GEOLOGY OF THE BAINE HARBOUR MAP AREA, WEST HALF (1M/7)

by S.J. O'Brien

INTRODUCTION

Mapping was initiated in the central portion of the Burin Peninsula during the 1977 field season. The western half of the Baine Harbour map area was mapped at the scale of 1:50,000. Previous work in the area includes geological reconnaissance by Anderson (1965) and Serem Limited (Schrijver, 1972, 1973). Detailed mapping of Oderin Island has been done by Williamson (1956).

GENERAL GEOLOGY

Sedimentary rocks of unit 1, tentatively correlated with the Rock Harbour Group (Strong *et al.*, 1977), are exposed on the islands in the southernmost parts of the map area. The stratigraphic position of the Rock Harbour Group as outlined by Strong *et al.* (1977) (e.g. the base of the sequence in the southern Burin Peninsula) cannot be verified in the present study area as its contact with the adjacent Burin Group (Taylor, 1976) is invariably faulted and neither the stratigraphic top nor bottom of the group is exposed in the map area. Conglomerate and sandstone beds of the Rock Harbour Group are disposed in downward facing structures near the Burin Group contact. Facing directions suggest the sequence youngs to the south in this locality. Flyschoid sedimentary rocks of the group are in fault contact with lowermost Cambrian strata on the north shore of Jude Island.

That part of the Rock Harbour Group exposed on Davis Island consists of very coarse boulder conglomerates composed of subrounded to well rounded clasts (up to 50 cm) of felsic to intermediate porphyritic intrusive and extrusive rocks and lesser amounts of fine grained clastic rocks in a matrix of fine to coarse grained sandstone and fine grained conglomerate. The maximum thickness of the unit is approximately 350 m. It fines upwards into a series of interbedded medium grained conglomerates and fine grained sandstone and siltstone. The conglomerates locally display cross-bedding and the siltstones commonly contain thixotrophic deformation features.

Rocks of the Rock Harbour Group exposed on Jude Island include finely laminated dark gray siltstone and fine grained sandstone, pebbly sandstone, thickly bedded argillites, and conglomerates. The sequence is tenatively interpreted as having been deposited, in part, in a deep water environment (e.g. turbidites).

A major fault separates the above sequence from a series of slates, shales, and slumped sandstone with a shaly matrix. The latter lithologies have been hornfelsed by the intrusion of numerous diabasic and gabbroic dikes.

Unit 2 consits of submarine basaltic rocks (equivalent to the Burin Group of Taylor, 1976) which underlie several small islands in the southern portion of the map area. They are in fault contact with sedimentary rocks of the Rock Harbour Group to the south and with polydeformed sericite schists to the north.

These rocks are tentatively subdivided into two units; namely, a sequence of basaltic pillow lavas and associated pillow breccias, with minor amounts of mafic tuffaceous rocks and massive basaltic flows, and a second unit composed mainly of mafic aquaqene tuffs, basaltic agglomerate and mafic breccias. The second unit contains stromatolitic limestone blocks up to 1 m in diameter.

Studies to the south of the map area (e.g. Taylor, 1976; Strong *et al.*, 1977) indicate that the Burin Group conformably overlies the Rock Harbour Group. Studies of lithologically similar rocks to the North (O'Driscoll, this volume) suggest the opposite stratigraphic relationship. A major fault separates the equivalents of the Burin and Rock Harbour Groups in the present area; hence, their stratigraphic relations remain unclear.

Unit 3a underlies approximately 60 percent of the map area. This unit contains equivalents of either the Marystown Group (Strong *et al.*, 1977) or the Love Cove Group (Jenness, 1963; Hussey, this volume). Most of the unit has been deformed to varying degrees and sericite and quartz-sericite schists are now the most common rock types. In areas of little deformation a variety of subaerial volcanic litholigies can still be recognized; e.g. welded and nonwelded ash-flow tuffs or ignimbrites, coarse to fine grained felsic and intermediate agglomerates, laharic breccias, crystal rich sillar deposits, flow banded and autobrecciated rhyolites, volcanic conglomerate and tuffaceous sandstone. Minor occurrences of mafic lithologies are represented by chlorite schist. Rapid facies variations,due to the mechanism of deposition of the felsic pyroclastic rocks combined with the results of deformation, make it difficult to establish meaningful lithostratigraphic subdivisions of the unit at this time.

