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Introduction to the Geology of North-Central Maine

New England Intercollegiate Geological Conference (NEIGC)

Caldwell, D. W.

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NEW ENGLAND INTERCOLLEGIATE GEOLOGIC CONFERENCE GUIDEBOOK

for

THE GREENVILLE - MILLINOCKET REGIONS, NORTH CENTRAL, MAINE

EDITORS

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75th Annual Meeting

October 7, 8 and 9, 1983

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NEW ENGLAND INTERCOLLEGIATE GEOLOGIC CONFERENCE

GUIDEBOOK

for field trips in

The Greenville - Millinocket Regions, North Central, Maine

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Forward

The 75th annual meeting is being conducted at the edge of and partly within the great north woods of Maine. Access to these woods is mostly by roads constructed within the past 30 years by wood-products companies, notably the Great Northern Paper Company, Scott Paper Company, St. Regis, and Diamond International. In addition to owning the cutting rights to these woods, these companies also own the mineral rights to these lands. For this reason they have been happy to have geologic studies conducted in this region and have been most helpful to those of us working on their lands.

The Rangley Lakes region to the southwest of this conference area was presented th during the 62nd Annual Meeting, Gary M. Boone, editor. The geology of the Presque Isle region and neighboring New Brunswick to the northeast was covered during the 72nd Annual Meeting, David C. Roy and Richard S. Naylor, editors. The guidebook presented here bridges the gap between these two important works. Since the earlier conferences Gary Boone has continued his studies toward the northeast and Dave Roy toward the southwest. We are pleased that both will be leading field trips during this meeting.

At the same time that this guidebook is being prepared, the Maine Geological Survey is putting the finishing touches on two new geologic maps of the State, one of the bedrock geology and the other of the surficial geology. Many of the guidebook authors have been involved in the preparation of these maps and much of the geology that will be shown in this conference was mapped in the past few years by these authors for these new maps. In this way, the Maine Geological Survey has played a major role in this conference, as it has in previous conferences during the past 23 years.

New England Intercollegiate Geologic Conference(NEIGC)

The NEIGC was began in 1903, when William Morris Davis led an informal field trip to the Connecticut Valley of Massachusetts. As in that first meeting, the sole purpose of the NEIGC has always been to conduct field trips in areas of recent geologic mapping. The 75th Annual Meeting is the 8th meeting in the State of Maine since 1960. The high frequency of trips in Maine is in recent years is a product of the support that the modern Maine Geological Survey and its State Geologists, John R. Rand, Robert G. Doyle, and Walter A. Anderson have given to geologic studies within the State.

