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SEDIMENTOLOGICAL, GEOCHEMICAL AND SEDIMENT–PROVENANCE CONSTRAINTS ON STRATIGRAPHY AND DEPOSITIONAL SETTING OF THE STRONG ISLAND CHERT (EXPLOITS SUBZONE, NOTRE DAME BAY)

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ABSTRACT

The Early Ordovician volcano-sedimentary succession of the Strong Island Chert is well exposed on the southwestern shore of Strong Island in New Bay, above a conformable contact with pillow basalts of the Tea Arm Volcanics (Exploits Group). The sedimentary package of the Strong Island Chert consists of deep-water ribbon radiolarites, graptolitic black shales, felsic fallout tuffs and volcaniclastic debrites and turbidites. The sediments are interbedded with a number of units of basalt pillow lava and basalt massive flow.

The preliminary geochemical data of the pillow lavas from the upper part of the Tea Arm Volcanics display signatures of island-arc tholeiites. The overlying basalts of the Strong Island Chert have signatures of alkaline basalts and ocean-island tholeiites and are interpreted to have erupted in a back-arc basin. The observed arc-to-back-arc, evolutionary nature of the entire volcano-sedimentary succession provides the basis for a provisional chemostratigraphic correlation of the Exploits Group with the Wild Bight Group.

The volcaniclastic debrites and turbidites constitute a significant component of the Strong Island Chert. They are characterized by the abundance of felsic, andesitic and mafic detritus and together with the felsic fallout tuffs are interpreted to have been transported into the back-arc basin from an active island arc. An additional continent- and ophiolite-derived sediment input may be represented by polymictic turbidites containing a metamorphic and chromite detritus.

INTRODUCTION

The New Bay sector of Notre Dame Bay (Figure 1) contains the type area of the Exploits Group (following the usage of Dean, 1977 and Kean *et al.*, 1981), which forms the substrate on which the Strong Island Chert was deposited. The unit has been subdivided into four mappable units of formational rank (Helwig, 1967; O'Brien, 1990). In ascending order these are: the Tea Arm Volcanics, the Saunders Cove Formation, the New Bay Formation and the Lawrence Head Volcanics (O'Brien, 1991) (Figure 2). The maximum combined stratigraphic thickness of the formations of the Exploits Group occurs in the east of the New Bay area, where at least 3.5 km of strata underlies the Strong Island Chert.

The Strong Island Chert, although relatively thin (around 200 m thick), is regionally extensive and has been provisionally designated by O'Brien (1990) as a mappable unit of a formational status (Figure 2). It rests conformably in different localities on the lower and the upper Tea Arm Volcanics, the upper New Bay Formation and the top of the Lawrence Harbour Volcanics. The Strong Island Chert passes conformably upward into graptolitic (Caradocian) black shales of the Lawrence Harbour Shale (O'Brien, 1991).

