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INTRODUCTION

The accompanying geologic map of the Eastport 2-degree sheet is compiled from the detailed quadrangle maps listed as sources in the References. It simplifies and generalizes the stratigraphy and structure in order to fit the small 1:250,000 scale and to emphasize the faults. For details of the stratigraphy, structure, and plutonic intrusions the reader should consult the original quadrangle maps and other references.

The following brief general description of the bedrock geology serves as background for understanding the brittle fracturing.

GENERAL GEOLOGY

Pre-Silurian Stratified Rocks

The two oldest formations are schists of probable Cambrian to Ordovician age whose relation to each other is masked by intervening plutons.

The Columbia Falls formation underlies the central part of the Cherryfield Quadrangle. It is bounded by faults with Silurian rocks and by intrusive contacts with younger plutons. It consists of amphibolites and chlorite-biotite schists, and of pyroxene-cordierite hornfels near contacts with intruding plutons (Gilman, 1961). The Columbia Falls formation has been correlated with the Ellsworth formation of probable Cambro-Ordovician age in the Mt. Desert and Penobscot Bay area on the basis of similar lithologies and structural deformation (Gilman, 1961).

The Cookson formation is exposed in the Wesley and Tug Mountain Quadrangles. It extends northeastward into New Brunswick and westward perhaps to Penobscot Bay. In the Wesley Quadrangle a fault separates it from Silurian rocks to the south; and the Digdeguash formation of Silurian age overlies it to the north. The Cookson formation contains a variety of metamorphic rocks including rusty-weathering quartz-biotite schists, some graphitic slates, and minor volcanic rocks (Westerman, 1980; Ruitenberg and Ludman, 1978). Graptolites found on Cookson Island in Oak Bay near St. Stephen, New Brunswick indicate an Early Ordovician age (Cumming, 1967), but the lower part of the formation may be Cambrian (Ruitenberg and Ludman, 1978).

Pre-Silurian Deformation

The metamorphic foliation of the Columbia Falls formation forms tight, steeply plunging isoclinal folds which have been rotated by at least one and possibly two subsequent episodes of folding with differing trends (Gilman, 1961). In the Cookson formation two phases of compressive deformation have produced two fold systems, each with its own axial-plane cleavage (Ruitenberg and Ludman, 1978). The multiple deformations of these formations can be dated only as preceding intrusions of Acadian (Devonian) plutons and hence could solely reflect the Acadian

orogeny. On the other hand, Silurian stratified rocks do not share the structural complexity of the Columbia Falls formation, and Gilman (1961) concluded that the latter's metamorphism was pre-Middle Silurian. The unconformity between the Cookson formation and the Silurian Oak Bay conglomerate on Cookson Island, New Brunswick, suggests uplift and erosion of the Cookson well before the Acadian orogeny, although most of its deformation is probably Acadian (Ruitenberg and Ludman, 1978).

Silurian-Early Devonian Stratified Rocks

Stratified rocks of Silurian and Early Devonian age fall into two groups: an inland section of pelitic and calcareous quartzose schists, the Digdeguash and Flume Ridge formations, and a thick sequence of only slightly metamorphosed marine volcanic rocks along the coast and also inland southeast of the Seavey fault in the Wesley Quadrangle.

The Digdeguash formation is very poorly exposed in the Wesley and Tug Mountain Quadrangles. Well-bedded quartz-mica schists and slates display graded bedding and other sedimentary structures typical of turbidite deposits (Westerman, 1980; Ruitenberg and Ludman, 1978). Lenses of pebble conglomerate occur near the presumably unconformable contact with the Cookson formation. A gradational facies change along strike with the Upper Silurian Waweig formation in New Brunswick is the basis for assigning a Silurian age to the unfossiliferous Digdeguash formation (Ruitenberg and Ludman, 1978).