INTRODUCTION TO THE GEOLOGY OF NORTH-CENTRAL MAINE

by

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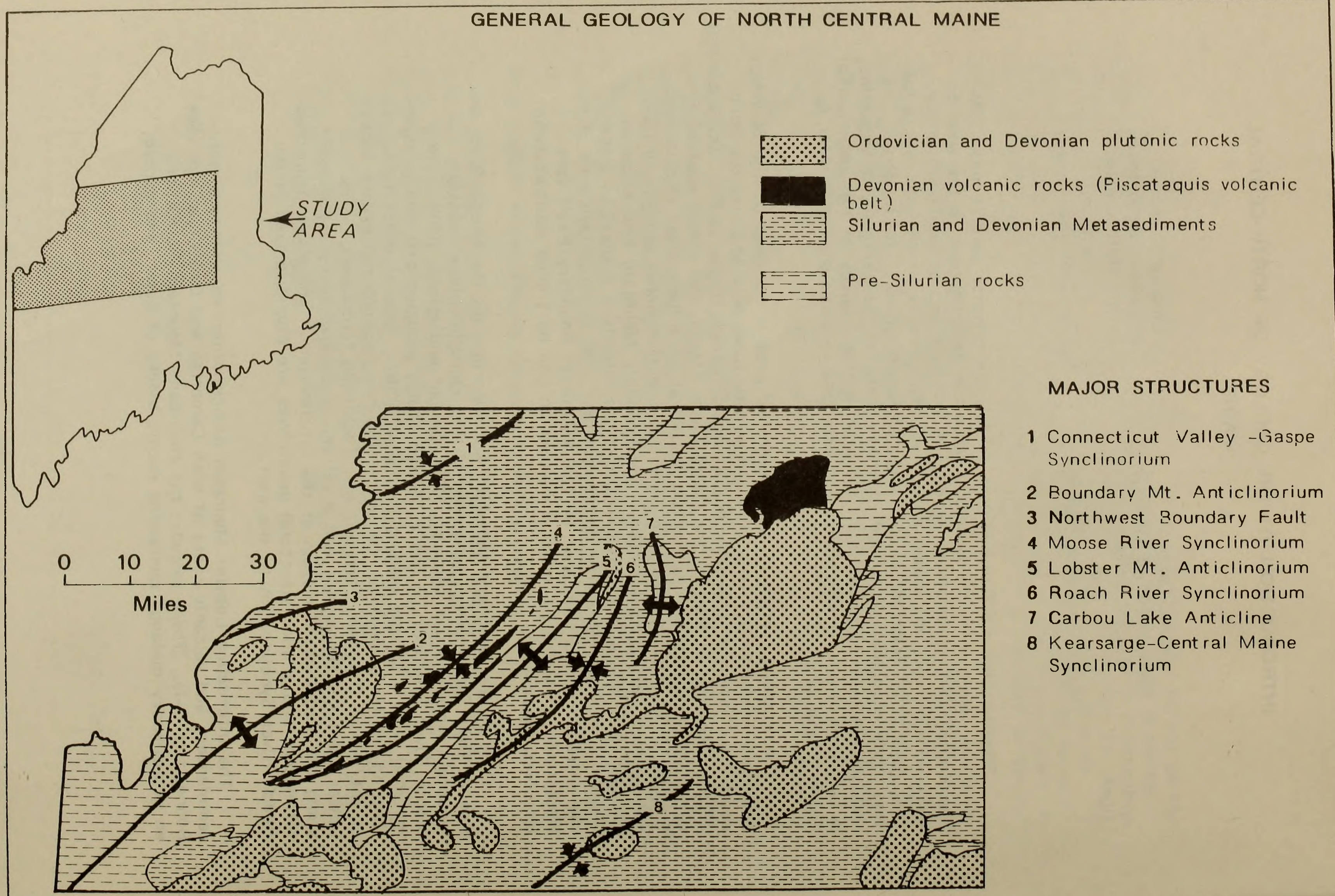
Together the fieldtrips of this conference traverse several major SW-NE structural belts; from the Boundary Mountain Anticlinorium in the west to the Kearsarge-Central Maine Synclinorium (Lyons and others, 1982) in the east. These belts encompass a wide variety of rocks which span over a billion years from Precambrian to Lower Devonian times. The fieldtrips of this conference investigate and illustrate many of the tectonic, stratigraphic, and geomorphic features which characterize the geology of this region. For a summary of the stratigraphies and principal formations of this refer to figure 2 and table 1.

The western portion of the conference area is occupied by the Boundary Mountain Anticlinorium (fig. 1), a major structural belt which is the northeastern extension of the Bronson Hill Anticlinorium to the south. The anticlinal core is occupied in part by the Chain Lakes Massif, the oldest exposed Precambrian basement in New England, dated at 1.5 billion years (Naylor and Others, 1973). Also exposed are Cambrian and Ordovician volcanic, metasedimentary, and plutonic rocks. The Boundary Mountain Anticlinorium plunges NNE where it eventually disappears beneath a blanket of Upper Silurian and Lower Devonian metasediments. The northwestern limb of the anticlinorium is truncated by the Northwest Boundary Fault (see Westerman, trip B-5), a major thrust which can be traced southwestward into New Hampshire.

East of the Boundary Mountain Anticlinorium lie the Moose River and Roach River Synclinoria, separated by the complimentary Lobster Mountain Anticlinorium (Boucot, 1961: Boucot and Heath, 1969). The Moose River Synclinorium has a SW-NE doubly plunging axis and is asymmetrical with a steeply dipping southeast limb. Several minor folds, reflecting similar geometries, lie within the synclinorium and expose rocks of the Lower Devonian Tarratine and Tomhegan formations. The Lower Devonian Seboomook and a variety of Silurian rocks are exposed along the southeastern margin of the synclinorium. The above-mentioned formations and similar structural geometries are also displayed in the Roach River Synclinorium to the east.

The intervening Lobster Mountain Anticlinorium encompasses metasedimentary and volcanic rocks of both Cambrian and Ordovician age (See Boone, trip B-1). These include; the Hurricane Mountain Formation, an accretionary melange containing exotic blocks of basalt and gabbro;

Figure 1. Generalized geology of North-central Maine.