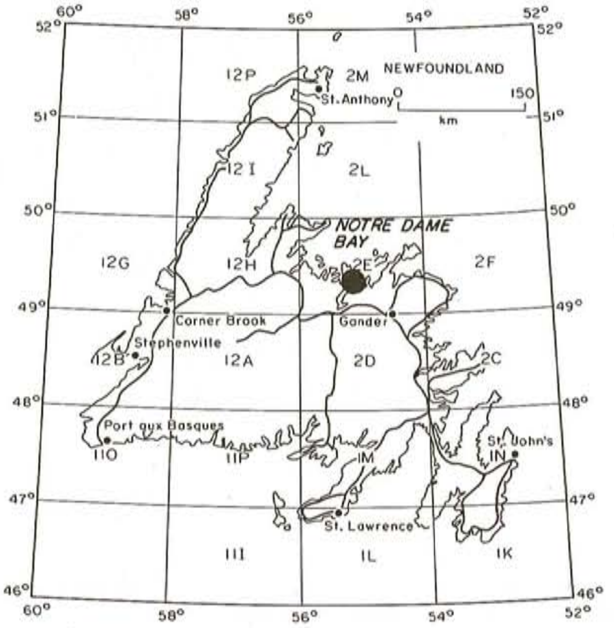

Figure 1. *Index map showing the location of the study area.*

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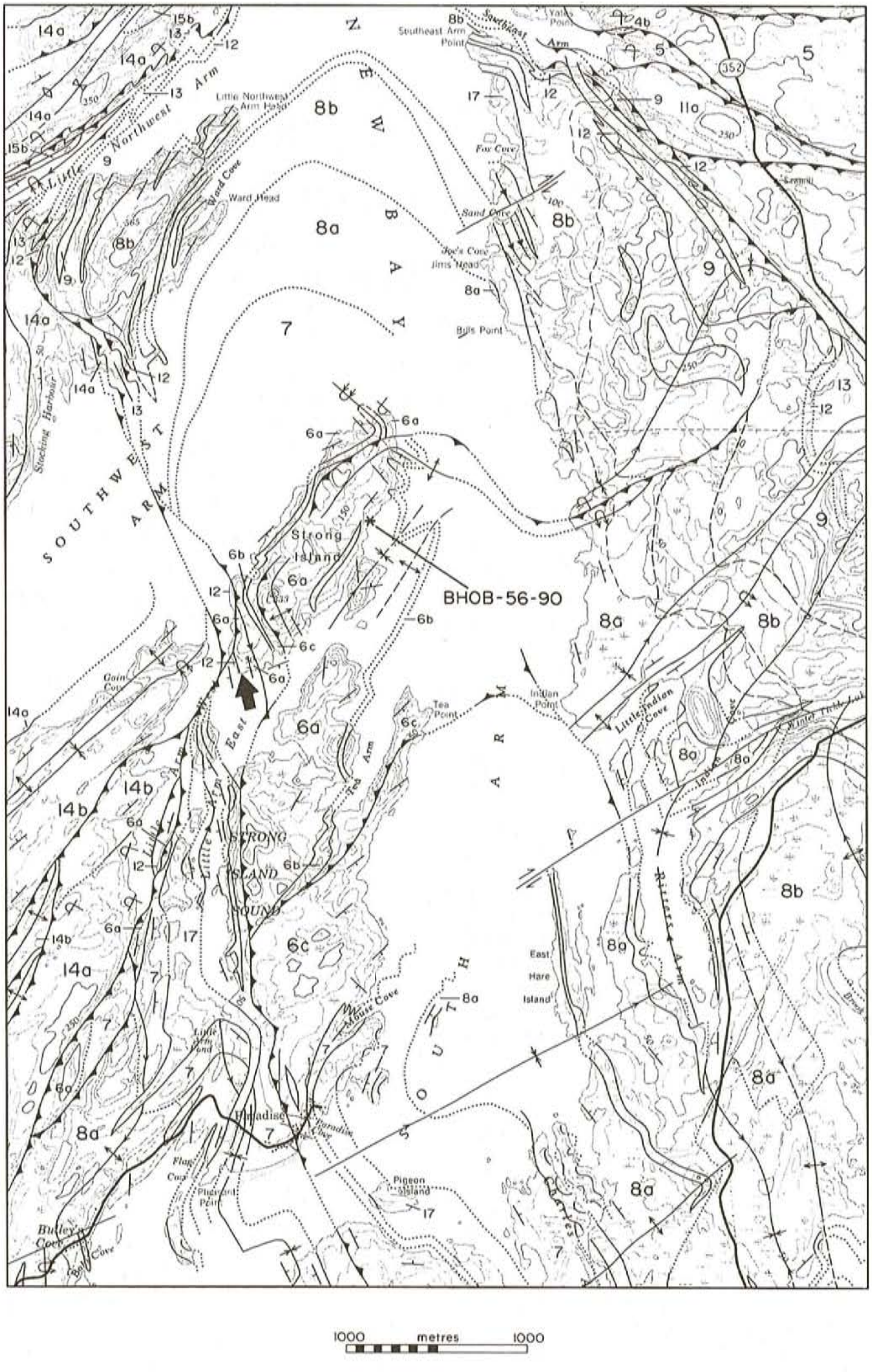


Figure 2. *Geological map of the New Bay area (modified part of the open file map by O'Brien, 1990). The bold arrow points to the contact of the Strong Island Chert with the Tea Arm Volcanics and the location of the type section (see Figure 3).*

LEGEND (for Figure 2)

SILURIAN OR DEVONIAN

SOUTH ARM GABBRO

17 *Dykes, sills and sheets of gabbro, diorite and associated diabase and mafic pegmatite*

ORDOVICIAN AND SILURIAN

GOLDSON CONGLOMERATE

15b *Poorly sorted and stratified, grey, feldspathic and siliceous wacke*

ORDOVICIAN

POINT LEAMINGTON GREYWACKE

14b *Dark grey, carbonaceous shale and light grey, quartzofeldspathic wacke; olistostrome having a black shale matrix*

14a *Interbedded grey shale and light grey, quartzofeldspathic wacke*

LAWRENCE HARBOUR SHALE

13 *Unseparated units of black carbonaceous shale; black pyritiferous siltstone having black shale partings; grey chert having bioturbated black argillite laminae*

STRONG ISLAND CHERT

12 *Interbedded, radiolarian chert, mafic pillow lavas and reddish-brown feldspathic wacke; minor, green and red, laminated argillite; rare felsic tuff*

COBBS ARM LIMESTONE

11a *Tectonized equivalents within melange belts of the Boones Point Complex*

ORDOVICIAN OR EARLIER

EXPLOITS GROUP

LAWRENCE HEAD VOLCANICS

9 *Mafic pillow lavas*

NEW BAY FORMATION

8b *Feldspathic wacke and grey argillite; minor conglomeratic to pebbly wacke*

8a *Thin-bedded grey shale; interbedded grey shale and sandy wacke; conglomeratic to pebbly wacke (lower part of unit)*

SAUNDERS COVE FORMATION

7 *Red chert; interbedded red and green, siliceous argillite; feldspathic wacke; minor conglomerate*

TEA ARM VOLCANICS

6c *Mafic pillow lavas, pillow breccia and agglomerate; minor feldspathic wacke and laminated argillite*

6b *Felsic tuff and agglomerate*

6a *Mafic pillow lavas*

COTTRELLS COVE GROUP

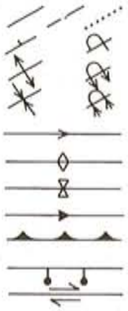
MOORES COVE FORMATION

5 *Thick-bedded to thin-bedded, reddish-brown feldspathic wacke; grey argillite*

FORTUNE HARBOUR FORMATION

4b *Dark green, mafic pillow lavas*

KEY



Geological boundary (defined, approximate, assumed)

Bedding (inclined, overturned)

Anticline (upright, overturned)

Syncline (upright, overturned)

Fold axial trace (plunge direction indicated)

Antiform

Synform

Sideways-closing fold

Thrust fault (teeth on upthrown side)

Normal fault (solid circle on downthrown side)

Strike-slip fault

NOTE

For the sake of simplicity, foliation symbols are purposefully omitted from all map units.

Numerical designations of rock formations are the same as in the Open File Map 90-124 by O'Brien (1990).