Exposures of the Flume Ridge formation are confined to a few outcrops along the northern boundary of the Tug Mountain Quadrangle, but it underlies a broad tract of land in the Fredericton 2-degree sheet to the north (Ludman, 1981). In the Tug Mountain Quadrangle it consists of thinly-layered calc-silicate granoblastic quartz-rich rocks in the metamorphic aureole of the Tug Mountain pluton. A gradational contact with the Waweig and Digdeguash formations in New Brunswick suggests a late Silurian to Early Devonian age for the Flume Ridge (Ruitenberg, 1967).

The coastal volcanic sequence, best exposed in the Machias and Eastport Quadrangles, is part of the Coastal Volcanic Belt (Boucot, 1968) which extends eastward into New Brunswick and occurs to the west in the Mount Desert, Penobscot Bay, and Newbury, Massachusetts areas. Abundant fossils in the Eastport Quadrangle establish an age range from Early Silurian into Early Devonian (Berry and Boucot, 1970). The section is at least 8,000 meters thick in the Eastport Quadrangle, but thins rapidly westward across the Machias and Columbia Falls Quadrangles. Hydrothermal metamorphism has partially altered many of the original minerals to those of the greenschist facies, but original sedimentary and volcanic structures and textures remain. The stratigraphic names used here were first proposed by Bastin and Williams (1914).

The Quoddy formation crops out in the Quoddy fault block between the Lubec fault zone and the Fundian fault in the Eastport, Cutler, and Machias Quadrangles. The lower part near West Quoddy Head (the base is not exposed) consists of rusty-weathering pyritiferous laminated argillite, thin volcanic ash falls, and black shale with Lower Silurian (Llandoverry) graptolites. The upper part in the Cutler area contains basaltic and rhyolitic flows and coarse pyroclastics and has a very sparse brachiopod fauna of Early Silurian (Late Llandoverry) age (Gates, 1961). Coarse tuff-breccias and bedded tuffs exposed on Mitton Mountain and Jim Wood Ridge in the northern part of the Columbia Falls Quadrangle are assigned to the Quoddy formation on the basis of a small graptolite collection in a black shale lens near the base of the exposed rocks. Rusty argillites and bedded tuffs in the northern part of the Gardner Lake Quadrangle are designated Quoddy formation because of similar lithology and a single graptolite collection by Bastin and Williams (1914).

The Dennys, Edmunds, Leighton, Hersey, and Eastport formations make up the Cobscook anticline and Machias syncline northwest of the Lubec fault zone. They are a collection of heterogeneous volcanic and sedimentary marine fossiliferous rocks. The Dennys formation (Wenlock) is composed largely of basaltic flows and coarse tuff-breccias, lesser rhyolitic domes and breccias, and minor bedded tuff and shale. The Edmunds formation (Ludlow) consists primarily of white, green, and pink coarse, massive tuff-breccias composed of a variety of volcanic rocks and volcanic fragments interlayered with bedded fine-grained marine tuffs and shale. Basaltic rocks are minor. The Leighton formation (Pridoli) is mostly blue-gray somewhat calcareous siltstone and shale along with thin basalt flows, lenses of basaltic tuff, and thin, tabular rhyolitic tuff-breccia units. The Hersey formation of maroon shales and siltstones is transitional to the Eastport formation of Early Devonian (Gedinne) age, the youngest unit in the coastal volcanic section. The Eastport formation contains shallow-water to subaerial basaltic-andesite flows and coarse tuff-breccias, pink rhyolite domes and breccias, and green to maroon siltstones and shale of probably tidal flat origin.

Gradational changes upwards in the coastal volcanic section from wholly marine sedimentary and volcanic rocks to tidal flat and subaerial ones accompanied by change from a varied shelf brachiopod-dominated fauna in the Dennys formation to a restricted ostracode, linguloid, and pelecypod fauna in the Eastport formation indicate a gradual shallowing of the sea during the Silurian, ending with final emergence during the Early Devonian.

The volcanic rocks of the Dennys, Edmunds, and Leighton formations form a bimodal suite of chemically similar basalts and rhyolites with a calc-alkalic aspect but without andesites. The basaltic-andesites and rhyolites of the Eastport formation are also bimodal but show a strong iron-enrichment trend (Gates and Moench, 1980).

