

LABRADOR GROUP IN GROS MORNE NATIONAL PARK

INTRODUCTION

The Labrador Group, comprising the Bradore, Forteau and Hawke Bay formations, was deposited during Early Cambrian sea level rise and fall through the late Early Cambrian and Middle Cambrian (James *et al.*, 1989). **In-board** shallow-water shelf facies occur in southern Labrador and northwest Newfoundland, **outboard** shelf successions in Canada Bay, Gros Morne and near Stephenville. The heterolithic **Early Cambrian** Forteau Formation was deposited during maximum flooding and shelf overlap that culminated with regional deposition of Middle Cambrian sandstone of the Hawke Bay Formation, the Hawke Bay Event (Palmer and James, 1980).

This study fleshes out the stratigraphy and facies of the Labrador Group in Gros Morne to underpin macrofossil (Boyce) and small shelly fossil ongoing studies of the Forteau Formation by Dr. Christian Skovsted (Swedish Museum of Natural History) (Figure 1). The area is complexly folded and faulted (Figure 2) and cleaved mudrocks.

PREVIOUS WORK IN GROS MORNE

1:50 000 mapping - Williams *et al.*, (1984) and Williams, (1985)
Stratigraphic studies - (Schuchert and Dunbar, 1934; James *et al.*, 1988, 1989)
Biostratigraphy - Logan *et al.* (1863), Schuchert (1919), Schuchert and Dunbar (1934) and Resser and Howell, (1938) – see Table 1.

STRATIGRAPHY IN GROS MORNE

The Labrador Group begins with a thin, purple-grey sandstone of the **Bradore Formation** that rests unconformably upon Grenvillian crystalline basement. It is conformably and gradationally overlain by the Forteau Formation.

Forteau Formation

The 200 m thick formation comprises 3 members:

Devils Cove Member - a distinctive pink to white, skeletal, nodular limestone, 12m thick; regionally known throughout western Newfoundland;

Mackenzie Mill member (informal)- well-lithified, calcareous mud rock, black and dark grey shale and mudstone, calcareous ribbon-bedded siltstone and sandstone, current bedded and bioturbated sandstone and nodular to lumpy, fine grained to skeletal-rich limestone, 200 m thick. It is divided into 5 units:

- 1) lower mudrock, 95 m thick, hosts lime mudstone nodules, intercalates with several, thin limestones;
- 2) **Deer Arm limestone**, 3.5 to 8.5 m marker bed of nodular to lumpy, fossiliferous, dark grey limestone with some intercalated black shale;
- 3) middle mudrock, 22 to 29 m thick, rare limestone nodules, some intercalated ribbon siltstone, some soft-sediment slump beds;
- 4) middle limestone, 2.5 to 11 m thick, of intercalated, nodular and phosphatic sandy dolostone, dark grey, fossiliferous nodular limestone, dark grey shale with limestone nodules, and intensely bioturbated siltstone and sandstone;
- 5) upper mudrock-ribbon rock, 45+ m thick, - heterolithic ribbon siltstone, sandstone, mudrock, bioturbated sandstone and rare limestone. Bioturbation increases upwards. Some soft-sediment slumping.; thin skeletal limestone near the top; and

Big Hill member (informal)- mapped by Williams *et al.* (1984) and Williams (1985), is rusty- to dark-brown weathering, ribbon bedded, very fine to fine grained, micaceous sandstone, dark grey to black mudstone and siltstone, black shale, sporadic thick beds of hummocky cross stratified sandstone, rare channel-based cross bedded sandstone and rusty weathering fossiliferous sandstone. Common hyolithid-rich sandy coquinas; some associated with deeply incised erosion surfaces; in-sediment trace fossils rare; wrinkle marks and arthropod scratch marks common; pot and gutter casts, compacted sandstone dykes and soft sediment structures occur.

The mud-dominated Mackenzie Mill succession, deposited in a deep, largely stable, lower ramp to deep shelf setting mostly below storm wave base, shallows upward overall through three, sequences, intervals 1 and 2, 3 and 4, and 5 into the Big Hill member. Fine-grained to skeletal rich nodular to lumpy limestone lacks nearshore shallow water allochems and archeocyathans, formed as subtidal, shelf carbonates at the shallow stage of sequences 1 and 2. **Rosselia ichnofauna** dominates the succession,.

