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BASAL MISSISSIPPIAN VOLCANIC ROCKS IN CAPE BRETON ISLAND, NOVA SCOTIA

(Report and 2 figures)

Danford G. Kelley and William O. Mackasey

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ABSTRACT

A sequence of volcanic and sedimentary rocks in western Cape Breton Island conformably underlies rocks mapped as Mississippian Horton Group. The volcanic rocks occur in a continuous belt for over 17 miles and intermittently throughout the length of the Island.

The volcanic and sedimentary unit is designated the Fisset Brook Formation and included with the Horton Group. The rocks included in the Fissett Brook Formation were previously assigned ages that range from Precambrian to Devonian. They are now known from spores to be Early Mississippian with a slight possibility they are Late Devonian.

BASAL MISSISSIPPIAN VOLCANIC ROCKS IN CAPE BRETON ISLAND, NOVA SCOTIA

INTRODUCTION

The purpose of this paper is to describe a Mississippian volcanic and sedimentary rock-stratigraphic unit in the western part of Cape Breton Island, Nova Scotia. In view of the inadequate definition of this unit, and the various stratigraphic positions assigned by earlier writers, it now seems advisable to define the unit more clearly, to propose a name, and to designate a type section.

The field work on which this report is based was carried out during the field seasons of 1959, 1960, and 1961, as part of mile-to-the-inch geological mapping. In 1959 and 1961 the junior author was attached to a field party under the direction of the senior author. In 1961 a study of the volcanic-sedimentary unit provided the junior author with the basis of a thesis, which he submitted for a M.Sc. degree at Carleton University in 1963. The interest and assistance of Professor W.M. Tupper is gratefully acknowledged. The National Advisory Committee on Research in the Geological Sciences provided financial assistance to the junior author during preparation of his thesis, which was greatly appreciated.

The widespread distribution of volcanic rocks in western Cape Breton Island, areally associated with the Lower Mississippian Horton Group, is apparent from an examination of the geological maps of this area (Norman, 1935; Ferguson, 1946; Cameron, 1948; Neale, 1963, 1964; McLaren, 1956; Kelley, 1957, 1960). The volcanic and intercalated sedimentary rocks were first mapped as a separate rock-unit by Norman (1933) in Lake Ainslie map-area. Other than Norman (1935), the geologists who have mapped in western Cape Breton Island devoted little attention to these volcanic-sedimentary rocks. This was probably because the volcanic-sedimentary rocks occupied such a small part of each map-area. The volcanic-sedimentary unit is most widespread and its stratigraphic relations are best examined in the Lake Ainslie and Cheticamp River map-areas.

STRATIGRAPHY

Introduction

Mississippian rocks in Cape Breton Island are divisible into three major rock-stratigraphic units. The lowest unit consists mainly of a sequence of conglomerate, sandstone, siltstone and shale. The medial unit is essentially a sequence of sandstone, siltstone, shale, limestone, gypsum, anhydrite, and salt; locally the unit includes conglomerate. The uppermost