Unit 3b is exposed in the westernmost part of the map area and reconnaissance mapping indicates that it is much more extensive further west in the Point Enragée map area (IM/6). The unit consists primarily of red vitrophyre (now devitrified) and variably welded, usually nonflattened, lithic and crystal-lithic tuffs. These rocks are lithologically and structurally similar to the Hare Hills Tuff (O'Brien *et al.*, 1977) and the Barasway Formation (Strong *et al.*, 1977) of the Marystown Group to the south.

Unit 4 outcrops in the northwestern part of the map area and is best exposed along the shores of Jacques Fontaine Gull Pond. This unit is not exposed in the southern Burin Peninsula but can be traced as a semicontinuous band north to the Bonavista Bay region (E.M. Hussey, personal communication). The unit consists mainly of secondary pyroclastic and epiclastic lithologies, with minor intercalations of primary pyroclastic rocks. The major rock types include cross-bedded tuffaceous sandstone and conglomerate; minor arkosic sandstone and conglomerate of nonpyroclastic orgin occur sporadically throughout the sequence.

Two notable features of these sedimentary rocks are: (1) the presence of weakly foliated granitic clasts in the conglomerates, and (2) thin cross-laminae of an opaque mineral in the arkosic sedimentary rocks.

This unit conformably overlies the schistose silicic volcanic rocks of unit 3 to the southeast and is assumed to be in fault contact with similar volcanic rocks to the northwest. Available facing criteria indicate that the unit becomes younger to the northwest.

Unit 5 is tentatively subdivided into units 5a and 5b. Unit 5a is composed mainly of subaerial mafic flows with minor tuffaceous sedimentary rocks whereas unit 5b consists of intercalated massive mafic subaerial flows, and mafic to felsic pyroclastic rocks.

