-Florenceville area. The first has produced large recumbent nappes which are interpreted from flat-lying overturned beds near Woodstock. There is no cleavage associated with these F_1-folds and the age of deformation is difficult to assess. The Smyrna Mills Formation has been demonstrated to conformably overlie the Carys Mills Formation near Houlton, Maine (Pavlides, 1968). Near Woodstock (Stop 7), the contact between the two formations appears to be conformable, suggesting at least part of the Smyrna Mills Formation was involved in the recumbent folding. As noted previously, the youngest age known for the Smyrna Mills Formation is Ludlow (Pavlides and Berry, 1966). The oldest age for the overlying Wapske Formation is Lower Devonian (Helderbergian). The intervening and unrecorded stratigraphic interval may represent a period during which uplift in the adjacent Miramichi Zone created unstable slope conditions in part of the Matapedia Basin initiating gravity slides prior to the main Acadian Orogeny. It is also possible that the Smyrna Mills Formation, where observed, is paraconformable over the Carys Mills Formation. If so, gravity sliding may have been initiated by Taconian movements in the Miramichi Zone in Upper Ordovician time.

A superimposed Acadian generation of folding and cleavage affects all rocks in the Matapedia Zone. The style and attitude of these folds varies with change in orientation of the earlier F_1-folds. On the limbs of F_1-folds, Acadian folds are open to close and have associated axial planar cleavage. Plunge of these folds is dependent on the attitude of the F_1-fold limb. In the vicinity of F_1-fold hinges, Acadian folds are tight and have large variations in plunge and bedding-cleavage intersection lineation.

MIRAMICHI ZONE

Stratigraphy

Rocks of the Tetagouche Group underlie most of the Miramichi Zone. The rocks range from Cambrian(?) to Middle Ordovician and can be divided into five map-units consisting of a thick basal unit of quartzite and slate(1) overlain in succession by (2)slate, siltstone and greywacke, (3)rhyolitic volcanics, (4)manganiferous slate, chert and andesitic volcanics, and (5) massive basic volcanics (Helmstaedt, 1971). In southwestern New Brunswick, lithostratigraphic equivalents of the first four units have been recognized (Venugopal, 1979; Lutes, Unpubl. Msc.). Manganiferous slate forms a readily recognizable marker horizon throughout the Miramichi Zone.

Structure

Rocks of the Miramichi Zone are structurally more complex than those of the Matapedia Zone or Canterbury Basin. First folds, which are rarely observed, have associated cleavage parallel to bedding. Later, second folds of bedding and the first cleavage in the Canterbury area pre-date the main third deformation which folds and cleaves both Cambro-Ordovician and Siluro-

Devonian rocks (Lutes, 1979). These third folds are generally steeply dipping with axial planar cleavage. Much of the Miramichi Zone is occupied by granitoid plutons, generally of Devonian age. Whereas regional metamorphism has little affected rocks of the Matapedia Zone and the Canterbury Basin, the grade of metamorphism in the Miramichi Zone reaches sillimanite grade within a megmatite complex that occurs in central New Brunswick. Deformation and regional metamorphism of this zone is attributed to the Taconian Orogeny of Middle-Upper Ordovician age and spans the time during which the Carys Mills Formation was being deposited in the Matapedia Basin.

CANTERBURY BASIN

Stratigraphy

Rocks of the Canterbury Basin comprise conglomerates, slates, mafic and felsic volcanics and limestone unconformably overlying rocks of the Miramichi Zone. These Siluro-Devonian rocks occupy a downfaulted basin bound by the Meductic Fault on the west and the Charlie Lake Fault on the east (Figure 1). Pocowogamis Conglomerate forms the base of the succession along the east side of the Meductic Fault. This is overlain by Scott Siding Slate succeeded by feldspar-quartz crystal tuff and mafic volcanics. In the southern part of the area, Cambro-Ordovician quartzite of the Miramichi Zone is unconformably overlain by Canterbury Limestone with some basal conglomerate. The Canterbury Limestone and Scott Siding Slate are gradationally overlain by calcareous sandstones and siltstones of the Hartin Formation containing intercalated mafic and felsic volcanics, microconglomerate and minor limestone. Fossils from the Hartin Formation have yielded a Lower Devonian (Helderbergian) age. Underlying formations may be Silurian.