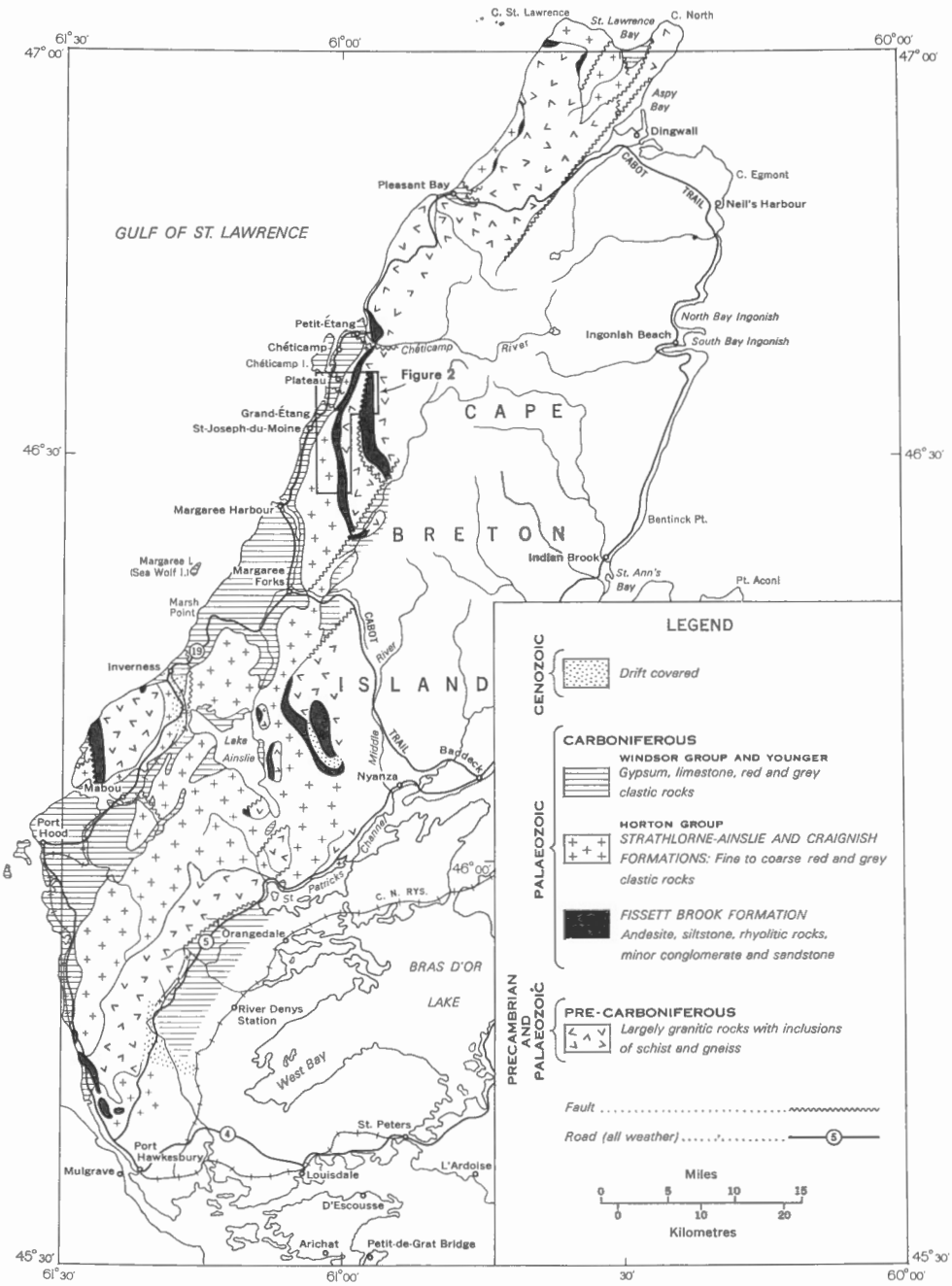

Figure 1. Distribution of Fissett Brook Formation, western Cape Breton Island

GSC

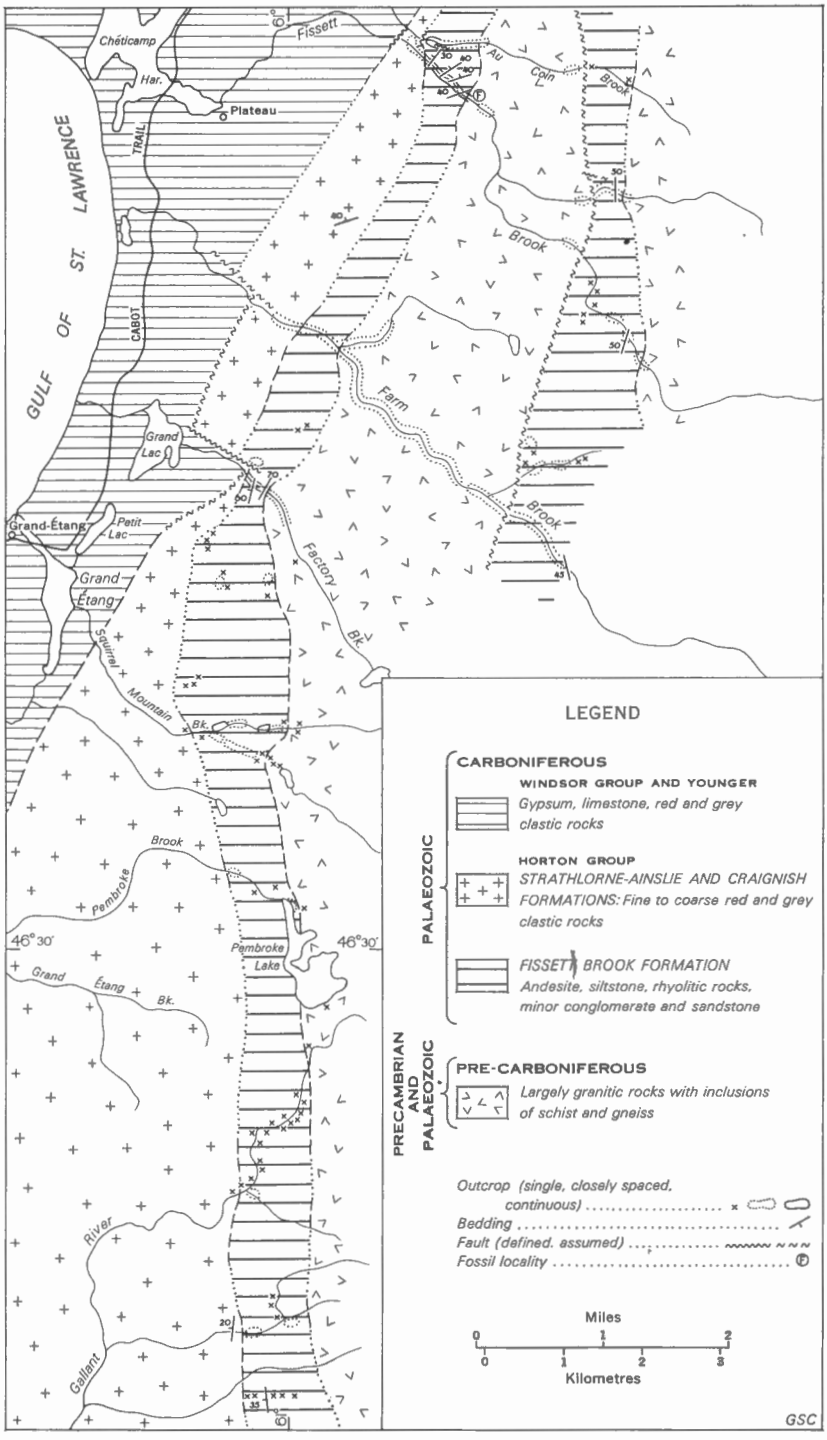

Figure 2. Type area of Fissett Brook Formation, Western Cape Breton Island.

unit consists of sandstone, siltstone, shale and minor limestone. These three rock-units have most commonly been called the Horton, Windsor and Canso Groups respectively.

The major problem that has arisen through usage of the terms Horton, Windsor, and Canso Groups is the age restrictions inherent in use of these terms. The problem of time-stratigraphic and rock-stratigraphic units of Carboniferous stratigraphy has been recently discussed by Poole, Kelley, and Neale (in press) and Kelley (in press). The Horton and Windsor Groups can be and usually have been used as rock-stratigraphic units in Cape Breton Island.