The Middle–Upper Ordovician Strong Island Chert and Lawrence Harbour Shale together form an overstep sequence onlapping various formations of the Exploits and Wild Bight groups (O'Brien, 1991). The Strong Island Chert is nonetheless in conformable contact with all these formations. The lack of a surface of erosional unconformity beneath the Strong Island Chert (the conformable contact with the Tea Arm Volcanics is marked with arrow in Figure 2) demonstrates that the considerable thickness changes of the constituents of the Exploits Group near the New Bay Fault Zone are an original depositional feature of the Early–Middle Ordovician sedimentation, rather than an artifact of later (Silurian) tectonic removal of parts of the succession (O'Brien, 1991).

The Strong Island Chert is composed of radiolarian cherts, siliceous shales, felsic tuffs (containing so far undated zircons and conodonts), black shales (containing early Llanvirn graptolites; see Williams *et al.*, *this volume*) and epiclastic sandstones and conglomerates (Figures 3 and 4). This remarkably heterogeneous sedimentary assemblage is interbedded with a number of pillowed and massive basalt flows. The type section of the Strong Island Chert is probably the most continuous, time-controlled and geochemically constrained record of Llanvirn–Llandeilo sedimentation and magmatism in central Newfoundland.

This report establishes sedimentological, geochemical and sediment–provenance constraints on the depositional setting of the Strong Island Chert. This information, as well as an understanding of the relationship with the underlying Exploits Group, is vital to drawing correlations between the Exploits and Wild Bight groups and deciphering the geology of the Exploits Subzone.

TYPE SECTION OF THE STRONG ISLAND CHERT

The type section of the Strong Island Chert is very well exposed on the southwestern shore of Strong Island, above a conformable contact with pillow lavas of the Tea Arm Volcanics (arrowed in Figure 2). The succession of north striking and near vertical sedimentary rocks and interbedded lavas is little deformed and a continuous section, 127 m thick, has been measured through the main portion of the Strong Island Chert (Figures 3 and 4). A pumpellyite–prehnite-facies mineral assemblage has been identified throughout the measured section. In this report, the rocks of the Strong Island Chert are subdivided into three main groups (Figure 4):

1) SILICEOUS DEPOSITS

The most characteristic rocks of the Strong Island Chert, constituting approximately 51 percent of the measured section, are brown-red and grey to green and turquoise-green radiolarian cherts together with associated siliceous brown-red, grey, green and black shales ('ribbon radiolarites', Plate 1a). Those cherts that occur directly above and close to the lavas have a distinctive turquoise colour, caused by abundant celadonite.

The grey and green cherts are commonly bioturbated. The burrows are seen in sections normal to the bedding as Fe-enriched, wispy mottles. The non-bioturbated cherts and shales show erosional bases, normal grading, parallel lamination and small-scale crosslamination that indicate deposition from low-density turbidity currents and from pelagic fallout. Early Llanvirn graptolites have been recovered from one black shale horizon (Figure 4; see Williams *et al.*, *this volume*). Parallel-laminated felsic tuffs and volcaniclastic sandy turbidites are a minor constituent of the siliceous deposits of the Strong Island Chert. Minor sedimentary slumping and bedding-parallel tectonic disruption (thinning–thickening of the section) is mostly confined to the assemblage of ribbon radiolarites.

2) VOLCANICLASTIC DEPOSITS

Volcaniclastic turbiditic sandstones and conglomerates and debris-flow conglomerates (or debrites) constitute around 19 percent of the measured section. The turbidites represent a broad spectrum of low- to high-density currents, some of which are transitional to debris flows. The debrites are matrix-supported, structureless and extremely poorly sorted. The gravel fraction of the volcaniclastic deposits is represented mainly by intrabasinal fragments of siliceous sediments that reach up to 50 cm in diameter. Some of the debris-flow beds display normal grading and have erosional bases, cutting up to 2 m deep into the underlying sediments (Figure 4).

One isolated debris-flow conglomerate consists of basalt clasts up to 30 cm in size set in a fine-grained siliceous matrix. This massive debrite is sharply underlain and overlain by the siliceous fine-grained deposits (Figure 4).

3) BASALT LAVAS

Seven massive and pillowed lava flows make up approximately 30 percent of the measured section. One massive unit consists of at least three amalgamated flows, separated locally by thin, fine-grained siliceous deposits and volcaniclastic sandstones (see the complementary section in Figure 4). The upper and lower contacts of the lavas with the sediments are sharp, with no evidence of brecciation or pyroclastic fragmentation. Locally, the underlying sediments have been squeezed and bulldozed by the overlying pillows (Plate 1b).

GEOCHEMICAL SIGNATURES OF THE LAVAS

Pillow lavas present a difficult problem in correlation for the field geologist because basalts that record distinctly different magmatic events may look very similar in the field. It has been shown in several areas of central Newfoundland that geochemical data from mafic volcanic rocks can provide important information about the nature and correlation of volcanic units, both on a local and regional scale (e.g., Swinden 1987; Swinden *et al.*, 1989; Dunning *et al.*, 1991; Swinden and Jenner, *this volume*). Of particular interest to this study are geochemical data for the Wild Bight Group