Structure

Rocks in the Canterbury Basin occupy a downfaulted basin (graben structure) and subsequent deformation produced north facing folds in the south and south facing folds in the north. First schistosity in these rocks has a similar trend and attitude as second schistosity in Cambro-Ordovician rocks and is probably the same age. Metamorphism by the nearby Pokiok Batholith has formed biotite in many of the Siluro-Devonian rocks on the north.

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ITINERARY

Assembly point is in Florenceville at stop 1, a deep road cut on route 103 about 0.5 km southwest of the intersection with route 2 on the west side of the bridge to East Florenceville across the Saint John River. Park vehicles along side of road. Assembly time is 9:00 a.m.

Kilometers	Miles	
00.0	00.0	Stop 1. Carys Mills Formation. The beds are closely folded (of Acadian generation) and plunge approximately 55° to 016. Grading and small-scale load structures suggest bedding is right way up and faces northward. Numerous faults cut the section and gabbroic dykes are common.
00.5	00.3	Intersection with rts. 2 at bridge. Proceed across bridge and travel southward on rte. 2.
06.1	02.4	Stop 2. Small exposure on east side of road. Carys Mills Fm. Thinly bedded and laminated calcareous siltstones and slate. Grading appears to be right way up on cleavage trending 014 and dipping vertically. Bedding-cleavage intersection plunges about 60° to 014. Structural style appears to be consistent to this point. Over the next 6-7 km we will be crossing a section of Smyrna Mills Fm. and Wapske Fm. which overlie the Carys Mills Fm. and appear to plunge northwesterly.
20.1	12.6	Stop 3. Carys Mills Fm. Current laminated, thinly bedded calcareous sandstone and lithographic limestone. Bedding consistently trends 020, dips 50° to the west and is right way up. Bedding-cleavage intersection is subhorizontal and indicates a change in the plunge of Acadian folds. As the Acadian folds are superimposed on an earlier (F_1) generation of recumbent folds, this must reflect a change in the attitude of first structure. We are interpreted to be on the western limb of an overturned recumbent F_1-fold (Figure 2a,b).