In the Wesley Quadrangle, the Oak Bay formation, a polymict roundstone conglomerate, and the Waweig formation of chloritic metasiltstone and metatuff are mapped in fault contact with the Cookson formation. Westerman (1980) named these rocks on the basis of lithologic correlation with the Oak Bay and Waweig formations of the Oak Bay area near St. Stephen, New Brunswick. There the Oak Bay conglomerate unconformably overlies the Cookson formation and in turn is overlain by the Waweig formation of Late Silurian age (Pickerill, 1976). The rocks of the Wesley Quadrangle designated Silurian-Devonian Undifferentiated consist of poorly exposed basaltic and rhyolitic rocks and maroon siltstones and shales. The contacts with the Waweig formation and with the Quoddy formation on Jim Wood Ridge are unexposed. To the writer, these volcanic rocks lithologically resemble the Eastport formation rather than the Dennys-Edmunds-Leighton section of the coastal volcanic rocks. Silurian Undifferentiated volcanic rocks, isolated by gabbroic and granitic plutons, occur also in the islands across the entrance to Narraguagas Bay. They consist of rhyolitic tuff-breccias and bedded tuffs and a thick polymict roundstone conglomerate much like the Oak Bay.

Acadian Orogeny

The Acadian orogeny brought the Silurian-Early Devonian volcanism to an end. Folding, development of cleavage, and low-grade regional metamorphism began some time after deposition of the Eastport formation and was followed by faulting and intrusion of gabbroic and granitic plutons which by the Late Devonian had been uplifted and exposed to subaerial erosion.

Inland and in part of New Brunswick there were two episodes of folding with accompanying cleavage (Ruitenberg and Ludman, 1978). In the coastal volcanic rocks of the Eastport and Machias Quadrangles, the principal structures are open folds and one cleavage followed by local folding and rotation of cleavage near the major faults. Faults that displace the folded rocks but are cut-off by Acadian plutons indicate that Acadian deformation also involved faulting.

The plutonic intrusive phase of the Acadian orogeny has been variously dated from late Early Devonian (Donohoe and Pajari, 1973; Lyons and Faul, 1968) to early Late Devonian (Page, 1968). Field relations in the Eastport 2-degree map area and in the Calais Quadrangle to the north (Amos, 1963) suggest initial, locally subconcordant, intrusions of gabbro-diorite complexes and associated granophyric hornblende-biotite granitic rocks into the Silurian-Lower Devonian volcanic pile, followed by discordant intrusion of biotite granitic rocks in steepsided roughly oval plutons (Chapman, 1962). Many of the gabbroic plutons are complex multiple intrusions of gabbro, diorite, and quartz diorite with local igneous layering, multiple dikes and sills, and wide border zones of brecciated gabbro and wall rocks veined by diorite, quartz diorite, and granite. On the geologic map small intrusions of diabase and gabbro in the coastal volcanic section carry the symbol d without an age letter. These small instrusions are penecontemporaneous with the formations they intrude.

Upper Devonian Stratified Rocks

The bedrock stratigraphic record in the Eastport area ends with deposition of the Perry formation, a section of maroon, subaerial, alluvial conglomerates, arkosic sandstones, red shales, lacustrine beds, and basalt flows (Schluger, 1978). The Perry formation rests with angular unconformity on the coastal volcanic rocks and disconformably on Acadian plutonic rocks. It was deposited in a local fault basin within or marginal to an uplifted mountain range. Plant fossils indicate a Late Devonian age.

Post-Devonian Geologic History

In the map area, except for a few probable Triassic diabase dikes, the only rocks younger than the Perry are Late Pleistocene to Recent glacial drift, marine sediments, and alluvium which form the ground surface over most of the region. In New Brunswick, however, there is a thick sequence of Carboniferous coarse clastics, carbonates, evaporites, and volcanic rocks, some of which were deposited in fault-basins (Potter, Jackson and Davies, 1965). It is very likely that similar rocks once covered much of the present map area and have since been eroded away. Triassic-Lower Jurassic(?) redbeds and diabase occur on Grand Manan Island, in fault blocks along the coast of New Brunswick to the northeast, and probably underlie much of the Bay of Fundy (Ballard and Uchupi, 1975). They also may once have covered part of the map area, most likely along the coast.

