UNCLOS IN THE ATLANTIC: AN UPDATE ON THE STATUS OF CANADA'S UNCLOS PROJECT OFF EASTERN CANADA

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SUMMARY

The Geological Survey of Canada and the Canadian Hydrographic Service have been working together to collect seismic and hydrographic data in Canada's Atlantic offshore to provide the scientific underpinning for an extended continental shelf (ECS) using the rules set out in the United Nations Convention on the Law of the Sea (UNCLOS). Even before ratification of UNCLOS in 2003, much scientific information had been collected that would prove to be useful for defining the outer limits of the ECS. Beginning in 2006, hydrographic and seismic surveys were conducted to supplement pre-existing data coverage and to better clarify critical elements in Canada's submission. With the 2013 submission deadline approaching, major survey activities have been completed. This paper provides an overview of the data collected and the surveys conducted under the auspices of the UNCLOS project and provides an update on the status of the project in eastern Canada.

1 INTRODUCTION

Canada ratified the United Nations Convention on the Law of the Sea (UNCLOS) on November 7 2003, setting in motion a ten-year time limit to determine and submit to the Commission on the Limits of the Continental Shelf (CLCS) the outer limits of the extended continental shelf (ECS). Three government departments, the Department of Foreign Affairs and International Trade (DFAIT), Natural Resources Canada (NRCan), and the Department of Fisheries and Oceans (DFO) share responsibilities for these efforts with numerous other departments and organizations contributing as needed.

For practical purposes, Canada's potential ECS area has been divided by region into independent project areas in the Atlantic and the Arctic (see Figure 1). The purpose of this paper is to provide an update on the status of the ECS project on Canada's Atlantic margin.

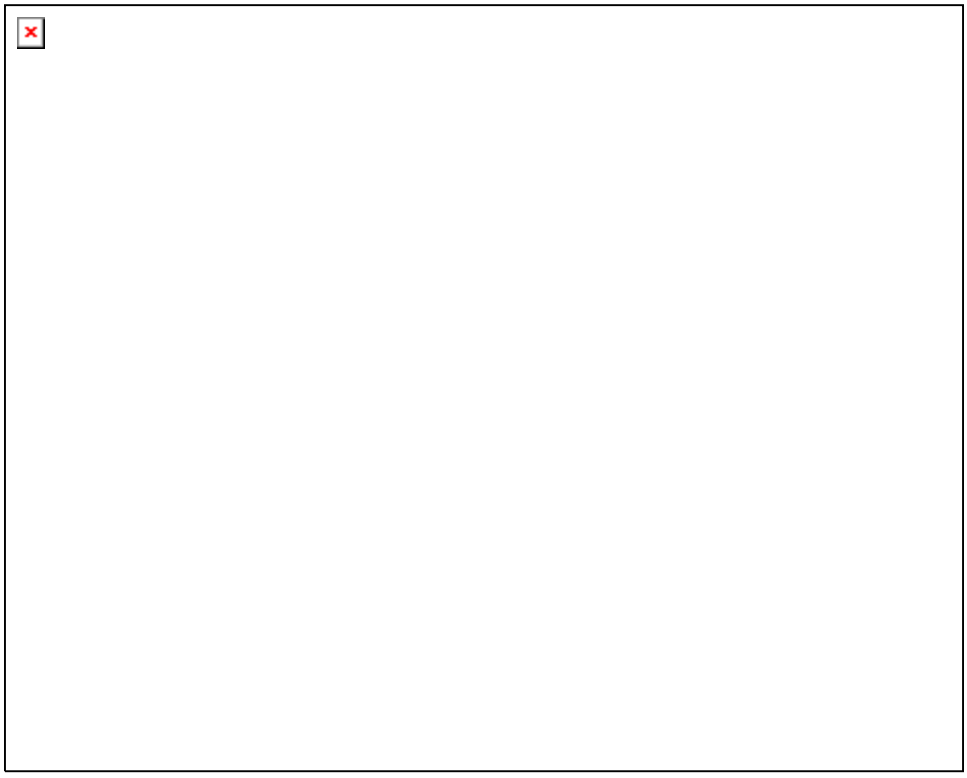

Figure 1: Canada's two ECS submission areas. Note that the coloured polygons are schematics to identify the approximate ECS potential and don't reflect the real ECS bounds.