	MOOSE RIVER-ROACH SYNCLINORIA	CAUCOMGOMOC LAKE REGION	NORTHWEST LIMB OF KEARSARGE-CENTRAL MAINE SYNCLINORIUM		PLUTONIC ROCKS
LOWER DEVONIAN	Tomhegan Kineo Volcanic Member	Seboomook	Seboomook(?)		Katahdin Pluton Moxie Pluton
	Tarratine Seboomook				
	Carrabassett		Carrabassett(?)		
	?	?			
SILURIAN	Capens	Allagash Lake	Madrid(?)	Lawler Ridge	
	undifferentiated Silurian		Smalls Falls	unnamed rusty unit	
			Perry Mt.	Allsbury	
ϵ-O	Lobster Mountain Volcanics	?			Attean Pluton (Jackman area)
CAMBRIAN(?)	Dead River				
	Hurricane Mountain	Hurd Mountain			
	Jim Pond	Caucomgomoc Lake Loone Stream			

Figure. 2. Generalized stratigraphic column of conference area.

TABLE 1. DESCRIPTIONS OF PRINCIPAL ROCK UNITS IN AREA OF CONFERENCE. MORE COMPLETE DESCRIPTION IN MOENCH AND OTHERS (1982)

Stratified Rocks

Devonian Rocks	Formation
Dto	Tomhegan Formation (Boucot, 1961; Boucot and Heath, 1969). These rocks are restricted in occurrence to the central region of the Moose River Synclinorium. The formation consists of dark metasandstone, dark tuffaceous metasandstone, slate, metasiltstone and quartzite. The formation contains abundant fossils, mainly brachiopods. The type locality is in Tomhegan Township, Brassua Lake Quadrangle.
Dtokm	Kineo member of the Tomhegan Formation (Boucot, 1961; Boucot and Heath, 1969). The Kineo member consists of a variety of rhyolitic rocks, including felsite, tuff, and volcanic breccia and conglomerate. The Kineo occurs at the edge of the Moose River Synclinorium and is correlated with similar volcanic rocks in Big Spencer Mountain, Sorburge Mountain in the Harrington Lake Quadrangle and with the Traveler Rhyolite (Hon, 1980). The formation is named for exposures in Kineo Mountain, Moosehead Lake Quadrangle.
Dt	Tarratine Formation (Boucot, 1961; Boucot and Heath, 1969). The Tarratine consists of dark metasandstone, slate and metasiltstone and is highly fossilferous. It is roughly equivalent in age with the Matagamon sandstone of Rankin (1965) and apparently represents shallower water deposition than was present during the deposition of the underlying slates and turbidites. The Tarratine is exposed along the margins of the Moose River Synclinorium. The type locality is on Misery Ridge in the Brassua Lake Quadrangle.
Ds	Seboomook Formation (Boucot, 1961; Boucot and Heath, 1969). The Seboomook is a cyclically bedded well-graded metasandstone and slate. The sandy layers weather to a chalky white and commonly show cross laminations.

The Seboomook is widespread in northwestern Maine and occurs in a broad belt between Greenville and the Katahdin Pluton. South of the Moxie Pluton is restricted within the area of this conference to the cores of synclines within the underlying Carrabassett Formation.

The type locality of the Seboomook is at Seboomook Lake in the Seboomook Lake Quadrangle. The Seboomook is considered to be partly equivalent to the Littleton Formation of New Hampshire and Gile Mountain of Vermont.

Dc — Carrabassett Formation (Boone, 1973). The Carrabassett is divided into an upper cyclicly bedded but poorly graded metasandstone that is similar to the Seboomook and a lower massive pelitic member. In earlier maps (e.g., Doyle, 1967), the rocks now mapped as Carrabassett were mapped as Seboomook. The slate quarries between Monson and Brownville are in the Carrabassett.

The Carrabassett is partly equivalent to the Littleton New Hampshire. The type locality is in the headwaters area of the Carrabassett River in the Little Bigelow Mountain Quadrangle.

Silurian Rocks

Sm — Madrid Formation (Osberg and others, 1968). The Madrid is primarily a thickly bedded pale gray to greenish-gray feldspalthic metasandstone (Moench and others, 1982). In the type locality in the village of Madrid the formation contains pods and lenses of calc-silicate minerals.