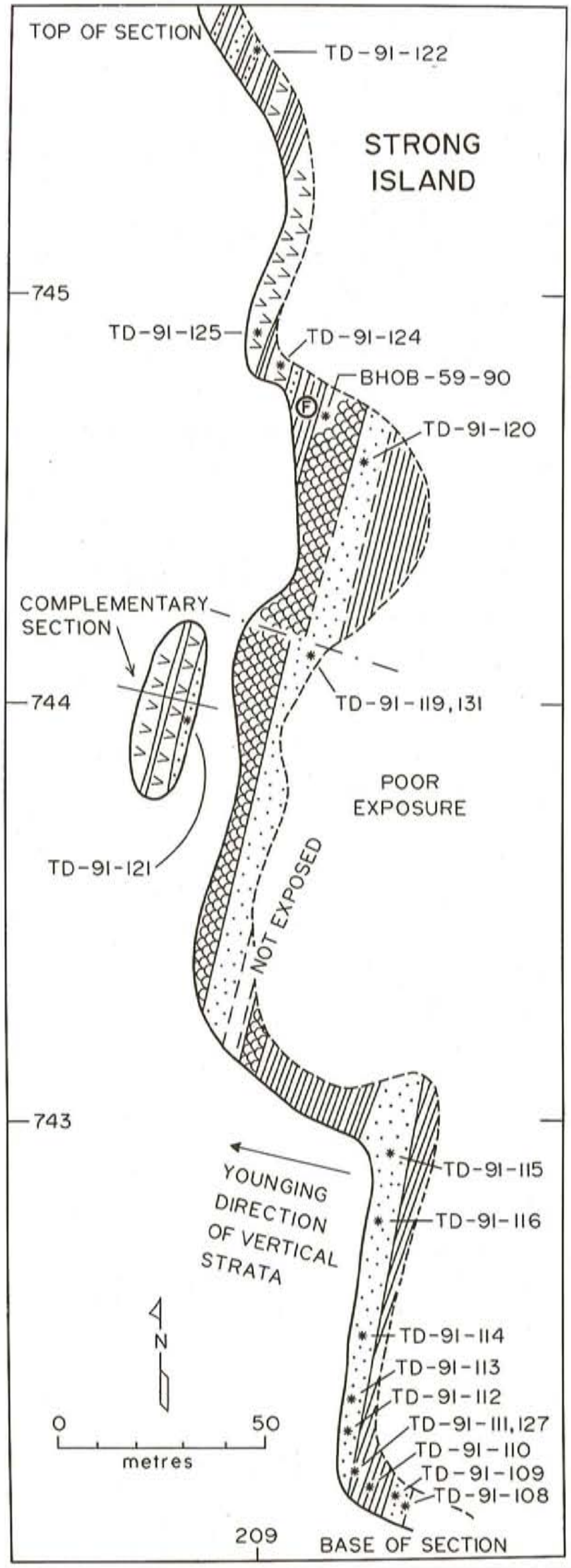
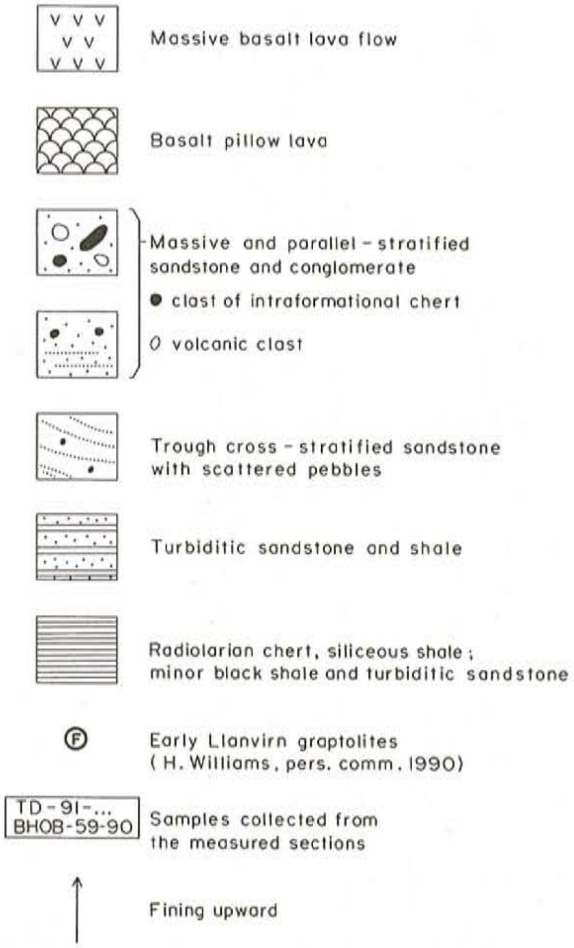


Figure 3. *Detailed map of the measured portion of the type section exposed on the southwestern shore of Strong Island.*



(Swinden, 1987; Swinden *et al.*, 1990), a probable correlative of the Exploits Group. Mafic volcanic rocks in the lower part of the Wild Bight Group have clear island-arc signatures (dominantly various types of island-arc tholeiites) whereas those in the upper part have non-arc geochemical signatures, and include mid-ocean ridge basalts (MORB) and tholeiitic and alkalic basalts of oceanic-island affinity. Swinden *et al.* (1990) have interpreted this stratigraphic relationship to record the rifting of an island arc (recorded by rocks with arc signatures) and the subsequent establishment of a mature back-arc basin (recorded by the rocks without arc-geochemical signatures).

In an effort to see if mafic volcanic rocks from the type section of the Strong Island Chert can be placed in the chemostratigraphic context of the Wild Bight Group, the analyses of four lavas are presented here. Samples BHOB-59-90, TD-91-124 and TD-91-125 are from lava flows interbedded with the sediments of the Strong Island Chert and listed in ascending stratigraphic order (Figure 4) whereas sample BHOB-56-90 is from the lavas of the Tea Arm Volcanics mapped as stratigraphically well below the Strong Island Chert (Figure 2). We have complete major and routine trace-element data for two samples, and trace-element data only for the other two (Table 1). These data were acquired