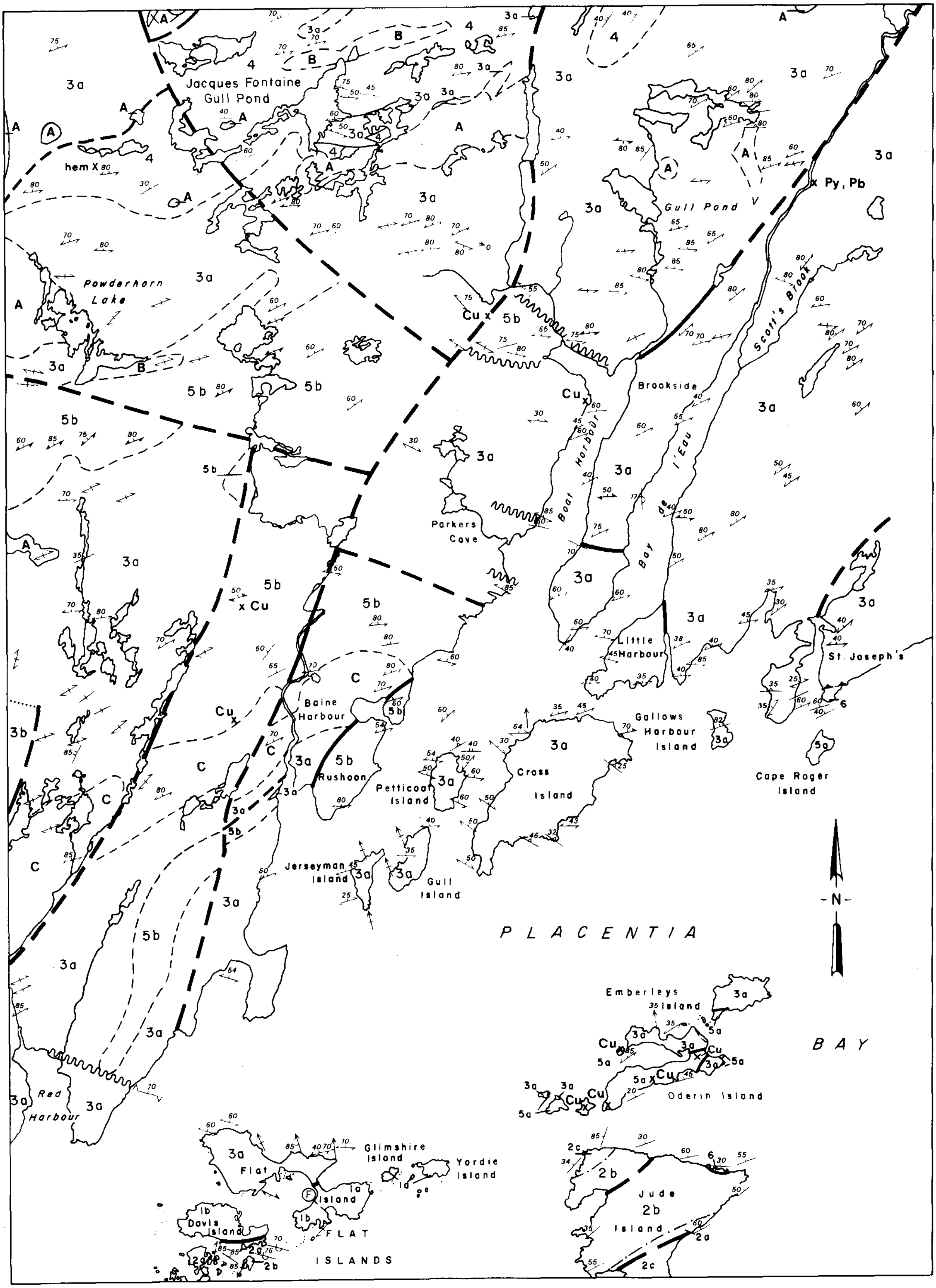
Unit 5a which is restricted in areal extent, is best exposed on Oderin Island, Placentia Bay. It consists of a series of gently dipping subaerial amygdaloidal basaltic flows which have an approximate thickness of slightly less than 100m. The major phenocryst phases are plagioclase and olivine. These flows exhibit prehnite-pumpellyite grade metamorphism; the recognizable metamorphic minerals include chlorite, epidote, prehnite, and minor calcite and pumpellyite. Botryoidal prehnite is present filling amygdules up to 5 cm in diameter. Zones of epidote alteration consistently parallel individual flow boundaries. Two stages of chlorite growth are present; early chlorite fills amygdules and later chlorite is present in zones of minor shearing.

The basaltic flows structurally (and possibly stratigraphically) overlie felsic volcanic rocks of unit 3a. Near a contact on the eastern side of Oderin Island, mafic dykes which cut the structurally lower felsic rocks appear to be feeders to the mafic flows.

Unit 5b consists primarily of undivided subaerial mafic and felsic flows and associated pyroclastic rocks with minor intercalated red tuffaceous sedimentary rocks. The mafic volcanic rocks are massive flows and coarse to fine grained oxidized agglomerates. These mafic pyroclastic rocks are intercalated (and often tectonically interleaved) with the felsic volcanic rocks. The massive mafic flows usually stratigraphically overlie this mafic-felsic assemblage. It is probable that the mafic flows are correlative with similar rocks in unit 5a.

Unit 6 consists of rocks of Eocambrian to Lower Cambrian age. These rocks occur only in two localities in the map area, on the western shore of Cape Roger Bay and on the north shore of Jude Island. The Cape Roger Bay occurrence is a sequence of red and green shales, siltstones and sandstones which have been overthrust by a sequence of intercalated felsic pyroclastic rocks and tuffaceous sandstones of unit 3a. The red siltstones are micaceous and display ripple marks and mudcracks.

The Jude Island occurrence is a small(less than 5 km^2) fault wedge of lower Cambrian strata; it is in fault contact with flyschoid sedimentary rocks of the Rock Harbour Group (unit 2). The sequence consists of red siltstone and sandstone with small (1-2 cm) sandy and limy nodular concretions. Possible algal structures (resembling oncolites) were noted at one locality.