The Lawler Ridge (Roy and others, this volume) is an equivalent rock northeast of Millocket.

Su — Silurian rocks, undifferentiated.

Ordovician Rocks

Ov — Ordovician volcanic rocks. This is a grab bag term for disparate volcanic rocks including the Kennebec volcanics and the Lobster Mountain volcanics, both exposed in the Lobster Mountain Anticlinorium (Boucot and Heath, 1969).

Cambro-Ordovician(?) Rocks

€Od — Dead River Formation (Boone, 1973). Metasiltstone and phyllite with minor feldspathic metasandstone. Typically the Dead River is greenish to greenish grey with a pearly phyllitic luster. The phyllite has three well developed cleavages, causing it to break off in sharp edged rhombic fragments.

The Dead River is exposed within the Lobster Mountain Anticlinorium. The type locality is near the Dead River in the northern part of the Little Bigelow Mountain Quadrangle.

Cambrian(?) Rocks

€h — Hurricane Mountain Formation (Boudette and Boone, 1976). A sedimentary melange consisting of a rusty weathering metasiltstone incorporating exotic blocks of granite, quartzite, amphibolite, and other types of rocks.

The type locality is on Hurricane Mountain in the Pierce Pond quadrangle. Within the conference area the unit is exposed in the Lobster Mountain Anticlinorium and is exposed within a fault-bounded block in the Coucomgomac Lake area where Pollack (this volume) has found a similar unit which he named the Hurd Mountain Formation.

€jp — Jim Pond Formation (Boudette, 1982). The Jim Pond consists of basalt flows and pillowed basalts with minor metagreywacke. Pllock (this volume) has named apparently equivalent rocks the Coucomgomac Lake Formation. These rocks are part of an ophiolite suite named the Boil Mountain complex by Boudette (1982). The formation is named for exposures near Jim Pond in the Jim Pond quadrangle. Within the conference area, the Jim Pond is exposed in the Lobster Mountain anticlinorium and in the Coucomgomac Lake area as described above.

Intrusive Igneous Rocks

Devonian Rocks

Dkp — Katahdin Pluton (Griscom, 1976; Hon, 1980). The Katahdin Pluton is an oval shaped laccolith with long axis trending NE-SW. The major rock within the pluton is the Katahdin granite, and the principal rock type within the granite is the Doubletop facies, a massive biotite granite of medium texture.

Most of the Doubletop Facies underlies lowland areas, except where it is capped by the very resistant, fine-grained Summit Facies (Hon, 1980). The Summit Facies has a tough, interlocking texture that resists erosion. Where the Summit Facies is removed, the Doubletop and other intermediate facies are quickly eroded.

Hon (1980) interprets the Katahdin as an S-type granite and follows other workers who believe that the Katahdin was part of the magma chamber for the Traveler Rhyolite.

Dmp — Moxie Pluton (Espenshade and Boudette, 1964; Espenshade, 1972). The Moxie Pluton is an elongate, irregular-shaped mafic pluton extending for about 50 miles (80km) from Moxie Mountain on the southwest to the southwestern end of the Katahdin Pluton on the northeast. It ranges in width from as little as a mile to more than 9 miles (15km) in several bulbous emanations spaced along the length of the pluton.

The Moxie is a highly differentiated mafic pluton, ranging from quartz diorite and diorite near the Katahdin Pluton, through troctolite and norite in the Greenville area, to dunite on the southwest end of the pluton at Moxie Mountain. Hon (1980), this volume, interprets this distribution of rock types to mean that the Moxie was originally formed as a vertically differentiated body that was then tilted upward toward the southwest and subsequently eroded to a common surface. Thus in moving along the pluton from the northeast to southwest one goes from the mafic-poor rocks of the upper part of the pluton to the mafic-rich cummulate rocks of the lower part of the pluton.

The Moxie breaks down rapidly when exposed to chemical and mechanical weathering and thus underlies low areas.

Ordovician Rocks

Oap — Attean Pluton (Albee and Boudette, 1972). The Attean is a pink or grey, two-feldspar porphyritic granite. It commonly is altered with the area of the pluton to unicite, containing pink feldspars and green epidote and quartz. The Attean is extensively jointed and fractured. These surfaces showing a rusty stain.