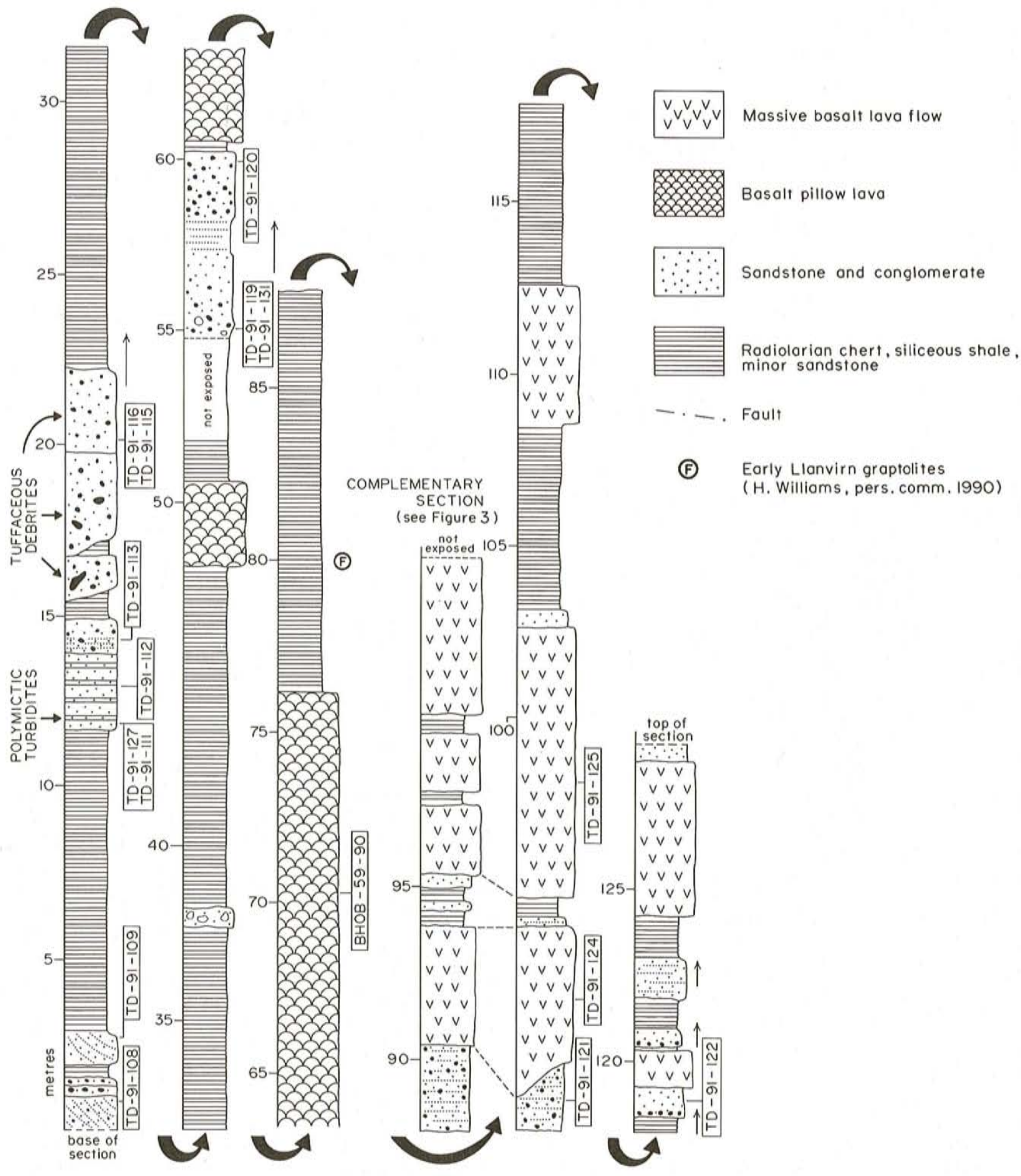


Figure 4. *Graphic log of the measured continuous section of the Strong Island Chert.*

by inductively coupled plasma–emission spectrometry (ICP-ES) in the Geological Survey Branch Laboratory using HF, $HClO_4$ and HCl digestion. In addition, we have a suite of high-field-strength element (HFSE) and rare earth-element (REE) data for two samples, analyzed by inductively coupled plasma–mass spectrometry (ICP-MS) at the Department of Earth Sciences, Memorial University. Techniques for accuracy and precision for the ICP-MS analyses are reported by Jenner *et al.* (1990).

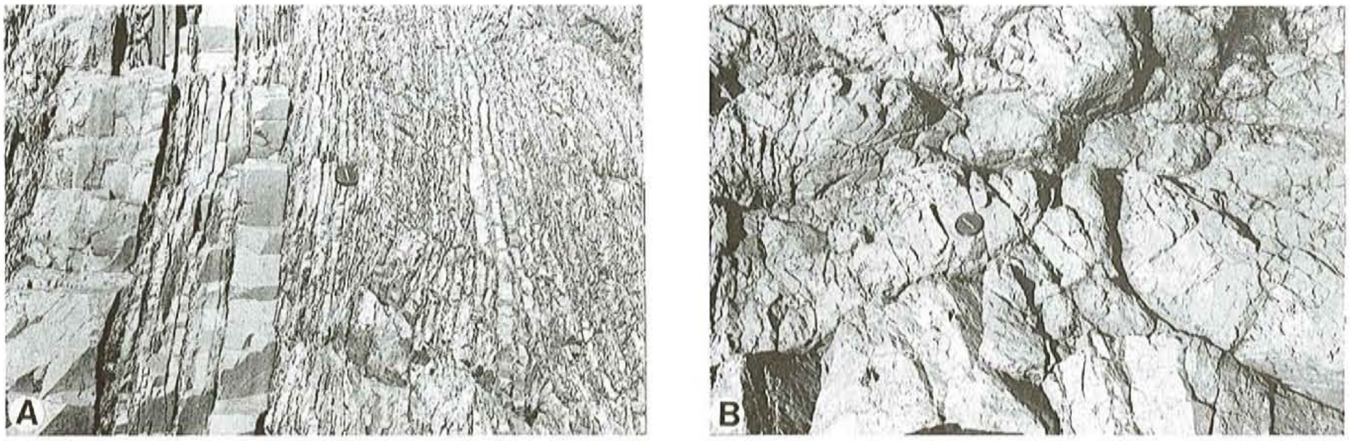


Plate 1. *(a) Ribbon radiolarites overlain by polymictic sandstone turbidites; the turbidites (samples TD-91-111, 127) contain cryptic fragments of phyllite, schist, quartzite detritus and accessory zircon, tourmaline, garnet, magnetite, chromite and epidote. Lens cap is 5 cm wide. (b) Pillow lavas squeezing underlying chert.*