Jacques Fontaine Gull Pond
Powderhorn Lake
Gull Pond
Scott's Brook
Brookside
Boat Harbour
Bay de l'Eau
Parkers Cove
Little Harbour
St. Joseph's
Baine Harbour
Rushoon
Petticoat Island
Cross Island
Gallows Harbour Island
Cape Roger Island
Jerseyman Island
Gull Island
PLACENTIA
BAY
Emberleys Island
Oderin Island
Red Harbour
Flat Island
Glimshire Island
Yordie Island
Davis Island
FLAT ISLANDS
Jude Island
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SCALE
Kilometres 1 0 1 2 3 4 5 Kilometres

LEGEND

VOLCANIC AND SEDIMENTARY ROCKS

CAMBRIAN

6	*Red shale with lime-rich nodules, red and gray sandstone and shale.*

LATE PROTEROZOIC

5	**5a**, *Subaerial basaltic flows;* **5b**, *subaerial basalt, mafic agglomerate, rhyolite and rhyolite tuff (may include* **MARYSTOWN** *and* **LOVE COVE GROUP** *equivalents).*
4	*Tuffaceous sedimentary rocks; arkose; minor conglomerate.*
3	**3a**, *Deformed and undeformed ash-flow tuffs, rhyolite flows, felsic agglomerate, minor basalt and tuffaceous sedimentary rocks; undivided sericite and chlorite schist;* **3b**, *undeformed red vitrophyre and lithic lapilli tuffs; (includes possible equivalents of* **MARYSTOWN** *and* **LOVE COVE GROUPS**).
2	**ROCK HARBOUR GROUP equivalents: 2a**, *Coarse boulder conglomerate, minor coarse grained sandstone and fine grained conglomerate;* **2b**, *flyschoid sedimentary rocks;* **2c**, *black slates, slumped shale and sandstone.*
I	**BURIN GROUP equivalents: 1a**, *Mafic aquagene tuffs and basaltic agglomerate; stromatolitic limestone breccies.*

INTRUSIVE ROCKS

A	*Granite; minor quartz diorite and syenite.*
B	*Porphyritic granite.*
C	*Quartz porphyry; minor porphyritic rhyolite.*

SYMBOLS

Geological boundary (defined, approximate, assumed and gradational) ....

Thrust fault (defined; teeth on upper slice) ....

Fault of unknown nature (defined, approximate) ....

Bedding; tops known (inclined, overturned, vertical) ....

Bedding; tops unknown (inclined) ....

Shearing and dip ....

Shear zone ....

Schistosity (inclined, vertical) ....

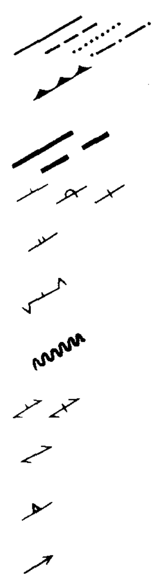
Cleavage ....

Igneous layering; tops unknown ....

Crenulation, minor folds ....

Mineral occurrence x

Fossil locality .... Ⓕ



STRUCTURAL AND METAMORPHIC HISTORY

The trend of the regional foliation varies from northeasterly in the southwest to east-west in the northwestern and central parts of the area. Localized east-west and northwest trending shearing, faulting, and associated schistosities may be related to the folding or flexuring of the regional fabric.

The regional schistosity is usually coplanar to bedding or primary layering. All recognizable first phase folds in the highly deformed volcanic terrain are tight isoclinal structures. The intensity of the foliation is related in part to competency of rock types.

Steep, northeast trending crenulations are well developed in the south-central parts of the map area where they locally define a second fabric. Second, and possibly third, phase folds are locally developed in sericite schists of unit 3a on Flat Island.

Much of unit 5a does not contain any tectonic fabric.

Metamorphism ranges from prehnite-pumpellyite facies in the subaerial basalts of unit 5a to lower greenschist facies in the volcanic rocks of units 2, 3, and 4.

INTRUSIVE ROCKS

The volcanic and sedimentary rocks are locally intruded by a series of granite, diorite, and syenitic stocks and bosses which have tentatively been divided into three intrusive suites. The absolute ages of these intrusive rocks are unknown, but all are pretectonic with respect to the regional deformation.