Three formations have been distinguished (Murray, 1960) and mapped (Kelley, 1958) in the Horton Group of Cape Breton Island. The lowest of these formations is the Craignish; the medial, Strathlorne; and the uppermost, Ainslie. Recently Kelley (in press) proposed combining the Strathlorne and Ainslie into one formation. During the 1950's when formations of the Horton Group were first mapped in Cape Breton Island, the volcanic and sedimentary rocks were regarded as a rock-stratigraphic unit underlying the Horton Group, and the one possible exception to the lowermost Horton lying unconformably on older rocks (Kelley, 1958, p. 175). Norman (1935, p. 23) had pointed out that the volcanic and sedimentary rocks were probably conformable with the Mississippian Horton Group even though he correlated them with Lower or Middle Devonian rocks in eastern Cape Breton Island.

The volcanic-sedimentary unit unconformably overlies older rocks and is conformably overlain by the Craignish Formation of the Horton Group. The sedimentary rocks of the volcanic - sedimentary sequence are indistinguishable from rocks of the Horton Group. It is here proposed that the volcanic-sedimentary unit be designated the Fisset Brook Formation and included in the Horton Group.

Fisset Brook Formation

The name Fisset Brook Formation is proposed for a rock-stratigraphic unit at the base of the Horton Group in western Cape Breton Island. The Fisset Brook Formation includes a basal, predominantly sedimentary unit, a predominantly andesitic unit, and an upper predominantly rhyolitic unit. The top of the formation is the top of the highest volcanic strata. This is the same basis Norman (1935, p. 23) used to separate the Horton Group from his volcanic and sedimentary unit in Lake Ainslie map-area.

Type section

The type section of the formation is along Fisset Brook, which is about 2 miles southeast of the town of Cheticamp. There, the formation is about 950 feet thick. Similar sections of variable thicknesses are well exposed on Au Coin, Farm, and Factory Brooks.

In the type section, the basal unit of the Fisset Brook Formation comprises about 50 feet of greenish red, polymictic conglomerate, red and grey siltstone, and andesite. Plant fragments occur in the siltstone. The andesitic unit, which is about 800 feet thick, consists mainly of andesite with thin intercalated beds of red hematitic siltstone. The andesite is structureless in outcrop and is massive to amygdaloidal. The intercalated siltstone beds suggest that the thickness of individual flows is in the order of tens of feet. The rhyolitic unit is about 100 feet thick, but as exposed in this type section is not typical of this unit. In this section, the rhyolitic unit consists of a basal 30 feet of rhyolitic and andesitic agglomerate, overlain by 20 feet of well-bedded red siltstone, 5-10 feet of conglomerate, and 30-40 feet of mixed red and green ripple-marked siltstone and andesite respectively.

Rhyolitic sections that are more regionally typical are exposed on Farm and Factory Brooks. On Farm Brook, where sedimentary rocks are also present in the rhyolitic unit, the section comprises 15 feet of intercalated red siltstone and rhyolite pebble conglomerate in beds about 8 inches thick. This is overlain by 20 feet of red siltstone, which in turn is overlain by quartz-feldspar porphyry.

On Factory Brook the rhyolitic unit consists of about 200 feet of quartz feldspar porphyry.

The internal stratigraphy of the three units varies in different sections. For example, in some sections the lowest beds in the basal unit are sedimentary whereas in others the lowest are volcanic. An example of the variation in internal stratigraphy of the rhyolitic unit is given above in the comparison of the section on Fisset and Farm Brooks. Such variations are an expected relationship in a sequence of this type.

Distribution and Thickness

The Fisset Brook Formation has been traced from Northeast Margaree River to north of Au Coin Brook, a distance of about 17 miles. The three lithologic units within the formation are present over this distance. These three units are also present in the volcanic-sedimentary sequences along Cooper Brook, in Lake Ainslie map-area, and in the upper part of Fisset and Farm Brooks, about 2 miles east of the type section. Strata in these three areas are homotaxial and on this basis are all considered Fisset Brook Formation.