The two samples for which there are both HFSE and REE data show a clear contrast in their geochemical signatures (Figure 5). The sample from the Tea Arm Volcanics (BHOB-56-90) displays light-rare-earth-element (LREE) depletion and a prominent negative Nb anomaly on a primitive mantle normalized basis. It is very similar to the Wild Bight Group Type A-II lavas (Swinden *et al.*, 1990), which are interpreted as island-arc tholeiites occurring in about the middle of the stratigraphy and below any lavas of non-arc affinity. Sample BHOB-59-90 from the Strong Island Chert, in contrast, is a strongly LREE-enriched basalt that lacks the arc-geochemical signature. It is similar to the Wild Bight Group Type N-I lavas, interpreted as mildly alkalic basalts that occur only in the upper part of the stratigraphic section. The geochemical dissimilarity of these samples is further emphasized by the disparity in ratios of more-incompatible to less incompatible elements, illustrated here on the Ti-V diagram (Figure 6). The relatively low Ti/V ratio of the Tea Arm Volcanics sample BHOB-56-90 is typical of arc basalts whereas the very high ratio of sample BHOB-59-90 is typical of alkalic basalts. In the two samples for which only trace-element data are available, the TiO_2 contents are a little high for most Wild Bight Group arc rocks but are not in themselves diagnostic. However, the ratios of more-incompatible to less-incompatible elements are higher than is typical of arc basalts (see Figure 6). These rocks appear to be geochemically similar to Type N-II basalts in the Wild Bight Group (Swinden *et al.*, 1990), which are interpreted to be tholeiites of oceanic-island affinity, although more complete data are required to confirm this interpretation. Such rocks characteristically occur together with alkalic basalts in the Wild Bight Group.

Although it is speculative to extrapolate too much from a limited analytical base, the geochemical data for the four samples from the southwestern shore of Strong Island do suggest some preliminary conclusions. The geochemical relationships are consistent with those observed in the Wild Bight Group. Probable oceanic-island tholeiites and alkalic basalts occur high in the section whereas island-arc thoeliites occur lower down. This provides some support to previous suggestions that the Wild Bight and Exploits groups are stratigraphically related. The association of alkalic basalts with high-TiO_2 tholeiites in the Strong Island Chert is similar to the association observed in the inferred back-arc section of the Wild Bight Group (Swinden *et al.*, 1990) and this, coupled with the stratigraphic correlations, suggests that the Strong Island Chert may have formed in the same back-arc basin as the upper part of the Wild Bight Group.

COMPOSITIONAL FEATURES OF THE VOLCANICLASTIC DEPOSITS

The volcaniclastic deposits of the Strong Island Chert carry additional information about the depositional context of the volcano-sedimentary succession. Reconnaissance fieldwork and preliminary petrographic investigations lead to a subdivision of the volcaniclastic deposits into four provenance categories. Except for one basalt-derived conglomerate, the volcaniclastic rocks have no direct affinity with the intercalated mafic lava flows.

The above mentioned *basalt-derived conglomerate* occurs in the lower portion of the measured section as a single, 0.5-m-thick debris-flow bed (Figure 4). It consists of angular basalt cobbles and pebbles surrounded by a fine-grained matrix.

Tuffaceous sandstones occur as turbidites and as the matrix material in both the debrites (TD-91-113, -115, -116; Figure 4) and the trough cross-stratified conglomerates (TD-91-108, -109; Figure 4). An abundance of highly vesicular, vitric, wispy fragments of predominantly pyroclastic origin (5.7 to 44.3 percent) suggests that there was little reworking of the tuffaceous sands. The vitric material is typically altered to chlorite, sphene, epidote, albite, prehnite and calcite, and represents mostly mafic and intermediate compositions. The tuffaceous sandstones contain abundant felsic detritus (felsitic texture) as well as fragments of andesite (identified through microlitic texture) and basalt (lathwork texture) (e.g.,

Table 1. Geochemical analyses of selected samples of basalts from the Strong Island Chert and Tea Arm Volcanics

	BHOB-56-90	BHOB-59-90	TD-91-124	TD-91-125
SiO_2	58.65	55.95	-	-
Al_2O_3	12.47	12.89	-	-
Fe_2O_3	1.98	1.47	-	-
FeO	9.45	10.36	-	-
MgO	4.26	4.67	-	-
CaO	6.36	5.14	-	-
Na_2O	4.27	5.18	-	-
K_2O	0.93	0.13	-	-
TiO_2	1.28	3.06	-	-
MnO	0.20	0.37	-	-
P_2O_5	0.16	0.79	-	-
LOI	7.85	4.79	-	-
TOTAL	99.08	99.22	-	-
Mg#	40.33	41.61	-	-
Cr	8	15	-	-
Ni	7	4	-	-
Sc	28	24	-	-
V	411	157	257	342
Ta	0.09	2.74	-	-
Nb	1.5	48	19	13
Hf	2.12	8.34	-	-
Zr	66	341	249	286
Y	24	44	38	47
Th	0.98	6	-	-
La	4.80	41.10	-	-
Ce	13.38	94.29	-	-
Pr	1.95	12.06	-	-
Nd	10.07	51.83	-	-
Sm	3.27	11.59	-	-
Eu	0.99	3.90	-	-
Gd	3.84	11.87	-	-
Tb	0.38	1.65	-	-
Dy	4.81	9.60	-	-
Ho	1.03	1.78	-	-
Er	3.11	4.74	-	-
Tm	0.44	0.64	-	-
Yb	3.20	4.02	-	-
Lu	0.46	0.58	-	-

– no data; major elements in wt %; trace elements in ppm

Dickinson, 1970; Ingersoll and Cavazza, 1991). The proportion of embayed volcanogenic quartz grains ranges from 8.7 to 44.0 percent (Table 2). Many volcanic rock fragments show some degree of Fe-oxide alteration dating from before the release as sediment into the basin.