2 PHYSIOGRAPHIC OVERVIEW

The Atlantic Canada margin is a broad continental shelf extending from the Davis Strait in the north to the American border in the south. Along its length, it varies in width from about 150 km at the narrowest point on the Labrador margin to over 500 km on the Grand Banks. Over much of this length there is a considerable area that can be defined as a potential ECS according to the UNCLOS definition (see Figure 1).

In geologic terms, it is a passive continental margin, having formed when stretching and thinning of the continental crust of the supercontinent Pangea led to rifting and the eventual formation of the Atlantic Ocean. The rifting progressed from south to north, beginning off the Scotian shelf around 180 Ma (millions of years before present) (Ebinger and Tucholke, 1988) and continuing north along the margin before finishing in the Labrador Sea, where seafloor spreading began around 62 Ma and ended about 35 Ma (Srivastava and Keen, 1990).

From a data collection and presentation standpoint, the margin has been divided into three regions (Figure 2):

- Scotian Shelf – The area directly off the Nova Scotia margin, extending from the international boundary with the USA in the south to the Laurentian Channel in the north. The seabed in the deep offshore here is referred to as the Sohm Abyssal Plain (SAP). Owing to Sable Island, the 200M EEZ, which forms the inner boundary of the ECS extends quite far seaward over the Sohm. In this region, Canada shares international boundaries with both France and the United States.

- Grand Banks – The region considered in the Grand Banks project area includes the southern Grand Banks margin beginning at the eastern edge of the Laurentian Channel, the deep-water rise extending from the tail of the Banks known as the Newfoundland Ridge, and around to the north, Flemish Cap and Orphan Knoll.

- Labrador Sea – The Labrador Sea project area extends from just north of Orphan Knoll to the shared boundary between Canada and Greenland in Davis Strait. In this area the Canadian ECS may overlap with a Greenland ECS.

This division of the margin provides obvious advantages for cartographic purposes, as larger scale maps can show more information, but it also divides the region up into sensible geographical regions for analysis. This division is being used internally by the UNCLOS team when analysing, portraying, and documenting the ECS results.

