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GEOLOGY OF THE BAIE VERTE MAP AREA WEST (12H/16W), NEWFOUNDLAND

by James P. Hibbard

INTRODUCTION

Geological mapping of the Baie Verte Peninsula, at the scale of 1:50,000, continued in 1978 with the completion of the Baie Verte (12H/16) map area. This survey, in conjunction with mapping to the north (Bursnall, this volume; Hibbard and Bursnall, this volume; DeGrace *et al.*, 1976), completes geological coverage of the north half of the peninsula.

The west half of the Baie Verte map area was previously mapped by Neale and Nash (1963) at a 1:250,000 scale; portions of it have been the subject of recent theses by de Wit (1972, the area south of the Seal Cove Road) and Bursnall (1975, the area northeast of the Fleur de Lys Road). The present investigation includes compilation and assessment of these studies as well as remapping of intervening areas.

The rocks of the area span the junction between Grenville basement and Paleozoic cover rocks of the Humber Zone to the west, and the paleo-oceanic realm of the Dunnage Zone to the east (Williams, 1978). Most of the area mapped encompasses the polydeformed and metamorphosed rocks of the eastern margin of the Humber Zone; in the Baie Verte map area these can be separated into two parts, 1) the East Pond complex (new), including rocks previously interpreted by de Wit (1972) as being largely Grenville basement, and 2) the Fleur de Lys Supergroup, a sequence of metasedimentary and metaigneous rocks. The Fleur de Lys rocks are tentatively considered as Eocambrian to Lower Ordovician in age, based on regional correlations with less deformed and metamorphosed fossiliferous rocks of the Humber Zone (de Wit, 1972).

Rocks of the Dunnage Zone are found along the eastern margin of the area and consist of dismembered ophiolite, greenschist, and sediments of the Advocate Complex (Williams *et al.*, 1977), which is a subdivision of the Baie Verte Supergroup of probable Cambrian-Lower Ordovician age (Hibbard, 1978). They are separated from rocks of the Fleur de Lys Supergroup by a high angle fault delineated by a discontinuous chain of serpentinized ultramafic pods. The Advocate Complex has been described by Hibbard (1978) and will not be mentioned further in this report.

EAST POND COMPLEX (Unit 1)

Rock types

The complex is composed of polydeformed metaconglomerate, psammite and semipelitic schist, amphibolite, migmatite, and cataclastic schists. The polymictic metaconglomerate (1a) contains dominantly rounded, pebble to boulder sized clasts of quartzite, granite, predeformed granitic gneiss, psammite, pelite, augen gneiss, and amphibolite set in a light gray psammitic to semipelitic matrix. The metaconglomerate is interbanded with massive psammitic schists that locally contain isolated clasts. The original thickness of the metaconglomerate cannot be determined because of structural complexities of the terrain. In areas of intense deformation, clasts are extremely attenuated, resembling layering or veining and thus take on a paragneissic aspect.

The metaconglomerate is in gradational contact with a thick sequence of psammitic and semipelitic schists (1b). These schists generally have a granoblastic texture and are locally garnetiferous. Thin pebbly and conglomeratic layers occur within these metasediments at the southern end of Gull Pond and locally inland; the clasts are dominantly of quartz and feldspar. On the

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Westport Road near the Bear Cove junction, the schists are fine grained and banded on a centimetre scale over distances of 100-200 m.

Amphibolite pods occur throughout the metasedimentary sequence; they are dominantly blackish green and massive, although layered amphibolites do occur. The amphibolites are eclogitic at the north end of Gull Pond; Church (1969) has reported eclogites from within the metaconglomerate terrain, though that observation has not been confirmed by recent work (de Wit and Strong, 1975; and the present study).