The tuffaceous sandstones contain a significant proportion (4.0 to 9.0 percent, Table 2) of slightly corroded, sand-size fragments of brachiopods, trilobites, sponges, algae, crinoids, bryozoa and possibly corals.

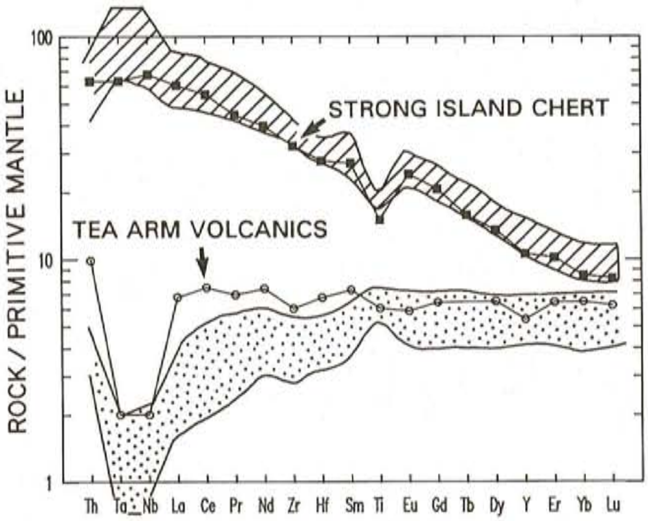


Figure 5. *Extended rare-earth plots for samples BHOB-56-90 (open circles) and BHOB-59-90 (closed squares). Note the prominent negative Nb and Ta and positive Th anomalies for BHOB-56-90, the characteristic island-arc geochemical signature (Swinden* et al., *1990). Stippled field is Type A-II, LREE-depleted island-arc tholeiites from the Wild Bight Group; hatched field is Type N-I alkalic basalts from the Wild Bight Group. Primitive mantle-normalization values are given by Swinden* et al. *(1990) and are approximately twice chondrite.*

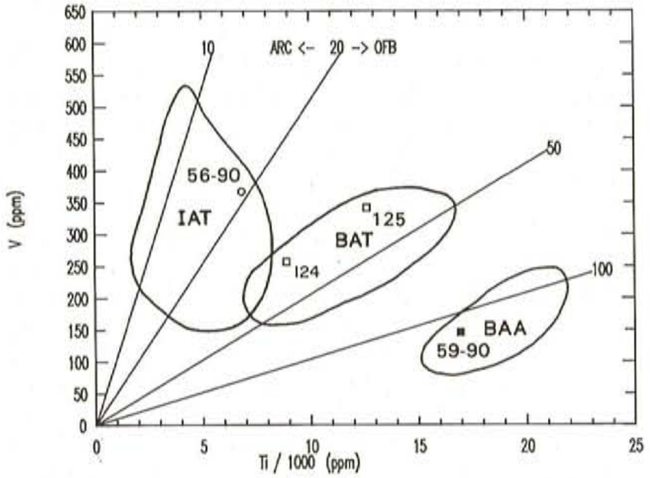


Figure 6. *The Ti-V diagram after Shervais (1982) illustrating the contrast in ratios of more-incompatible to less-incompatible elements in the four samples from Strong Island. Fields are from the Wild Bight Group (Swinden, 1987): IAT–island-arc tholeiites; BAT–tholeiites of back-arc origin, including MORB-like rocks and rocks of oceanic-island affinity; BAA–back-arc alkalic basalts.*

Reworked volcanogenic sandstones have been found in two turbidite beds (TD-91-119, -120 and -121). The sandstones are coarse grained, well sorted, grain-supported and contain only trace amounts of vitric detritus. A secondary cement

Table 2. Mineralogy of detrital constituents in the volcaniclastic deposits of the Strong Island Chert

Sample	TD-91-113	TD-91-115	TD-91-116	TD-91-120	TD-91-119	TD-91-121	TD-91-111
PETROFACIES	Tuffaceous Sandstones			Reworked Sandstones			Polymictic Sandstones
Monocrystalline quartz	21	13	8.7	44.0	47.3	36.1	29.7
Plagioclase	9.3	21.9	10.3	33.7	42.3	50.5	44.3
ROCK FRAGMENTS							
Felsic	28.0	15.0	17.3	11.7	4.0	8.0	15.3
Andesite	14.0	7.0	7.7	2.7	2.3	4.3	1.3
Basalt	6.0	12.6	4.7	2.0	1.0	0.3	0.3
Bioclasts	9.0	4.0	5.7	–	–	–	0.3
Quartz arenite	–	–	–	–	–	–	2.3
Other rock fragments	0.0	1.3[1]	–	–	–	0.7	0.7[1]
Vitric	11.0	6.6	44.3	5.7	1.3	–	–
Tuffaceous shale	0.3	18.3	1.3	0.3	0.6	–	–
ACCESSORY MINERAL GRAINS							
Zircon	tr	–	–	tr	tr	tr	tr
Tourmaline	–	–	–	–	–	–	tr
Garnet	–	–	–	–	–	–	tr
Hornblende	–	–	–	–	–	tr	–
Muscovite	–	–	–	–	–	tr	tr
Biotite	tr	tr	tr	tr	tr	tr	5.0
Epidote	tr	–	–	–	–	tr	tr
Chromite	–	–	–	–	–	tr	tr
Magnetite	tr	tr	tr	tr	tr	tr	tr
Ilmenite	tr	tr	–	–	–	–	–
Apatite	–	–	–	–	–	tr	tr
Matrix/cement	48.0	62.9	38.0	28.9	16.7	13.1	48.4

[1] phyllite–schist, tr–trace, – no data

of pumpellyite–prehnite mineral assemblage fills the pore spaces. Abundant volcanogenic quartz (36.1 to 47.3 percent) and albitized plagioclase (33.7 to 50.5 percent) are accompanied by mafic to felsic volcanic-rock fragments (Table 2).