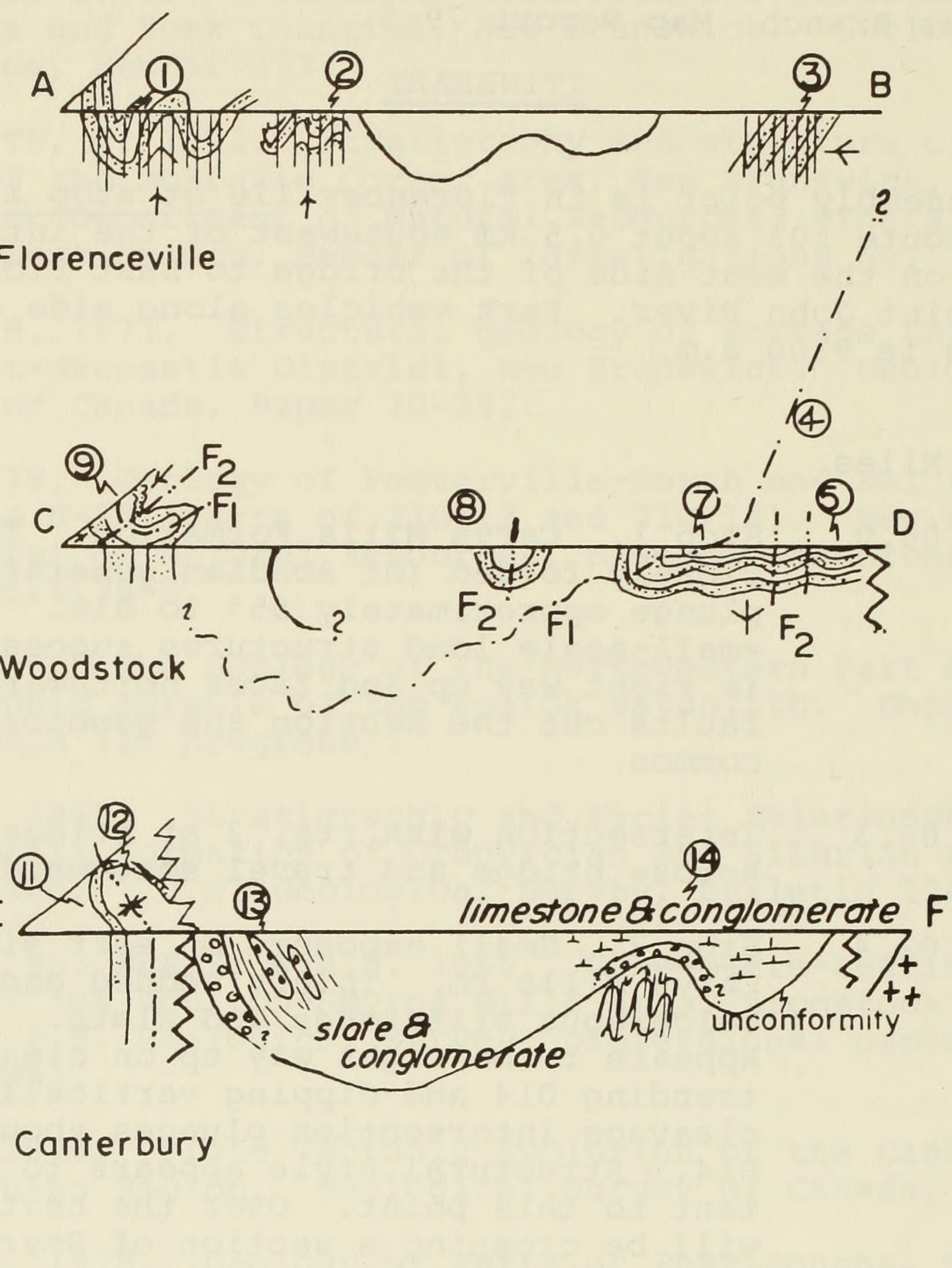

FIGURE 2.

Schematic cross-sections through parts of western New Brunswick. Trip stops are indicated.

Kilometers	Miles	
31.5	19.7	Stop 4. Carys Mills Fm. Calcareous slate and siltstone. Small isoclinal F_2 (Acadian) folds with axial planar cleavage trending parallel to road (024). The plunge of these folds is extremely variable within the outcrop as is indicated by bedding-cleavage intersections. This appears to be the affect of superimposed folding over F_1-folds. We are interpreted to be in the hinge area of a major F_1-fold (Figure 2a,b). Younging indicators are inconclusive, but exposure 1 km to the south appears to be downward facing.
32.6	20.4	F_2-folds in this exposure plunge about 20° to 204 and bedding appears to be downward facing.
38.5	24.1	Stop 5. Intersection of rte. 2 and hwy. 550. Carys Mills Fm. Calcareous slate and siltstone. Bedding is flat lying, downward facing and openly folded by upright, horizontal F_2-folds (Figure 2b). Grading and dewatering structures give facing direction. We are interpreted to be on the overturned limb of the F_1-recumbent fold.
41.3	25.8	Intersection of rte. 2 and rte. 95 to Houlton. Turn right.
41.5	25.9	Stop 6. Carys Mills Fm. Similar lithology and structure as stop 5. This exposure contains the best criteria for downward facing. Grading is well developed and a sedimentary cut-off provides convincing evidence of way up.
42.3	26.4	Intersection, bear right.
43.6	17.0	Stop 7. Carys Mills Fm. is steeply dipping, tightly folded and faces southward. An apparently conformable contact with Smyrna Mills Fm. is exposed to the west, on the south side of the highway. Smyrna Mills Fm. here consists of steeply dipping thinly bedded sandstone and slate which also appear to be tightly folded by steeply plunging F_2-folds which face to the southwest. We are interpreted to be in the hinge area of the F_1-recumbent fold.