Patches of migmatitic rock (1c) occur within both the metacongomerate and psammitic-semipelitic schist terrains; the contact between the migmatites and surrounding rocks is apparently gradational, with zones of garnetiferous paragneiss occurring between the units. The migmatites are composed of a granoblastic quartzofeldspathic neosome that permeates an amphibolitic, psammitic, and semipelitic paleosome. Commonly, the amphibolitic paleosome and the neosome are interbanded as discontinuous foliae and, in places, the neosome contains small clots of hornblende. The migmatites also display agmatitic, diktyonitic and nebulitic structures. On the west side of East Pond, a small discrete body of pink granite is associated with a patch of migmatite; similar pink granite occurs as veins cutting highly deformed metaconglomerate on the east side of the pond. The migmatite is most extensively developed in the area of Highcliff Pond, and may represent the northern margin of a more extensive terrain to the south of the map area.

At the southern end of East Pond and at Highcliff Pond, the paleosome consists of remnant clasts of quartzite, granitic gneiss, and metasediment, indicating that at these places the matrix of the metaconglomerate has been mobilized to form part of the migmatite.

Regularly banded (mm-cm scale) gneiss of unknown affinity occurs on the Westport Road. It is composed of alternating fine grained gray granodioritic, and pink granitic layers; prekinematic fine grained quartz-feldspar dikes crosscut the banding and include xenoliths of the gneiss.

South of East Pond, the complex is commonly cut by massive granitic pegmatites that are locally wider than 4 m.

Cataclastic zones (Unit 1d) of feldspar porphyroblastic biotite-muscovite schists occur within and surround large portions of the complex. Contacts with all surrounding rocks are tectonically gradational and the intensity of cataclasis varies throughout these zones. On the east side of East Pond, feldspar porphyroblasts occur up to 5 cm long in the schists. At Southern Pond, the cataclastic zone is more psammitic than at other locations.

Age of the East Pond complex

De Wit (1972) considered the terrain described as the East Pond complex as reconstituted Grenville gneisses and migmatites unconformably overlain by Eocambrian metaconglomerate, which he relegated to the Fleur de Lys Supergroup (de Wit, 1974). The metaconglomerate is very likely a basal Eocambrian deposit, as envisaged by de Wit, but large portions of the remainder of the complex appear to represent a metasedimentary sequence that is interbedded with the metaconglomerate.

The similarity of the metaconglomerate matrix to the psammitic and semipelitic schists (Unit 1b), the occurrence of metaconglomeratic layers in the psammitic and semipelitic schist terrain, and the apparently gradational contact between the two units indicate that a large portion of the East Pond complex may have originally been deposited as a conformable sedimentary sequence. Local mobilization of the metaconglomerate suggests that migmatization is at least partially Paleozoic in age. If Grenville basement does occur within the East Pond complex, it is of a restricted and almost totally reconstituted nature.

FLEUR DE LYS SUPERGROUP (Units 2,3,4)

The Fleur de Lys Supergroup (Church, 1969) consists of polydeformed, crystalline rocks that can be traced 50 km south of the area to the Trans Canada Highway and as far north as the Gray Islands, approximately 100 km north of Baie Verte. In the Baie Verte area, it has been separated into three divisions of metasedimentary and metaigneous rocks that form an apparently conformable sequence, though locally contacts are faulted. The contact between the East Pond complex and the Fleur de Lys Supergroup appears to be gradational at one locale; this may indicate that a portion of the East Pond complex represents the strongly deformed and partially migmatized base of the Fleur de Lys Supergroup.

Seal Cove group (Unit 2)

Almost half the area is underlain by the Seal Cove group (de Wit, 1972), a monotonous sequence of interlayered feldspathic psammites, semipelites and pelites with minor interlayers of metaconglomerate, graphitic schist, and quartzite. Primary structures other than layering are very rare within this sequence. Abundant pods and layers of feldspar porphyroblastic amphibolite, commonly garnetiferous, occur with the metasediments, and locally crosscutting relationships are

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found. The metasediments are generally interlayered on a scale of 10 to 50 cm, though on the coast north of Seal Cove massive psammitic layers range up to 5 m thick. Metaconglomerates in the sequence are composed of pebbles of quartz and feldspar with local angular flakes of graphitic schist.