There is, however, a record of post-Acadian faulting together with local folding and development of cleavage adjacent to faults and in shear zones. A few faults inland that offset the margins of Devonian plutons, faults in the Perry formation, the Lubec fault zone of probable Carboniferous age, and the Fundian fault of Triassic-Jurassic age indicate that the Acadian orogeny was followed by a long period of brittle fracturing.

BRITTLE FRACTURES

Introduction

The brittle fractures described in this report are faults and fracture cleavage. Jointing has been systematically mapped only by Westerman (1980) in the Wesley Quadrangle, to which report the reader interested in joint patterns is referred. The accompanying map shows a decrease in the number of faults from east to west and from the coast inland. Part of this decrease reflects the scarcity of outcrops in the Tug Mountain, Wesley, Columbia Falls, and Gardner Lake Quadrangles, which have a more widespread cover of glacial drift than the Eastport and Machias Quadrangles. However, the greater number of faults in the latter quadrangles also reflects the preponderance of relatively weak heterogeneous sedimentary and volcanic rocks in contrast to the many massive gabbroic and granitic plutons inland and to the west.

Faults

Faults were mapped on the basis of one or several criteria. Direct observations of fault planes was possible largely only where faults intersect rocky shoreline where such typical features as fault gouge, fault breccia, slickensided surfaces, quartz and calcite veining, pyrite mineralization, and water seepage together with an abrupt discontinuity in rock types could be seen. Very closely spaced fracture cleavage with smeared out minerals and slickensided chlorite is typical of the faults making up the Lubec fault zone and was used elsewhere to indicate the proximity of a fault. Drag folds and rotation of the regional cleavage also suggested a nearby fault.

Most of the faults shown on the map were located on the basis of offsets of contacts, abrupt discontinuities in lithologies, or narrow zones of sheared rocks, the faults themselves being unexposed. In areas of few or no outcrops, many of the contacts whose offsets were used to delineate faults were projected long distances beneath glacial drift; and such faults are only approximately located.

The attitude of a few exposed fault planes could be measured directly, and in a few places the trace of the fault across hilly topography indicated its dip. Over most of the map area, however, the topography does not have sufficient relief and outcrops are too scarce to permit determination of a fault's dip. The symbols for displacement direction indicate only the apparent displacement based on offsets of stratigraphy.

Age of Faulting

Five episodes of faulting are designated on the map based on a variety of criteria: Silurian, Early to Middle Devonian (Acadian), Late Devonian, Carboniferous, and Triassic-Jurassic. Some faults without age criteria were assigned to one of the five age groups on the basis of location and trend.

In the following descriptions, I have assigned informal names to a number of prominent faults for ease of identification or have used names previously assigned by others as cited.

Silurian Faults

Indirect geologic evidence suggests that the Gardner fault in the Gardner Lake Quadrangle was active during deposition of the Dennys and Edmunds volcanic rocks. The fault brings the Dennys and Edmunds formation in contact with the Quoddy formation, slightly foliated and hornfelsed in the contact aureole along the edge of the large gabbroic pluton to the north. North of this fault in the Gardner Lake and Wesley Quadrangles, the Dennys and Edmunds formations are missing. Thick basalt flows and coarse basaltic tuffs of the Dennys and very coarse breccias of the Edmunds are concentrated along the east side of the fault. The Gardner fault is thus presumed to be a normal fault which served as a

conduit for the Dennys and Edmunds eruptions and on whose down-dropped block the volcanic rocks accumulated. The Columbia fault together with its branch to the north in the Columbia Falls Quadrangle is assumed to be a continuation of the Gardner fault because the two line up on strike.