The Fisset Brook Formation ranges in thickness from about 800 feet to 1,500 feet. The thickest section is possibly along Squirrel Mountain Brook, although there may be repetition of strata because of faulting. The basal unit of the formation appears to vary between 30 and 50 feet. The andesitic unit may vary from 800 feet to 1,200 feet in thickness depending on whether there is repetition of strata along Squirrel Mountain Brook.

The rhyolitic unit is apparently between 100 feet and about 350 feet thick. The thickest observed rhyolitic section is along Pembroke Brook.

Lithology

The Fisset Brook Formation consists mainly of andesitic volcanic rocks with rhyolitic rocks and conglomerates, sandstones, and siltstone. Sedimentary rocks of the Fisset Brook Formation include the basal, predominantly sedimentary unit and intercalated sedimentary strata in the predominantly volcanic units.

Polymictic conglomerate and conglomeratic sandstone, with clasts of granitic rocks, metamorphic rocks, and, in places, fresh andesite and vein quartz are the most common rocks of the basal part of the formation. Arkosic sandstone is commonly associated with the conglomerate, but, in the Pembroke Lake area conglomerate appears to be the only sedimentary rock present.

Blocky, greyish red siltstone is present throughout the formation in beds averaging less than 10 feet thick.

The andesitic unit consists predominantly of andesitic rocks with minor basalt. Breccia zones were noted rarely, where the andesites were deposited on the red siltstone. Thin andesitic flows are also intercalated with the basal sedimentary rocks on Fisset and Factory Brooks and with the rhyolitic unit on Fisset Brook. In most outcrops the andesite and basalt have a smooth, uniformly fine-grained texture. Amygdaloidal zones are present in all large outcrops and the contacts between the massive and amygdaloidal rocks are commonly irregular. Possible flow banding and ellipsoidal features that may be pillows were rarely seen. The amygdules are mainly carbonate and chlorite, with some quartz and feldspar.

The feldspars of the andesite and basalt are commonly saussuritized and identification is difficult. Of the eleven thin sections of andesitic rocks examined by Mackasey five were identified as andesites and two as basalts, based on the An content of the plagioclase as determined by the Michel-Levy method.

The rhyolitic rocks were determined by Mackasey to be quartz-feldspar porphyry, rhyolite breccia, crystal breccia, spherulitic rhyolite, and banded rhyolite. Some of the rhyolitic rocks have textures suggestive of pyroclastic origin. It is not known whether they represent ash falls and ash flows with intercalated normal flows or whether they are all of pyroclastic origin.

Other Areas of Fisset Brook Formation

It is tentatively proposed that volcanic and sedimentary rocks in the Pleasant Bay and Cape St. Lawrence map-areas mapped by Neale (1963, 1964) as the highest unit below the Horton Group, are correlative with the Fisset Brook Formation. These areas are shown as underlain by Fisset Brook Formation in Figure 1. This suggested correlation is based only on the similarity of the rhyolites and andesite to those of the Fisset Brook Formation (Mackasey, 1963, p. 89) and because they occupy the same stratigraphic position as the Fisset Brook Formation.

The volcanic and sedimentary rocks in the western part of Lake Ainslie map-area (Norman, 1935, p. 19 and 20) may also be correlative with the Fisset Brook Formation. They occur in a fault block where their stratigraphic relations to Carboniferous rocks are unknown and in a small area north of the main block where they are unconformably overlain by Pennsylvanian rocks (Norman, 1935, p. 20). The rocks include flows, tuffs, and breccia of rhyolitic and andesitic composition intercalated with conglomerate and sandstone, including a thin hematite bed. They are more highly altered than rocks considered Fisset Brook Formation in the other areas; the phenocrysts of feldspar in the flows are commonly altered to epidote and the sedimentary rocks are more highly indurated.