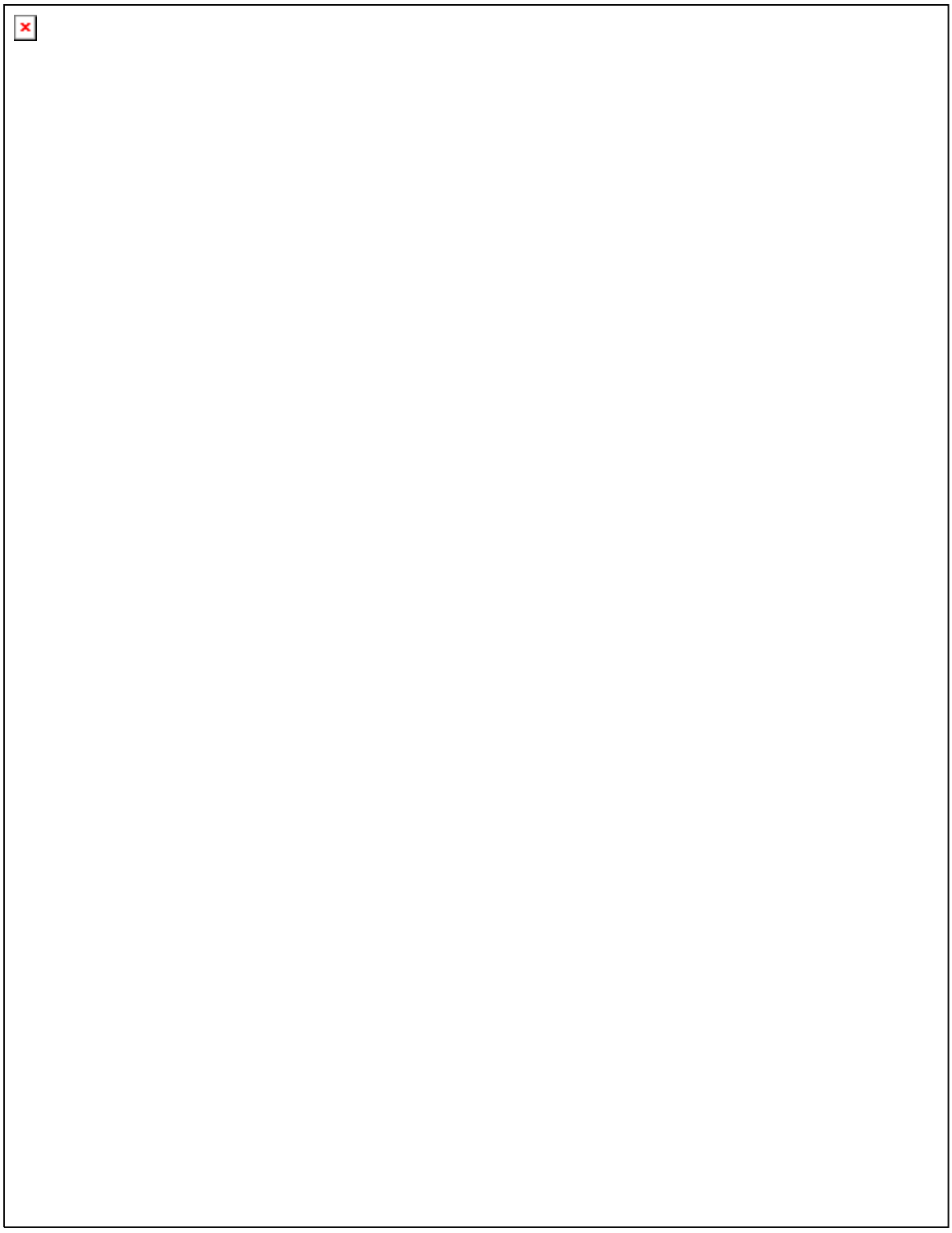

Figure 2: The Atlantic margin divided into three project regions.

3 DATA

Article 76 paragraph 4 (United Nations, 1982) defines two formulae by which the coastal State may identify the ECS;

- The sediment thickness formula:

4(a)(i) a line delineated in accordance with paragraph 7 by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; or

- The foot of slope formula:

4(a)(ii) a line delineated in accordance with paragraph 7 by reference to fixed points not more than 60 nautical miles from the foot of the continental slope.

These paragraphs essentially lay out the physical data required for the establishment of the outer edge of the ECS: bathymetry for the foot of slope and bathymetry and seismic reflection for sediment thickness.

The Grand Banks and the shallow water shelf off Labrador and Nova Scotia have been mapped by the Canadian Hydrographic Service and many areas are well-studied by at least regional petroleum-related seismic programs. The deeper waters of the lower slope and rise however, are much less well known; they do not pose significant navigation risks and their depths and geology make them less attractive economic targets than the shelves and upper slope at the present time. Thus, the central challenge for the ECS program is that the areas that are potentially within the new extended continental shelf coincide with areas that are the least well studied on the margin.

3.1 HYDROGRAPHY

Scientific work and planning related to UNCLOS had begun long before Canada's ratification in 2003. The Canadian Hydrographic Service (CHS) with the Geological Survey of Canada (GSC), performed deep-water single beam mapping and geophysical operations in the Labrador Sea from the 60's to the 80's and off the Scotian Shelf in the 80's and 90's as part of their mandate to map the offshore. Early thinking on the potential shape and dimensions of Canada's ECS were largely based on work performed during these cruises. These views are summarized in Macnab (1994). Bathymetric data collected on these surveys has been archived by CHS in field sheets and in the case of the data in the Scotian Shelf region, a *collector sheet*. The collector sheet survey lines and the boundaries of the field sheets consulted by this project are shown in Figure 3.

After ratification, a survey of existing single- and multibeam sonar data from agencies other than CHS was undertaken. Although industry's search for resources has not ventured (yet!) into the deep waters of the lower slope and rise, universities, government scientific agencies, and other scientific organizations have worked in these waters. Much of this data has been collected and made freely available at the National Geophysical Data Center (NGDC), http://www.ngdc.noaa.gov/mgg/bathymetry/relief.html. Processed multibeam data from this site, shown in pale green in Figure 3, was down-loaded in MB-System format and exported into ASCII sounding files and added to the bathymetric compilation. Single beam sonar data acquired from international sources is shown in pale yellow in the same figure.

In 2009 and 2010, NRCan and DFO participated in a Northwest Atlantic Fisheries Organization (NAFO) survey of the shelf break and upper slope around the outer Grand Banks and Flemish Cap. The mission, commissioned by NAFO and called NEREIDA, aimed to identify vulnerable marine ecosystems in this important area. One of the products of the survey was a high-resolution multibeam dataset, which has been added to the compilation.