The **Big Hill** member marks a transition from the Mackenzie Mill member into the Hawke Bay Formation laid down in a lower shoreface setting, strongly influenced by storms and repetitive movement of fine sand into the offshore.

Hawke Bay Formation

A partially exposed and logged succession (greater than 100 m), it consists of decametre-thick, cleaning-upward sequences of recessively weathering, brown-weathering, ribbon-bedded, fine grained, micaceous sandstone, siltstone and dark grey and green, silty mudstone overlain by white, pink and purple, quartz arenite. The brown-weathering recessive units prove to be quite fossiliferous, hosting inarticulate brachiopods, hyolithids, often as distinct coquina beds, and trilobites.

Quartz arenites are rich in wedge-shaped sets of planar thin stratification and lamination in the lower part to stacked sets of planar-tabular cross beds with some cross lamination in the upper part of units. Shale drapes are common in the tabular cross sets that also are commonly wedge shaped. Paleoflow is predominantly southeastward. Pebbly and intraclastic sandstones mark the top of some units. Traces are rare.

The cleaning- and coarsening-upward Hawke Bay Formation sequences reflect deposition of prograding, current-influenced sand bodies across lower to middle shoreface deposits of a strongly storm-influenced shelf during high-stand regression.

PALEONTOLOGY AND BIOSTRATIGRAPHY

Forteau Formation – **Olenellid trilobite** sclerites and complete carapaces dominate the mudrock facies and nodular limestone of the Mackenzie Mill member. Scattered *Salterella* cones and small colonial clusters are common; inarticulate brachiopods are locally seen. Several *Bonnia* species also mark the

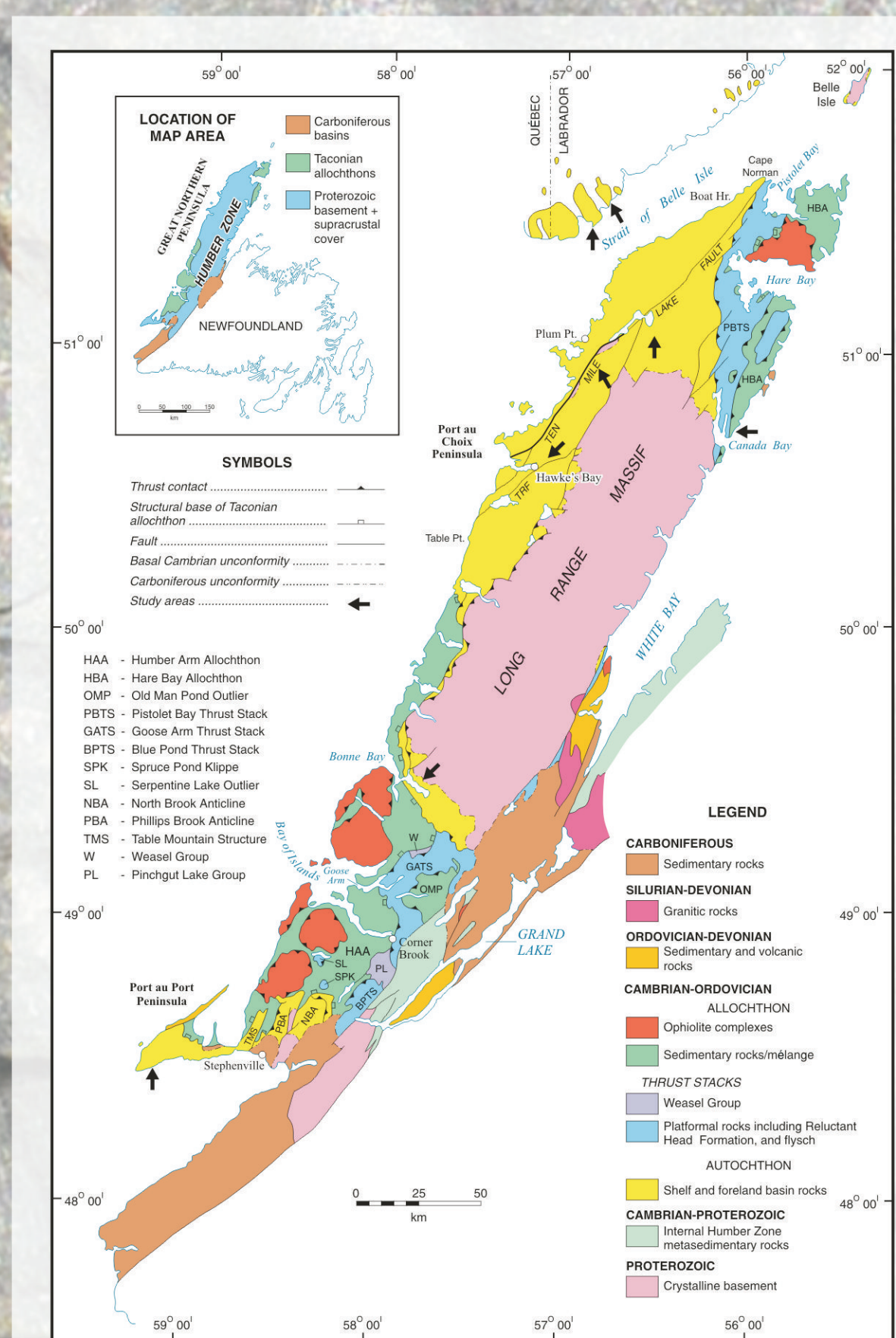
limestones. The Big Hill member has olenellid trilobite fragments, inarticulate brachiopods and hyolithid cones. The Dyeran Stage, **Olenellus faunal zone** fauna suggests that the members lie entirely within the upper part of Cambrian Global Series 2.