Polymictic sandstones are restricted to thin turbidites in the lower part of the measured section (TD-91-111, -127; Plate 1a). The sandstones are poorly sorted but contain no vitric material. Apart from the ubiquitous volcanogenic detritus the polymict sandstones contain fragments of phyllite, phyllite-schist, quarzite and quartz arenite, as well as an unusually abundant detrital biotite. Although some of the biotite is present as phenocrysts in the felsic volcanic-rock fragments, there are common grains of kinked biotite, which might have been derived from metamorphic schists. Detrital zircon, tourmaline (occurring as a detrital constituent of the quartz arenite clasts), garnet, epidote, magnetite, chromite and apatite occur as accessory components (Table 2).

DEPOSITIONAL SETTING OF THE STRONG ISLAND CHERT

Despite the fact that the Deep Sea Drilling Project has failed to find a modern analog for the ancient biogenic cherts (e.g., Hein and Karl, 1983), there is an agreement among researchers that the ribbon radiolarites are deep-marine deposits that accumulated in small, arc-related, marginal basins (Jenkyns and Winterer, 1982; Hein and Karl, 1983; Jones and Murchey, 1986).

A substantial proportion of the Strong Island Chert probably formed in an oxic environment, assuming that the metabolism of the radiolarian ooze-burrowing organisms was based on oxygen. The abundance of corroded bioclastic material found in the tuffaceous debrites (e.g., TD-91-115, -116; Table 2) suggests that the basin floor was, at least temporarily, either above or not far below the carbonate compensation depth.

Examination of the association of radiolarian cherts with ophiolites appears most instructive when addressing the problem of depositional environment (Jenkyns and Winterer, 1982; Jones and Murchey, 1986) because many ophiolites represent relicts of arc-related basins. The geochemical data and the correlation with the Wild Bight Group strongly suggest that the volcano-sedimentary succession of the Strong Island Chert formed in a back-arc basin.

The paleotectonic model for the upper part of the Wild Bight Group takes into account a possibility of concurrently operating island-arc and back-arc volcanism (Swinden *et. al.*, 1990, p. 235). The tuffaceous debrites of the Strong Island Chert, which are dominated by sand-size felsic, andesitic and basaltic detritus having a significant pyroclastic component (samples TD-91-113, 115, -116; Figure 4, Table 2), must have been derived from an active volcanic arc (e.g., Klein, 1985; Nishimura *et al.*, 1991) rather then from the intercalated submarine basalts. The postulated island-arc volcanism would also explain the felsic tuff bands and the reworked, quartz-enriched, epiclastic sediments. The scoured bases of the tuffaceous debrites imply that the Strong Island Chert was relatively proximal to the site of the debris-flow mobilization (e.g., Pierson, 1980; Prior *et al.*, 1984).

Only one basalt debrite might have been derived from lava flows, similar to those present within the section. Geochemical signatures of the basalt clasts will be examined to confirm or reject such a provenance.

The emplacement of volcaniclastic debris flows and turbidites was most likely linked to a copious supply of pyroclastic ejecta from the island arc. The accumulation of such an arc-derived volcaniclastic aprons would have been essentially independent of relief and tectonic uplift (Klein, 1985; but see also Carey and Sigurdson, 1984).

Unlike the felsic tuffs in the Wild Bight Group (Swinden *et al.*, 1990), those in the Strong Island Chert contain abundant euhedral zircon. The inferred island-arc eruptions are, therefore, distinctly different from those recorded by the felsic tuffs of the Wild Bight Group.

Polymictic sandstone turbidites in the lower part of the section (TD-91-111, -127, Figure 4 and Plate 1A) contain fragments of phyllite-schist, quartzite and quartz arenite, accompanied by exceptionally abundant detrital biotite and trace garnet (Table 2). This exotic material may have been derived from rocks of continental affinity. The accessory chromite indicates a minor sediment input from an eroded ophiolite. Detritus of continental (Gander Zone) and ophiolitic (Gander River Complex) provenance has also been found in the late Arenig—early Llanvirn sandstone of the Weir's Pond Formation (basal unit of the Davidsville Group), which rests unconfomably on the ultramafic rocks of the Gander River Complex, and in the time-equivalent sandstone of the Indian Bay Big Pond Formation (O'Neill, 1991; Wonderley and Neuman, 1984; Boyce *et al.*, 1988; see also Dec and Colman-Sadd, 1990; Colman-Sadd *et al.*, *in press*).

CONCLUSIONS

Preliminary sedimentological and geochemical data suggest that the type section of the Strong Island Chert contains a record of Early Ordovician deep-water sedimentation in a back-arc basin that accompanied a coeval island-arc volcanism. The geochemical signatures of the basalt flows and pillow lavas from the Strong Island Chert and from the underlying Tea Arm Volcanics support a provisional correlation of the Exploits Group with the arc-to-back-arc succession of the Wild Bight Group.

The deposition of the felsic tuffs and the volcaniclastic debrites and turbidites was controlled by a sediment supply from an active island arc. Local polymictic sandstone turbidites are characterized by a metamorphic detritus of a possible continental provenance and detrital chromite derived from ophiolite.

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