Early to Middle Devonian (Acadian) Faults

Faults of this age displace Silurian-Lower Devonian folded rocks but not the Acadian plutons. Also included are a few faults that are mapped as cutting some plutons but not others. These Devonian faults presumably developed during or after Acadian folding and prior to most, but not all, of the Devonian Acadian granitic plutonism. Two of these faults have curving generally northeast trends, highly sheared adjacent rocks, and little stratigraphic separation. The Seavey fault in the Wesley Quadrangle brings Cookson formation against the Oak Bay and Waweig formations. It cuts a gabbroic pluton and a small granitic stock but is cut off by the Tug Mountain granite to the west and the Meddybemps granite to the east. Westerman's (1980) map of the Wesley Quadrangle indicates that the fault marks an abrupt change in metamorphic grade from the quartz-biotite schists of the Cookson formation to the chloritic metasiltstones and metatuffs of the Waweig. Along the fault, clasts of the Oak Bay conglomerate are stretched; minor fold axes and lineations plunge steeply; and there are strong cleavages and crenulations. Juxtaposition of Cookson, Oak Bay, and Waweig formations along the fault is like that at Oak Bay where the contacts are depositional, suggesting that stratigraphic separation on the Seavey fault is slight. Perhaps the displacement is largely strike-slip. The Machias Bay fault in the Machias Quadrangle also has a sinuous northeast trend, is marked by highly sheared rocks, and has small stratigraphic separation. It too may have predominantly strike-slip displacement.

The Starboard fault in the Machias Quadrangle trends northwest. It is mapped as displacing the Machias Bay fault but not the Jonesboro granite. The southwest side of the fault is stratigraphically down and the rocks near the fault at Starboard Cove are folded. In the northern part of the Eastport Quadrangle, a cluster of faults also trend northwest and cannot be traced through Acadian plutons in the Calais Quadrangle adjacent to the north (Amos, 1963).

Late Devonian Faults

These faults are concentrated in the Eastport Quadrangle near Passamaquoddy Bay, which is largely underlain by Perry formation. They are northeast trending normal faults along most of which the southeast side is down. They fault Perry conglomerate against the Eastport formation. Fault planes are vertical or dip steeply to the southeast; and along some faults, the Perry formation has been dragged upwards to nearly vertical. Along the fault that crosses Hersey Neck, a wedge of very coarse conglomerate consisting of boulders of the volcanic rocks on the upthrown side thins rapidly away from the fault and interfingers with arkosic sandstones and siltstones in the downthrown side. This suggests that the fault was active during deposition of the Perry formation.

Faults with similar trends bringing Perry against Eastport formation are considered to be of Late Devonian age also although they lack clastic wedges.

Carboniferous Faults

The cluster of northeast-striking faults that make up the Lubec fault zone (Bastin and Williams, 1914) are probably of Carboniferous age. Several cut a small patch of Perry conglomerate and siltstone near the base of Denbow Neck in the Eastport Quadrangle. In New Brunswick several large through-going east-northeast striking faults delineate Carboniferous fault basins and can be traced to Passamaquoddy Bay (Potter, Jackson, and Davies, 1968). The Lubec faults have the same east-northeast trend and are on strike with several of these Carboniferous faults. The Lubec fault zone consists of a lens-shaped down-dropped fault block of Eastport formation sandwiched along faults between Edmunds formation on the northwest and Quoddy formation on the southeast. The rocks within and adjacent to the fault zone are highly sheared, displaying closely-spaced vertical to southeast dipping fracture cleavage, tight isoclinal folds with nearly horizontal plunges, and slickensiding and mineral streaking down the dip of the cleavage. The largest displacement is along the fault that brings Quoddy formation against the Eastport, a stratigraphic throw of at least 6,000 meters. Movement on the Lubec fault zone has greatly steepened and sheared the southeast limb of the Cobscook anticline and probably produced the system of faults that radiate like spokes of a wheel around the anticline.