Two additional deep-water multibeam surveys have been conducted under the banner of the UNCLOS program. In 2007, CHS and contracted a deep-water survey consisting of a series of down-dip profiles from the shelf onto the rise, the 2500 m isobath, and a denser network of survey lines over the Laurentian Fan for the GSC. In addition to this, a series of multibeam lines were collected during the summer of 2009 in the Labrador Sea as part of a multichannel seismic (MCS) program discussed in the next section. The coverage of these two surveys can be seen in Figure 3 in pink.

All surveys used in the ECS project are summarized in Table 1.

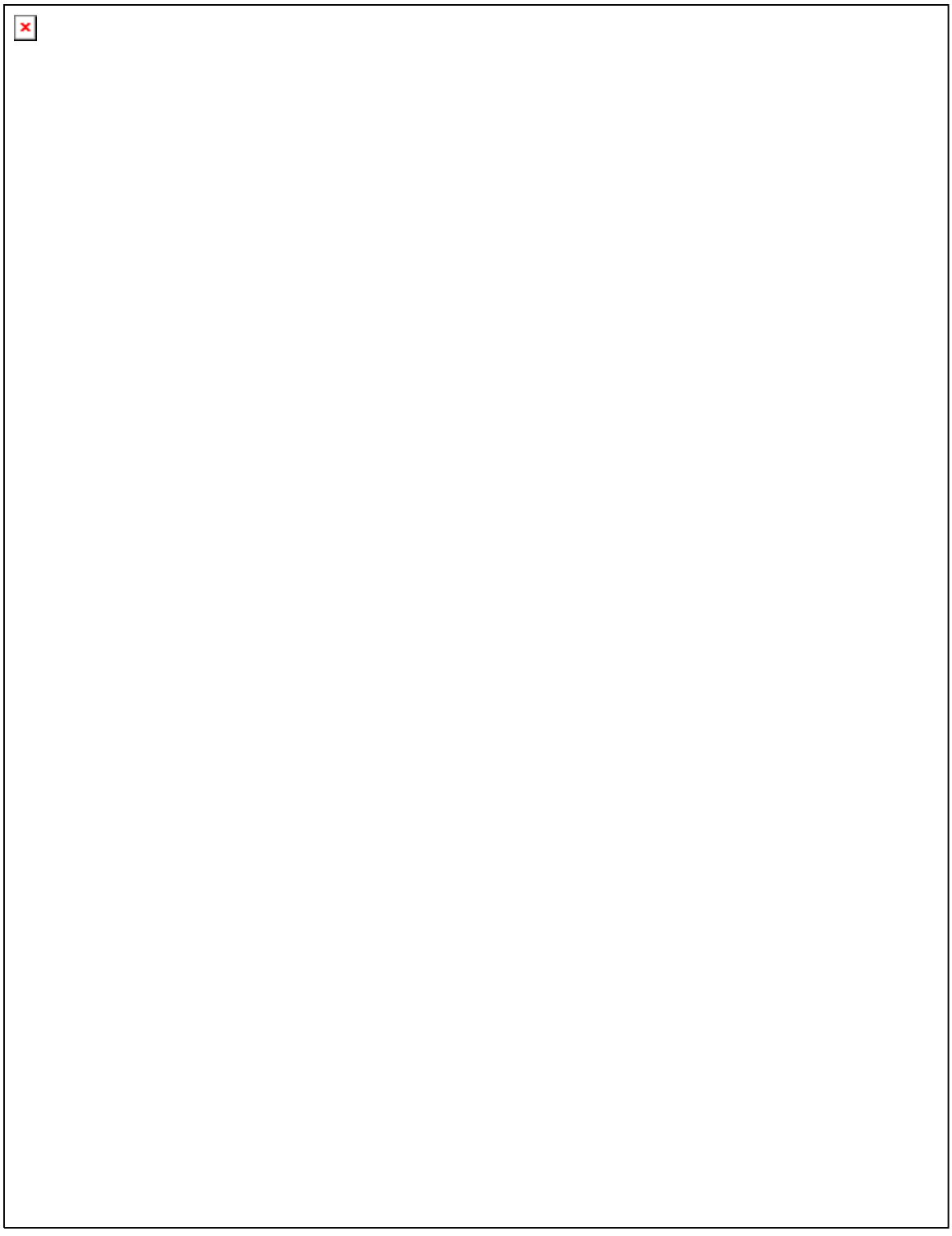

Figure 3: Bathymetric data used on the Atlantic margin.