Kilometers	Miles	
48.2	30.1	Stop 8. Smyrna Mills Fm. Fine-grained green calcarenite and slate. Large upright syncline has very shallow plunge. Graptolites can be found in this exposure.
49.2	30.6	Intersection with rte. 540. Turn right and follow road past Belleville and Jackson Falls to Oakville.
61.7	38.6	Stop 9. Oakville. Turn right, cross bridge and park on east side of river. Polydeformed Carys Mills consists of argillaceous limestone with thinly bedded and laminated sandy limestone. Steep F_1-folds are refolded by superimposed F_2-folds and cleavage trending 010 (Figure 2b).
82.1	51.3	Turn and proceed back to Intersection of rte. 2 and rte. 95 at Woodstock, past stop 6. Turn right and travel southward.
84.3	52.7	Stop 10 (optional). Strongly sheared quartzite, quartz wacke and slate of the Miramichi Zone southeast of the Woodstock Fault. This fault separates the Matapedia and Miramichi Zones and has a pronounced topographic expression trending in a northeasterly direction.
104.1	65.1	Stop 11. Polydeformed quartzite and slate just east of Meductic across Eel River. This is the typical lithology of the basal Tetagouche Gp. of northern New Brunswick and is similar to Grand Pitch type lithology in Maine. Small-scale, vertically plunging, asymmetric F_2-folds with axial planar fracture cleavage fold bedding, first cleavage (which is subparallel to bedding), and L_1-intersection lineation which, if axial planar, suggests F_1-folds were originally plunging southwards.
105.1	65.7	Stop 12. Long road-cut of steeply dipping reddish, manganiferous slate, chert and volcanoclastic sedimentary rocks. These overlie the quartzite-slate unit and are interpreted to occupy the axial zone of a steeply plunging, southward facing syncline

Kilometers	Miles	
		(Figure 2c). More quartzite outcrops to the east, and the northeasterly trending Meductic Fault truncates the Cambro-Ordovician sequence approximately 2 km to the east and to the south.
105.2	65.7	Turn vehicles and proceed southward on rte. 122 towards Canterbury.
108.4	67.8	Intersection. Turn left toward Johnson Sett.
109.4	68.4	Stop 13. Small outcrop on left of strongly cleaved polymict conglomerate. Conglomerate is extensive in the Siluro-Devonian sequence of the Canterbury Basin along the Meductic Fault. Venugopal (1979) has envisaged formation of the conglomerates along an escarpment formed by the Meductic Fault. Grey Scott Siding Slate, a dominant lithology in this area, becomes calcareous to the south and grades into the Canterbury Limestone.
110.4	69.0	Return to main road, turn left and proceed to Canterbury.
119.4	74.6	Canterbury. Bear right past school and turn right past cemetery.
122.4	76.5	Intersection. Turn left and proceed southward across railway tracks.
128.4	80.3	Stop 14. Pass church on right side of road and park in drive of deserted house at bottom of hill on left. Exposure is scattered in back field. The rock is essentially a quartzite-pebble conglomerate with a limey matrix. This represents the base of the Canterbury Limestone and unconformably overlies Cambro-Ordovician quartzite and slate immediately to the west from which the pebbles were derived. The relatively higher topography marks areas underlain by quartzitic rocks.

END OF TRIP

Return to cars and retrace to route 2.