The Oak Bay fault (Cumming, 1967) strikes north-northwest beneath Passamaquoddy Bay and the St. Croix River from Campobello Island to beyond Oak Bay, a distance of 50 kilometers. It offsets the Perry formation and thus is post-Devonian in age. It also offsets the probable extension of the Lubec fault zone along the northwest shore of Campobello Island (McLeod, 1979) and thus is Carboniferous or younger. Vertical shearing parallel and close to the fault in Oak Bay and offsets of stratigraphic and plutonic contacts at Oak Bay and along the St. Croix River indicate that the fault plane is vertical and that the net slip is oblique down to the northwest, with a vertical component of at least one kilometer, northeast side down (Gates, 1981).

Triassic-Jurassic Faults

The Fundian fault (Johnson, 1925) parallels the shoreline beneath the Bay of Fundy from West Quoddy Head to at least as far west as Great Wass Island. The fault clearly shows on seismic-reflection profiles of the floor of the Bay of Fundy, and is only one of the swarm of normal faults bordering Triassic-Jurassic fault basins in the Gulf of Maine and the Bay of Fundy (Ballard and Uchupi, 1975). Highly sheared and folded Quoddy formation and intrusive diabase at West Quoddy Head and brecciated granite along the shore of Great Wass Island (Ward, 1972) suggest that the fault is not far offshore.

Fault Patterns

Because not all of the faults mapped in the individual quadrangles can be shown at the scale of the compilation, the strikes of all faults, regardless of length of trace, angle of dip, or amount of displacement, were measured on the original quadrangle maps and plotted on Figure 1. The pattern of Figure 1 is only an approximation because an age based on trend was assigned to many faults that lacked independent evidence of age. All faults combined show a strong concentration of general northeast strikes and a lesser concentration to the northwest. Faults assigned a pre-granite Acadian age have a rather broad spread of generally northeast and northwest trends compared to post-granite faults which cluster more closely near northeast and to a lesser extent near N 60° W. The Carboniferous faults of the Lubec fault zone have a distinct N 60° E average strike that is quite distinct from the northeasterly strike of all other post-granite faults combined. Figure 1 suggests that a rectilinear NE-NW pattern of faulting began during the Acadian orogeny and continued at least into the Carboniferous.

Cleavage

Fracture cleavage is common throughout the map area in stratified rocks. Two cleavages cut the Cookson, Digdeguash, and Flume Ridge formations inland (Ruitenberg and Ludman, 1978). In the coastal volcanic rocks a regional northeast to east-northeast striking cleavage occurs in shales and siltstones throughout the Eastport, Machias, and Columbia Falls Quadrangles and becomes a pervasive penetrative cleavage through all the volcanic rocks and many diabase and gabbro bodies in and near the Lubec fault zone. The cleavage is generally vertical or dips steeply southeast except where folded near faults. This regional cleavage is axial-planar to the Machias syncline, but in the Cobscook anticline approximately parallels the southeast limb and cuts across the northeast limb, apparently bearing no relation to its present axial plane. It is not found in the Perry formation, where cleavage occurs only near some Late Devonian or younger faults, and thus is Acadian in age. It probably once was axial-planar to a broad open ancestral Cobscook anticline and Machias syncline with northeasterly plunges. Steepening of the southeast limb of the ancestral Cobscook anticline by faulting along the Lubec fault produced the anticline's present plunge to the east, divergent from the regional cleavage.

Minor Brittle Fractures

In the rocks of the coastal volcanic section in the Machias and Eastport Quadrangles, almost every outcrop displays numerous joints, small faults, and general fracturing without apparent pattern. During the regional mapping over the last 20 years, primarily by the author, systematic recording of joints and other fractures on an outcrop scale was not done (except by Westerman in the Wesley Quadrangle), and hence whether or not there is significant regional pattern is not known.