The Attean occurs in northwestern Maine in the Jackman region. It is abundant in both the Attean and Skinner quadrangles and is apparently named for exposures along Attean Lake in the quadrangle of the same name.

the green, phyllitic Dead River Formation, a Cambro-Ordovician(?) flysch; and the volcanic and volcanoclastic rocks of the Lobster Mountain Volcanics. Similar rocks are exposed in an isolated fenster through Upper Silurian and Lower Devonian metasediments in the Caucomgomoc Lake area to the north (Pollock, trip C-5).

The above fold belts are separated from the Kearsarge-Central Maine synclinorium by the Greenville Plutonic belt which includes the granitic Katahdin Pluton and the highly differentiated, mafic Moxie Pluton (Hon and Schulman, trip C-1). These rocks comprise the plutonic core of a volcanic arc formed by subduction during the Acadian Orogeny (Rankin, 1968; Hon, 1983). The Piscataquis volcanic belt (fig. 1), which includes the Kineo (lower member of the Tomhegan Formation) and Traveler rhyolites, is what remains of the thick volcanic piles formed during this time. These volcanics comprise some of the youngest rocks in the region and have been preserved from post-Acadian uplift and erosion only where down-folded in the troughs of synclines, such as the Kineo in the Moose River Synclinorium, or down-faulted, as in the Traveler Caldera (Rankin, 1968).

Contact aeroles of granofels are common where late Acadian plutons intruded pelitic rocks or the Roach River and Kersearge-Central Maine Synclinoria(Hanson, trip B-2, and Caldwell and Hanson, trip C-2). The width of the aeroles vary and is generally governed by the temperature of the pluton during implacement and the complexity of the contact.

The Eastern margin of the conference area is occupied by the Kearsarge-Central Maine Synclinorium, a belt dominated by Silurian and Devonian flysh which extends southwest through central Maine and New Hampshire (Roy, Trip C-3, and Hanson Trip, B-2).

The major SW-NE fold belts in this region are the product of the Acadian Orogeny. Folding was accompanied by low-grade regional metamorphism and the development of vertical to nearly vertical penetrative cleavage in pelitic rocks. Locally rocks were contact metamorphosed by the intrusion of Late Acadian plutons.

The present landscape of the region is the result of upward tilting of the orogen to the southeast followed by several kilometers of erosion. Ridges and valleys characterize the differential erosion within fold belts and basins of deeply weathered, coarse-grained plutonic rock are surrounded by irregular mountains of granofels.

Glaciation, which is responsible for only a few meters of erosion, has not greatly altered the topography of this region. Glacial deposits average only a few meters in thickness, but locally may exceed several tens of meters. The only record of glacial deposition in Maine during the Pleistocene dates from the Wisconsin Stage, with a possible early Wisconsin till and soil exposed at New Sharon (Caldwell and Weddle, Trip D-3).

The Late Wisconsin ice sheet advanced to its terminal moraine on the continental shelf about 17,000 years ago. The ice sheet subsequently retreated

to near the present Maine coast about 13,500 years ago (Stuiver and Borns, 1975). For the next 1,000 years the ice sheet was marine based, with the rate of ice retreat determined by the depth of water and tidal conditions rather than by climatic factors.

The incursion of the sea occurred as the ice retreated from the coast. The greatest transgression of the sea into Maine occurred in the large river valleys; to near Millinocket in the Penobscot Valley; north of Brownville Junction in the Pleasant River; near Bigham in the Kennebec Valley; and near Dixville in the Androscoggin Valley. By the time the ice sheet retreated to near the present Maine Coast the Champlain Sea separated the Laurentide Ice in the St Lawrence Lowlands and an ice cap was stranded over northern Maine. Flow from the northern Maine ice cap was both northwestward into the St. John Valley and southeastward into the headwaters of the Penobscot drainage (Lowell, trip A-1).

There is a continued debate over the timing of Alpine glaciation at Mt. Katahdin (Caldwell and Hanson, 1982; Davis, 1983; Caldwell and Davis, trip B-4). Caldwell believes alpine glaciation followed the maximum Late Wisconsin continental glaciation, while Davis believes there is no evidence for Late Wisconsin alpine glaciation on Mt. Katahdin.

The final melting of the remnant ice cap northwest of Katahdin left small, scattered deposits of sand and gravel, perhaps indicating wholesale stagnation (Lowell, trip C-4).

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