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**RELATIONSHIP BETWEEN BEDROCK GEOLOGY AND GEOMORPHOLOGY IN PORTIONS
OF THE COLD RIVER AND ASHUELOT RIVER WATERSHEDS,
SOUTH-CENTRAL NEW HAMPSHIRE.**

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In north-central Maine, Hanson and Caldwell (1988) have found a clear relationship between bedrock geology and topography. In particular, in the Greenville-Rockwood area metasandstones and felsites form long, continuous ridges. The highest terrain is composed of hornfels in contact aureoles near Devonian plutons. The erosion of granularly disintegrated Acadian plutonic rocks has formed numerous lake basins and low hills. Slaty rocks have also been weathered and eroded to low topography. In southwestern New Hampshire, with higher grades of regional metamorphism, the relationship between bedrock geology and topography is more complex than in Maine. The Acadian plutonic terranes, however, are similar in the two areas.

The field area extends through portions of three major structural belts, the Connecticut Valley-Gaspé Synclinorium (CVGS) on the west, the Bronson Hill Anticlinorium (BHA), and the Kearsarge-Central Maine Synclinorium (KCMS). These fold belts were formed during the Acadian Orogeny. Pre-Silurian rocks in the BHA generally contain evidence of multiple episodes of deformation, while Silurian and Devonian metasediments are generally less complexly deformed. The CVGS in this area is underlain by the Devonian Littleton Formation. The Littleton has a variety of topographic expressions, underlying the Connecticut Valley (Stop 1), is draped over the gneiss domes in the BHA (Stops 2 and 5), and holds up the summit of Mt. Monadnock in the KCMS. This variation in resistance to erosion is related to degree of regional metamorphism and to the thermal effects of Devonian plutons. The BHA is characterized by nappe structures which are cored by Oliverian (Ordovician) gneiss and covered by a variety of Ordovician through Devonian sedimentary and volcanic rocks (See Chamberlain, Thompson and Allen's (A-2) guide in this volume for a new interpretation of the nappe stratigraphy in this area). The Alstead dome (Stop 5) has been breached, with overlying units dipping symmetrically away from the gneiss core. The Ammonoosuc volcanics have locally been weathered to orange and red, clay-rich saprolite, some exposures of which are under till (Stop 4). This saprolite is considered to be Tertiary in age. The Beryl Mountain pegmatite forms a prominent knob within the valley of the Cold River (Stop 6). This and other pegmatites in the area are likely late Paleozoic in age, as other New England pegmatites are now believed to be. East of the gneiss domes there are large areas underlain by the Devonian Kinsman porphyritic granite. The Kinsman in this area underlies long narrow valleys, such as the headwaters of the Ashuelot and Contoocook Rivers (Stops 7 and 8). The highest elevations in the field area are underlain by rocks assigned to the Silurian Rangeley Formation (Stop 8).

Landslides and catastrophic floods continue to modify the valley of the Cold River. Although houses were built by the early settlers on the floodplain, they were reached only by roads descending from the uplands. Some roads that run along the valley bottom were constructed as recently as 1914.

REFERENCE

Hanson, Lindley S. and Caldwell, D.W., 1988, Relationship between bedrock geology and geomorphology in the mountainous areas of northcentral Maine, *in* Tucker, R. and Marvinney, R., *eds.*, The Geology of Maine: Maine Geological Survey, Augusta, Maine, .

ITINERARY

The trip begins in the Keene State College Commons parking lot. No mileage is given until North Walpole, New Hampshire. Exit parking lot and turn right onto Main Street. At first traffic light, turn right onto Route 12. At third traffic light, Route 12 turns right again. Follow Route 12 for about 20 miles to North Walpole.

Miles

0.0 The mileage of the trip will begin near the mouth of Cold River, at the junction of Routes 123 and 12. Continue north on Route 12, with the Connecticut River on the left and Fall Mountain on the right.

0.1 Mouth of Saxton's River and USGS Connecticut River Gauge on left.

0.8 Turn left at traffic light. Roundhouse of Green Mountain Railway on right.

1.0 Oldest canal in the United States.

1.1 Bellows Falls, Vermont. Turn left onto Westminster Street.

1.4 Junction with Route 5 and 121 at traffic light.

Continue ahead on Route 121.

2.3 Turn left onto unnamed street.

2.4 Straight ahead on dirt road.

2.7 STOP 1. Pull over and park on left side of road. Descend bank of Saxton's River on right. Outcrops of Devonian Littleton Formation are regionally metamorphosed to staurolite grade. First turbidite beds encountered dip to the south and are upside down. On the cliff immediately upstream, similar units also dip to the south and are right side up. The stream course here is roughly controlled by the strike of the beds. Sandy portions of turbidite beds have well-developed climbing ripples. Some sandy layers in the turbidites are disturbed and broken, indicating soft-sediment deformation.

Return to cars and continue along dirt road.

3.2 Turn right on Route 121.

3.7 At light, straight ahead on Westminster Street.

4.0 Turn right at corner.

4.3 Turn right onto Route 12 at traffic light.

5.2 Turn left onto Route 123.

5.4 Cross Cold River.

5.7 Turn left again on Route 123 and begin climb up foreset slope of Lake Hitchcock delta.

6.6 STOP 2. Lake Hitchcock delta surface. Foreset beds are usually visible in pits below. Most of the coarser topset beds have been mined away and operator has had to crush stone to make up proper aggregate sorting. Stone used in crushing operation is Devonian Bethlehem gneiss quarried a short distance up the road. Fall Mountain nappe across the valley.