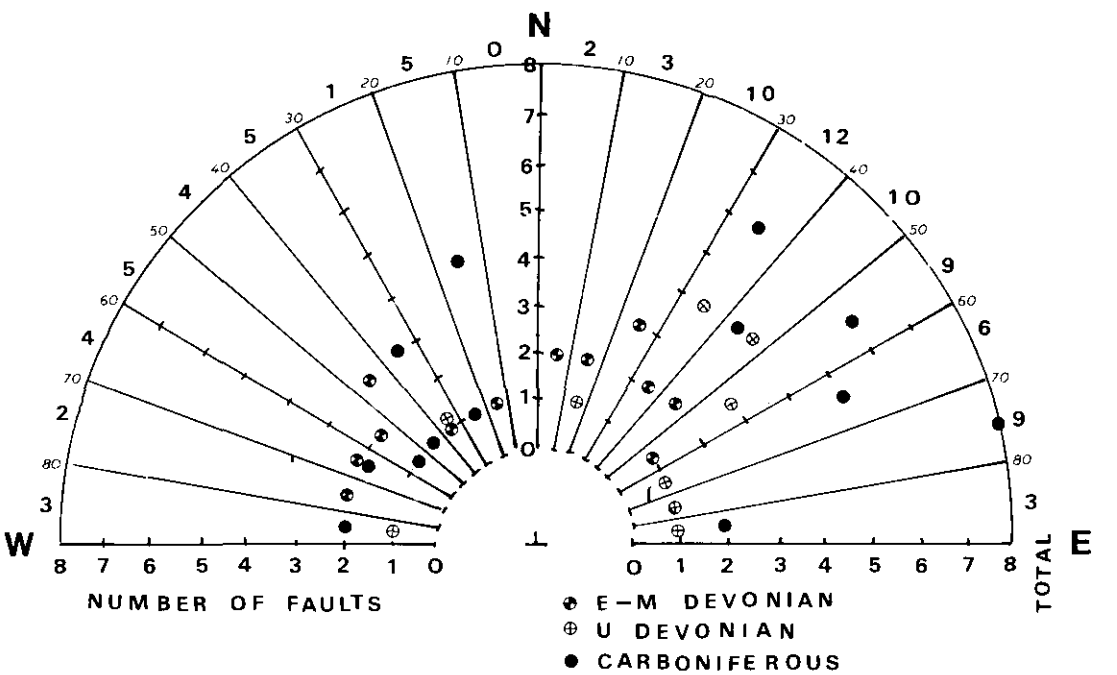

Figure 1

Diagram showing strike distribution of faults of Early-Middle Devonian, Late Devonian, and Carboniferous ages, Eastport 1:250,000 Quadrangle, Maine.

The gabbroic and granitic plutons of the map area, however, have rather widely spaced jointing in few sets, making some suitable for quarrying operations. Dale (1907) in his review of quarries in the map area reports joint orientations for a few of them. Joints that are vertical or nearly so are spaced 2 to 70 feet apart, depending on the quarry and location within a quarry, and have strikes that range 15 degrees either side of N 45° W and N 75° E. Subhorizontal sheeting is spaced 2 to 22 feet apart. Because quarries are located to avoid highly fractured rocks, their absence of closely spaced fractures is not necessarily representative of all the Acadian plutons. Westerman (1980) mapped numerous fractures in some of the gabbroic plutons of the Wesley Quadrangle, but found simpler patterns of jointing in the granitic plutons except near faults.

Late Pleistocene to Recent

All the brittle fractures in bedrock described so far are clearly older than the glacial drift and marine sediments which cover most of the bedrock in the map area. However, the dense network of faults in the Machias and Eastport Quadrangles must provide many planes of weakness along which movement could relieve present strain in the earth's crust. The periodic reports of the Northeastern U. S. Seismic Network together with historical records have been used to compile a summary of seismic activity in the northeastern United States (Barosh, 1979). The Passamaquoddy Bay area and the adjacent Bay of Fundy is one of 12 areas of high seismicity in the region covered by Barosh's report. Recent accurate levelling and the study of glacial-marine deltas, salt marshes, salt marsh dikes, old shipyards, and Indian shell heaps suggest that the coast in the Passamaquoddy Bay area is downwarping, with the present subsidence rate as much as 9 mm/year (Borns; Anderson and Race; Smith and Bridges; and Tyler and Ladd in Thompson, 1980; Thompson and others, this volume). The seismicity and the warping indicate current crustal strain in the Passamaquoddy Bay area.