At the north end of Gull Pond and at Southern Arm, the contact between semipelites and psammites of the Seal Cove group and semipelites of the East Pond complex appears to be gradational, though exposure is not complete; elsewhere, as at Middle Arm, cataclastic schists intervene between the units.

At Crow Head, a small, fine grained, light green to cream, felsic intrusion cuts psammites and semipelites identical to those of the Seal Cove group and has been deformed with them. De Wit (1972) interpreted this intrusion and surrounding rocks as representing a totally reconstituted Grenville basement inlier; in the present study, these rocks are considered as part of the Seal Cove group.

Rattling Brook Group (Unit 3)

This group, first defined by Watson (1947), is a varied assemblage of psammitic and semipelitic schist, amphibolite, marble, carbonate schist, graphitic schist, garnetiferous quartz-muscovite semipelitic schist, and quartzite. The psammitic and semipelitic schists locally contain abundant magnetite and chlorite that distinguish them from similar rocks of the Seal Cove group.

The Rattling Brook Group outcrops in a y-shaped pattern, with different sequences occurring in the northwest trending limb and the main outcrop belt. The northwest trending outcrop limb consists of a sequence of amphibolite, marble, and graphitic, semipelitic, and pelitic schists. The amphibolite in this sequence is generally massive, though the following features indicate a possible extrusive origin for the rocks: 1) it is interbanded with marble; 2) vague pillow forms are present;and 3) local concentrations of chlorite-feldspar-epidote nodules (up to 10 cm) resemble clasts in a fragmental volcanic rock. The marble occurs as discontinuous pods, locally up to 5 m thick. The main outcrop belt is composed of garnetiferous semipelite, quartz-muscovite semipelite, greenschist, and graphitic and psammitic schists. The junction of the two sequences is unexposed although a fault marked by two small pods of brecciated ultramafic rock (3a) occurs in this area and may indicate a tectonic contact. South of this junction, the outcrop pattern generally thins and deformational effects are very intense, such that the Rattling Brook Group is indistinguishable from the Seal Cove group near Middle Arm Brook.

Exposed contacts between the Rattling Brook Group and the Seal Cove group are tectonic to the north. East of Southern Pond, the contact appears to be transitional and conformable. Based on indirect evidence from outside the field area, de Wit (1972) has interpreted the Rattling Brook Group to conformably overlie the Seal Cove group.

Birchy Group (Unit 4)

The Birchy Group (Bursnall, 1975) is composed dominantly of chlorite-epidote-actinolite schist with local interlayers of psammitic and semipelitic schist. It is equivalent to the Birchy schist of Fuller (1941) in the Fleur de Lys area to the north. It forms a thin outcrop belt along the eastern margin of the map area, though north of the area it thickens substantially (Bursnall, this volume). At Advocate Mines, the Birchy Group contains garnetiferous amphibolite (reported in Bursnall, 1975).

The contact between the Birchy Group and the Rattling Brook Group is unexposed in the map area; to the north, in the Fleur dy Lys map area, they are in conformable contact (Bursnall, this volume), though the stratigraphic sequence of these units is disputed (Bursnall, 1975; Williams *et al.*, 1977).

STRUCTURE AND METAMORPHISM

All of the rocks in the East Pond complex and the Fleur de Lys Supergroup have undergone a complex tectonic history involving at least three phases of deformation and associated metamorphism. Deformation in both units has been intense and extremely inhomogeneous. Structure in the East Pond complex appears to be simpler, although more intense, than that of the Fleur de Lys Supergroup, as the latter unit was more susceptible to late deformations.

The main penetrative fabric, S_m, in the area is generally subplanar to layering over large areas; locally it is a composite fabric. The earlier fabric, S_{m-1} is defined by oriented mica and chlorite between S_m planes and by platy minerals that can be traced around the hinges of minor folds associated with $S_m(F_m)$. No folds have been recognized as being associated with S_{m-1}; thus this fabric may be related to local early faulting as suggested by de Wit (1972). F_m minor folds are tight to isoclinal and generally have upright to inclined attitudes. One large scale F_m fold has been mapped out as the northwest outcrop limb of the Rattling Brook Group. It is best defined by the closure of a graphitic schist band and an amphibolite unit around the north end of the outcrop limb. From the map pattern, it appears to be a southerly plunging synform.