Return to cars and continue up Route 123.

7.9 Cross Cold River and turn right on Route 123 at blinking light.

- 9.7 Turn right at next blinking light on Route 12 and 123. Cross Cold River.
- 10.3 Intersection of Route 123A. Bear right on Route 123 and 12.
- 10.9 Pull into rest area on right and make U-turn, going back north on Route 123 and 12.
- 11.3 STOP 3. Pull over on right shoulder and park. Bellow's Slide on Great Brook. See Ridge (B-4, this volume) for a detailed description of this section. Lake sediments are underlain by tills with interbedded silt. Possible lower till here. This is the largest of a number of slides and flows that continue to modify the valley walls of the Cold River and its tributaries, particularly in the middle third of the watershed. Other slides have and are diverting the Cold River from its course. Commonly slides bring trees into the river which form debris dams, sometimes augmented by beaver works and always by ice jams, which causes the river to move its channel.

Return to cars and continue north.

- 11.5 Turn right on Route 123A.
- 13.8 Cross Cold River. There are numerous active alluvial fans in this area that have built onto the flood plain.
- 14.4 Bear left.
- 14.6 STOP 4. Park on right of road. Walk up small gully on left. Blue tubing is used to gather maple sap from up the hill. Saprolite developed on Ammonoosuc volcanics. Other saprolite exposures occur up this gully and along other tributaries in this section of the Cold River. Original section exposed in catastrophic flood in 1986 showed till overlying weathered diamict, then saprolite, with bedrock at the base. Exposures of Ammonoosuc up the gully contain knots of chalcopyrite.

Return to cars and continue up Route 123A.

- 15.1 Turn right down driveway of home of Dr. and Mrs. George Hanson, who will provide lunch for us. Continue past house and park in designated area.

STOP 5. View of the Alstead gneiss dome. The dome cover has been eroded through to the Oliverian gneiss core. Ammonoosuc volcanics, the Quimby Formation, and the Littleton Formation dip away from the axis of the structure.

Return to cars and turn right on Route 123A.

- 16.4 Turn right and cross one-way bridge over Cold River.
- 17.0 STOP 6. Park in lot of the Acworth town garage parking area. Cross road and ascend washed out mine road leading to the Beryl Mountain pegmatite quarry. This deposit was mined for beryl in the 1940's and for feldspar and quartz in the 1950's. It still yields some choice rose quartz and golden, white and green beryl. This is one of a number of pegmatites in the region, the so-called Keene pegmatite district. Climb crude trail on the left side of quarry to summit which is composed of the glacially polished quartz core of the pegmatite. Follow trail away from quarry face for good view of Cold River valley, the Alstead dome, and glacial lake terrace below. Note that pegmatite forms an isolated bump on the upper slope of Cold River valley.

Return to cars and continue along Beryl Mountain road.

- 18.0 Turn left at mineral shop.
- 22.5 Turn left on Route 123.

23.6 STOP 7. Kinsman porphyritic granite. This thin, elongate sheet-like pluton is occupied by the headwaters of the Ashuelot River. The Kinsman also forms a small knob on the left in which the not-so-famous Marlow Profile may be found with some difficulty. It resembles Richard Nixon or Fred Flintstone more than the stern features of the famous New Hampshire rock profile.

Return to cars and continue along Route 123.

24.3 Turn right on Routes 10 and 123. PC-MAC Connection sells discount software for those computers.

25.1 Turn left on Route 123.

28.3 Turn into Pitcher Mountain parking lot on left. Secure cars and climb about 1/3 mile to the summit near look-out tower.

STOP 8. This elongate ridge is near the eastern edge of the BHA and is underlain by rocks that have been assigned to the Silurian Rangeley Formation. The first beds that we cross display rusty weathering and may be correlated with the Rangeley "C" in northwestern Maine. On either side of Pitcher Mountain, the valleys are underlain by the Kinsman granite. Note especially the chain of ponds in the valley immediately to the east. Further to the east lies the western limit of the Kearsarge-Central Maine Synclinorium, underlain extensively by the Littleton Formation. Mt. Monadnock to the southeast is part of the Littleton trend. Mountains composed of similar rocks in Massachusetts are hidden by Monadnock but are visible from the road ahead of where we parked. One is supposed to be able to see Mt. Greylock in western Massachusetts and some of the trap ridges in the Mesozoic basin from here. To the north, Sunapee Mountain is underlain by Littleton rocks, with Rangeley units to the east. Mt. Kearsarge may be visible to the northeast. To the west, the Alstead dome forms a long ridge. To the northwest, in front of the Acworth church is Beryl Mountain and Ascutney Mountain beyond. Ascutney is composed of syenite that is related to Mesozoic hotspot activity. To the west lies the Connecticut Valley and the Green Mountains beyond.

End of trip. Those continuing east and to the Boston area continue on Route 123 to Route 9. East on 9 to I-89 and I-93 in Concord. To go southwest or north, return west along Route 123 to Route 12. Access to I-91 near Bellows Falls. To return to Keene, follow Route 123 back to Route 10, then left on Route 10 to Keene.

Thank you. Drive carefully.