Most of the granitic rocks (unit A) in the western portion of the map area are clearly intrusive into units 3a and 4. Intrusive relations with some of the felsic volcanic rocks of unit 3a are present in the Gull Pond region; comagmatic extrusive phases also appear to be present locally in this area. Extensive pyritiferous hornfelses are developed in rhyolitic tuffs adjacent to a granite-quartz diorite body immediately west of Powderhorn Lake.

Unit B is composed mainly of quartz porphyry, typified by large (2 cm) euhedral phenocrysts of quartz in a fine grained quartzofeldspathic matrix. Its contact with the felsic volcanic rocks of unit 3a is intrusive, but its contact with the basalts and rhyolites of unit 5b is not exposed.

Unit C consists of a series of fine grained "quartz eye" porphyries and comagmatic porphyritic rhyolites and rhyodacites. The porphyries show pretectonic contact relationships with the adjacent schistose felsic volcanic rocks of unit 3a. Its contact with unit 5b, where exposed, is invariably fault modified. The basaltic rocks of unit 5b are believed to disconformably overlie the prophyritic rhyolites of unit C.

ECONOMIC GEOLOGY

Mineralization in the map area occurs within the mafic and felsic rock types of units 3 and 5. No mineral occurrences were noted in units 1, 2 or 4. Minor base metal showings are related to the emplacement of the intrusive bodies in the area.

Copper mineralization (bornite, covellite, chalcopyrite and native copper) is common in the subaerial mafic flows of unit 5. Occurrences in units 5b contain any combination of the above minerals, usually localized in mafic flows in minor chloritized shear zones. Native copper is the most common copper phase present in the occurrences in unit 5a; no copper sulfides were noted in this unit.

Native copper mineralization is also locally present in the basaltic flows on Oderin Island. It is found as small (10 mm) flecks in amygdules (commonly with prehnite), in chloritized shear zones, and in quartz and quartz-prehnite- epidote veinlets. These mineral assemblages are similar to the native copper bearing associations in the Keweenawan basalts of Michigan (Jolly and Smith, 1972;Jolly, 1974).

Small scale copper occurrences are present in narrow (10 cm) quartz veinlets and pods which cut sericitized felsic proclastics of units 3 and 5. The main copper phases are chalcocite and malachite, with lesser amounts of chalcopyrite. Galena was also recognized in one such veinlet.

Pyrite and specular hematite are common in hornfelsed felsic volcanic rocks adjacent to many of the intrusive bodies in the area. Pyrite also occurs in association with east-west shear zones in the felsic volcanic sequence.

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GRAND BANK (1M/4), LAMALINE (1L/13), MARYSTOWN (1M/3) AND ST. LAWRENCE (1L/14) MAP AREAS

by D.F. Strong and H.S. Swinden

The 1977 field season was the third and last one for the completion of the Department of Mines and Energy-Memorial University of Newfoundland contract for 1:50,000 scale mapping of these four areas. As the Marystown and St. Lawrence maps have already been published, with the accompanying report in press, and the preliminary versions of the Grand Bank and Lamaline maps and report have been released, the following is kept especially brief.

The field season was spent checking and refining the geology of all four map areas, with an emphasis on detailed mapping and structural-stratigraphic studies of the key areas of the Grand Bank and Lamaline maps. Strong began fieldwork in May, with field assistant K. Jarrett; Swinden joined them for the months of August and September. Swinden did detailed mapping and structural studies of 15 key areas, with help from T.P. Fletcher (U.K. Institute of Geological Sciences) in the stratigraphic studies of Cambrian rocks. Together they have suggested a correlation chart for the Late Precambrian-Cambrian rocks of the four map areas, a modified version of which will be included in the final report for the Grand Bank-Lamaline areas.

Petrological and geochemical studies have continued, with 350 rock analyses (major and trace elements) completed for samples from the Grand Bank and Lamaline map areas. These data show that most rock analyses are chemically comparable to those of the Marystown Group in the Marystown-St. Lawrence map areas. The major exceptions are those from the Burin Group occurring in the southeast corner of the Lamaline map area.

One week was spent with T.P. Krogh (Royal Ontario Museum) collecting 13 samples from all major units for radiometric dating of zircons by the uranium-lead method. Although zircons have already been separated from three of these samples, the dates will not be available before conclusion of this project.