Hawke Bay Formation – Newly discovered trilobites together with hyolithid cones and inarticulate brachiopods along Route 430 comprise poorly preserved *Glossopleura*, several Ptychopariid genera (including *?Eoptychoparia*.) and *Olenoides* that indicate Delamaran Stage *Glossopleura* Zone to perhaps younger Marjuman Stage implying the formation straddles Sauk I to II sequence boundary and entirely within Cambrian Global Series 3.

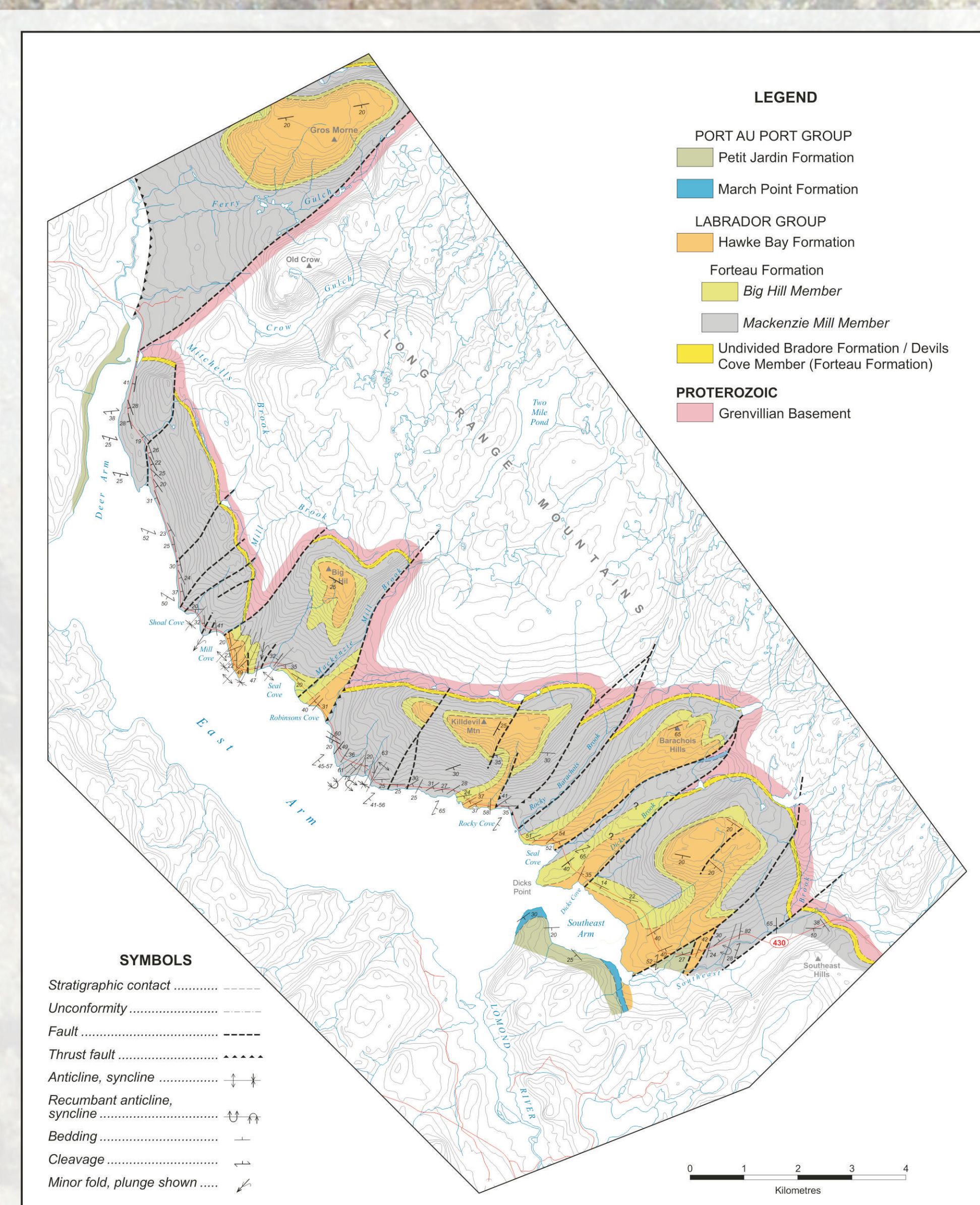
CORRELATION IN WESTERN NEWFOUNDLAND

These new faunas support correlation with coeval shelf sequences elsewhere in western Newfoundland. On **Port au Port Peninsula**, Hawke Bay Formation shoreface-clastics range from *Glossopleura* zone to *Polypleuraspis* Zone (Knight and Boyce, unpublished data, 1998).

In **Canada Bay**, high-energy, oolitic and stromatolitic carbonates, mudrocks and ribbon bedded quartz sandstones of the Bridge Cove member, Hawke Bay Formation (Knight and Boyce, 1987) yielded Middle Cambrian **Plagiura-Poliella to Glossopleura** Zones trilobites. A karst breccia tops the 2nd carbonate cycle in the *Glossopleura* Zone confirming that the Sauk I-II boundary within the formation. **Olenellus** Zone trilobites in underlying ribbon sandstone and shale suggest comparison with the Big Hill member of Gros Morne.



Geology map of western Newfoundland showing ongoing research areas (indicated by arrows)



Geology map of the Labrador Group, Gros Morne National Park. Modified and adapted from Williams (1984) and Williams *et al.* (1985)

Series	Stages	Bounding Zones or Subzones
IBEXIAN	Skullrockian	<i>Eurekaia apopsis</i>
		<i>Saukiella serotina</i>
MILLARDIAN	Sunwaptan	<i>Irvingella major</i>