In the northwestern part of Port Hawkesbury map-area some of the volcanic rocks mapped as "Cambrian and/or Earlier" (Ferguson and Weeks, 1950), especially those overlain by outliers of Horton Group, are probably correlative with the Fisset Brook Formation. These rocks should be re-examined, as it is possible the outliers of Horton Group rocks are actually intercalated with the volcanic rocks. Rhyolite and andesite are included in the volcanic rocks.

Age and Origin

Norman (1933) interpreted the age of the volcanic rocks to be pre-Carboniferous and post-granite. The granite was considered to be Precambrian so the age of the volcanic rocks had a long range of possibilities. He (Norman, 1935, p. 23) later considered the volcanic-sedimentary unit to be correlative with the Devonian-aged McAdam Lake Formation of Sydney map-area (Bell and Goranson, 1938). It is apparent from Norman's

discussion of these rocks (1935, p. 18-23) that he would have correctly interpreted the relationship of the volcanic rocks to the overlying Horton Group, had the Horton Group not been regarded as a time-stratigraphic unit. Ferguson (1946, p. 4) interpreted the volcanic rocks as pre-granite in the Strait of Canso area. Ferguson may also have grouped in one unit, rocks that are not part of the volcanic-sedimentary unit under discussion in this paper, as well as rocks that are part of the volcanic-sedimentary unit.

Cameron (1948, p. 4) interpreted the volcanic-sedimentary unit in Margaree and Cheticamp map-areas to be pre-granite and possibly Cambrian age. The volcanic rocks studied by Cameron and at least some of those studied by Ferguson occur in the same stratigraphic position and are lithologically similar to those in the eastern part of Lake Ainslie map-area studied earlier by Norman (1935).

More recently, geologists (Neale, 1963, 1964; MacLaren, 1956; and Kelley, 1957) placed the volcanic rocks tentatively in the Devonian or in the pre-Mississippian but post-Devonian (?) granite.

Following an examination of the volcanic rocks in the eastern part of Lake Ainslie map-area in 1960 Kelley concluded these strata were Lower Carboniferous or Upper Devonian (Kelley, in Lord and Jenness, 1961, p. 42) because of their stratigraphic position, which was apparently conformable beneath the Horton Group, and the presence of carbonized plant fragments in sandstone at the base of the volcanic-sedimentary sequence. The range in age was necessary because the age of the basal part of the Horton Group in Cape Breton Island was unknown.

The Early Mississippian age of the volcanic rocks was reasonably confirmed in one area from a study of spores obtained in 1961 from sandstone at the base of the type section of the Fisset Brook Formation.

The following spores were identified by M.S. Barss (Report CRS-2-63-MSB).

Leiotriletes sp.
Calamospora sp.
Punctatisporites spp.
Granulatisporites sp.
Cyclogranisporites spp.
Apiculatasporites sp.
Endosporites sp.
Grandispora spp.
Perotrilites spp.
Reticulatisporites spp.
Convolutispora sp.
Phyllothecotriletes sp.

cf. Acanthotriletes spp.
cf. Chaetosphaerites sp.
Hystricosporites sp.

Concerning these spores Barss commented as follows: "The spores in the assemblage are fragmentary with some well-preserved specimens. Only generic identifications were attempted, but comparison of the better preserved specimens with specimens from other samples from Nova Scotia and New Brunswick indicate a lowermost Mississippian age for the sample." Barss mentioned that the presence of Hystricosporites gives some suggestion of a late Devonian age. He considered that because the range of Hystricosporites is unknown in the Maritime Provinces, and because this genus is known to occur in Lower Mississippian rocks in other areas, an age of other than earliest Mississippian for the assemblage would be hazardous.

The presence of plant fragments in the basal part of the Fisset Brook Formation and the presence of clastic sedimentary rocks of continental characteristics interbedded with the volcanic rocks suggest that the Fisset Brook Formation is of continental origin.

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