At least two deformational events have been superposed upon D_m structures; as these later events are

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difficult to separate, they are collectively referred to here as the late deformation, D_L. The late fabric (S_L) is a crenulation cleavage that is commonly axial planar to tight inclined plunging folds (F_L) with moderate plunges to the north and northwest. Locally, on the coast of White Bay, the late folds attain 10 m in amplitude. Interference patterns between F_m and F_L are common, particularly Ramsey type 3 patterns. The y-shaped outcrop pattern of the Rattling Brook Group may represent a type 3 interference pattern; a large scale F_m, the northwest outcrop limb has possibly been refolded by a large, faulted modified F_L, with the Rattling Brook Group in the limbs and the Seal Cove group in the core of the fold.

Metamorphic events are associated with each deformational event. Early metamorphic events associated with D_{m-1} and D_m appear to have occurred synkinematically, whereas peak metamorphism, reaching lower amphibolite grade, occurred after D_m and before D_L (de Wit, 1972). Peak metamorphism is characterized by extensive garnet and feldspar porphyroblast formation thoughout the Fleur de Lys Supergroup whereas porphyroblast formation occurred only locally within the East Pond complex.

The age of deformation and metamorphism for the area is pre-Middle Silurian based on $^{40}Ar/^{39}Ar$ age spectra (Dallmeyer, 1977). It has been reasoned that these events are related to the transport of allcohthonous ophiolite complexes across the Humber Zone (Bursnall and de Wit, 1975; Williams *et al.*, 1977); thus deformation and metamorphism are most likely Middle Ordovician to Middle Silurian in age.

ECONOMIC GEOLOGY

Two new chalcopyrite showings, found by John Tuach, occur within a discontinuous marble belt in the Rattling Brook Group. Both occurrences consist of disseminated chalcopyrite and bornite with strike lengths of approximately 3 to 4 m and widths up to 1 m. These occurrences are very similar to the Hodder prospect (Fuller, 1941), a copper showing to the north of the field area. The amphibolite-marble-graphitic schist assemblages with which these occurrences are associated may be correlative.

No significant base metals showings have been found in the other map units, although disseminated pyrite is locally common.

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LEGEND

Fleur de Lys Supergroup

CAMBRO-ORDOVICIAN(?)

4 **Birchy Group:** *Dominantly greenschist.*

3 **Rattling Brook Group:** *Unseparated psammites and semipelites with amphibolite, marble, and graphitic schist interlayers;* **3a,** *serpentinized ultramafic rock.*

EOCAMBRIAN(?)

2 **Seal Cove Group:** *Dominantly psammitic and semipelitic schists with abundant amphibolite sills and dikes.*

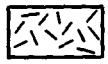
1 **East Pond Complex:** *Mainly quartz-rich metasediments and included amphibolite pods that are locally eclogitic; all intensly deformed and migmatized in places;* **1a,** *metaconglomerate;* **1b,** *mainly psammitic schists;* **1c,** *migmatitic rocks;* **1d,** *zones of cataclasis, dominantly feldspar porphyroblastic pelites.*

Baie Verte Supergroup

Advocate Complex

5 *Unseparated vestiges of ophiolite, with mafic volcanic and volcaniclastic rocks and graphitic slate; locally very intensely deformed.*

Sheeted diabase dikes.



Gabbro and metagabbro.

Mainly serpentinized ultramafic rocks.