	Stepteo	<i>Elvinia</i>
		<i>Coosella perplexa</i>
LINCOLNIAN	Marjuman	<i>Crepiccephalus</i>
		<i>Proehmaniella</i>
	Delmaran	<i>Eoptychoparia plochensis</i>
WAUCOBAN	Dyeran	<i>Olenellus</i>
		<i>"Nevadella"</i>
	Montezuman	<i>"Fallotaspis"</i>
BEGADEAN	unnamed	

Cambrian Series and Stages of Laurentia (from Palmer, 1998)

Mackenzie Mill member



Typical thin stratified and laminated, cleaved silty mudstone from lower part of member. Horizons of limestone nodules weather as holes



Coquina of hyolithid cones, Big Hill member

Deer Arm Limestone marker bed of nodular to lumpy, skeletal limestone rich in *Salterella*, brachiopods and trilobites, 100 m above base



Brown to dark grey beds of nodular limestone, middle limestone interval (arrowed) enclosed by mudrocks



Olenellus crassimarginatus (Walcott, 1910), upper mudrock interval



Mesonacis sp., upper mudrock interval

Big Hill member



Typical ribbon sandstone and mudstone, displaying numerous gutter and pot casts left of stick. Lower part of member



Uppermost sequences of member include dark heterolithic ribbon beds alternating with scour-based, wedge-shaped, white quartz arenites just below Hawke Bay Formation



Hawke Bay Formation



Typical thick, cleaning upward cycles of Hawke Bay Formation. Note recessive, rusty weathering, often fossiliferous, ribbon bedded, mudstone, siltstone and fine sandstone overlain by pink, cross bedded quartz arenite



A thick quartz arenite unit in the Hawke Bay Formation. Note several large east-dipping planar tabular cross beds at top of cliff in pink unit above person



Olenoides sp. pygidium. Note axial nodes and paired marginal spines; 2 cm wide