However, no postglacial faults have yet been found in the Eastport region. The postglacial fault on Mathews Island near Eastport proposed by Gates (1979) was reexamined in the company of other geologists who disagreed with the original conclusion. The Oak Bay fault and the Lubec faults are the most likely candidates for renewed movement in response to present strains in the crust of the Eastport area. Both are large regional faults that probably go deep into the earth's crust and both are relatively young, Carboniferous or perhaps younger. Historical and current seismic events in the Passamaquoddy Bay area have a general north-northwest trend near and parallel to the Oak Bay fault. The Lubec fault zone parallels the east-northeast trend of seismicity in the Bay of Fundy near the New Brunswick and Maine coasts. During the levelling that discovered the crustal downwarping in the region, it was found that a bench mark in the town of Lubec had dropped 169 mm between 1935 and 1978 relative to a bench mark 5 km to the south across part of the Lubec fault zone (Tyler, personal communication, 1981). This suggests that there may be an active fault in the Lubec fault zone, but none has yet been found.

Lineaments

Lineaments found on high altitude photographs have been discussed by Gates (1979), and several are included on the present map. Comparison between the map in Gates (1979) and the map of this report shows that several lineaments correspond to the Lubec, Machias Bay, and Starboard faults, that some reflect the strike of layered rocks, and that others seem to have no relation to the bedrock geology.

Conclusion

The stratified volcanic rocks of the Machias and Eastport Quadrangles have the highest density of brittle fracturing in the Eastport 2-degree map area and are within an area of continuing seismicity and crustal warping. The large Acadian plutons inland and along the coast to the west, particularly the granitic ones, have no cleavages, few faults, and simpler joint patterns. They are somewhat removed from the loci of current seismicity although they are apparently participating along with the other rocks in the crustal downwarping.

As yet no postglacial faults have been found; but the continuing seismicity and crustal warping combined with the high density of brittle fractures in the layered rocks, especially of the Eastport, Cutler, and Machias Quadrangles, mandate very detailed examination of potential sites for large installations.

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PRELIMINARY

BEDROCK AND BRITTLE FRACTURE MAP OF THE EASTPORT 2° SHEET, MAINE

COMPILED BY

OLCOTT GATES

1982

OPEN FILE NO. 82-29

Maine Geological Survey

DEPARTMENT OF CONSERVATION

WALTER A. ANDERSON STATE GEOLOGIST

EXPLANATION

UPPER DEVONIAN	Dp	Perry Formation			
		uncomformity			
LOWER-MIDDLE DEVONIAN	Dgr	Granite			
	Ds	Syenite			
	Dd	Diabase, gabbro, diorite			
LOWER DEVONIAN	De	Eastport Formation		Df	Flume Ridge Formation
	SDu	Undifferentiated volcanic rocks			
	d	Penecontemporaneous diabase			
SILURIAN	Sh	Hersey Formation		Sdi	Digdeguash Formation
	Sl	Leighton Formation		Sw	Waweig Formation
	Se	Edmunds Formation		So	Oak Bay Formation
	Sd	Dennys Formation			
	Sq	Quoddy Formation			
	Su	Undifferentiated volcanic rocks			
		unconformity			
ORDOVICIAN	Oc	Cookson Formation		ODvm	**Undiffentiated mafic volcanics of uncertain age.**
CAMBRIAN ?	ec	Columbia Falls Formation			

SYMBOLS

- Triassic-Jurassic fault
- Carboniferous fault
- Late Devonian fault
- Early-Middle Devonian fault
- Silurian? fault
- 25 Strike and dip of bedding
- Strike of vertical cleavage
- Contact
- Selected lineaments

D Downthrown side (apparent)

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

LOCATION DIAGRAM

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