SYMBOLS

Geological boundary (defined, approximate, assumed, transitional)

Bedding, tops unknown (inclined)

Main schistosity (inclined, vertical)

Secondary schistosities (inclined)

Fault (defined, approximate, assumed)

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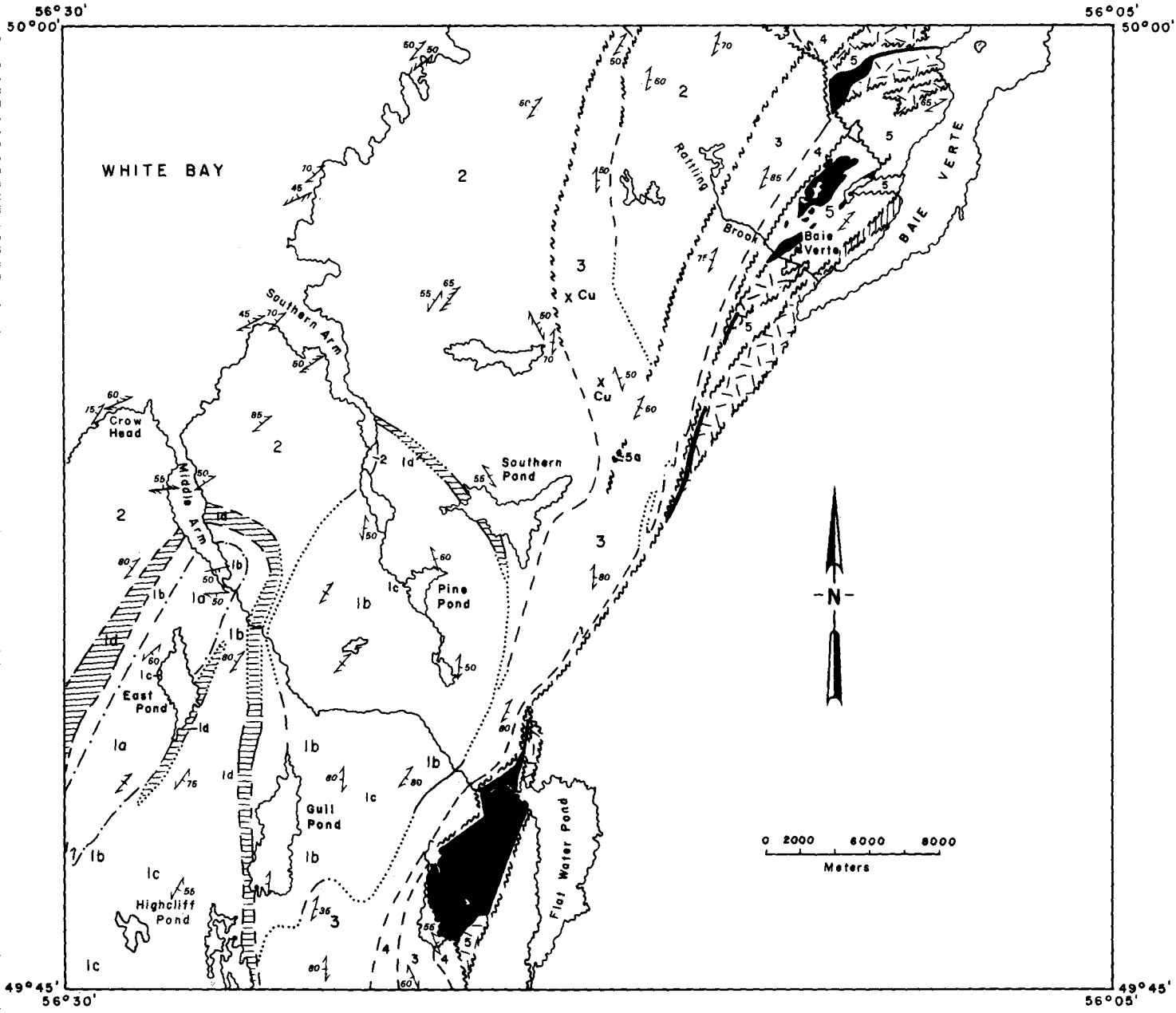

BAIE VERTE MAP AREA (12H/16 WEST), NEWFOUNDLAND