Year	Region	Geographic target	Data collected	Agency
to 2003	All		Single beam	CHS
Various	All		Multibeam	Various - NGDC
1977	Labrador Sea	North	Multichannel seismic	BGR
1979	Scotian Shelf	Sohm Abyssal Plain	Multichannel seismic	LDEO
1984	Grand Banks	Eastern Grand Banks and Newfoundland Ridge	Multichannel seismic	UTIG
1988	Scotian Shelf	Sohm Abyssal Plain	Multichannel seismic	GSC
1989	Scotian Shelf	Sohm Abyssal Plain	Multichannel seismic	GSC
1989	Scotian Shelf	Sohm Abyssal Plain	Multichannel seismic	BGR
1990	Labrador Sea	Central	Multichannel seismic	GSC
1992	Grand Banks	Flemish Cap	Multichannel seismic	GSC
2003	Labrador Sea	Central	Multichannel seismic	GEUS
2006	Labrador Sea	Central	Multichannel seismic	GEUS
2006	All	All	Multibeam	DFO
2007	Scotian Shelf	Sohm Abyssal Plain	Multichannel seismic	GSC
2009	Labrador Sea	Southern	Multichannel seismic	GSC
2009	Labrador Sea	Southern	Multibeam	GSC
2009	Grand Banks	Upper/mid slope	Multibeam	NAFO (Nereida)
2010	Grand Banks	Upper/mid slope	Multibeam	NAFO (Nereida)

Table 1: Summary of data used for the Atlantic margin ECS project. Acronyms used in table: (GSC) – Geological Survey of Canada, (DFO) – Department of Fisheries and Oceans, (NAFO) – Northwest Atlantic Fisheries Organization, (GEUS) – Geological Survey of Denmark and Greenland, (BGR) – Federal Institute for Geosciences and Natural Resources (Germany), (NGDC) – National Geophysical Data Centre, (UTIG) – University of Texas Institute for Geophysics, (LDEO) – Lamont-Doherty Earth Observatory.

3.2 SEISMIC

The situation with the seismic component of the ECS program is similar to that of the hydrographic in that some data was available in the areas of interest before the program, but much had to be collected to fill holes. NRCan had collected some of this data for

scientific purposes prior to ratification, so it was already on hand. Other datasets had to be acquired by the ECS project (see Figure 4).

In 1977, the German Federal Institute for Geosciences and Natural Resources (BGR) conducted a MCS program across the Labrador Sea, traversing the sea from margin to margin several times. This data was supplemented in 1990 by a series of three lines shot by the GSC through a program called the Frontier Geoscience Project (FGP) that together form a continuous transect of the Labrador Sea. Before seismic acquisition in the last decade specifically for ECS purposes, these lines were the only data available in the deepest section of the northern Labrador Sea.

In 2003 and 2006, the Geological Survey of Denmark and Greenland (GEUS) acquired MCS lines in the central and southern Labrador Sea to identify the extent of the Greenland ECS. Through a data-sharing agreement between the Canadian and Danish governments, these data have been made available to the Canadian ECS project. These data were supplemented and extended further south in 2009 with lines acquired by the GSC.

Existing MCS programs around the Grand Banks have yielded enough information that no additional data acquisition has been necessary. In 1984, a network of MCS lines was acquired by the Lamont Doherty Earth Observatory (LDEO) over the north-western end of Newfoundland Ridge and off the eastern edge of the Grand Banks. The following year, an FGP line was acquired from the central Grand Banks, north-east over Flemish Cap out onto the rise beyond. Then, in 1992, in collaboration with the French Institut français pour l'exploitation de la mer (IFREMER), the GSC acquired MCS lines around the south-eastern and north-eastern flanks of Flemish Cap.

On the Scotian margin, only a relatively small amount of MCS data existed over the area of interest, though several programs provided useful information nearby. A 1979 LDEO program acquired MCS lines on the central and northern Sohm Abyssal Plain. Later, in 1988 and 1989, MCS lines shot by the GSC combined with a 1989 program by BGR to create two long cross-sections from the shelf edge out onto the SAP. In 2007, a GSC seismic project collected a network of seismic lines (nearly 7,000 km) across the New England seamount chain and over the heart of the SAP.

Serving a similar role to the National Geophysical Data Center, the University of Texas Institute of Geophysics (UTIG) has created a database containing a considerable amount of academic seismic reflection data (http://www.ig.utexas.edu/sdc/). Both of the LDEO surveys mentioned cited in this section were acquired from this website (red lines in Figure 4).

In addition to these data, some one million kilometres of industry multichannel seismic, collected mainly on the shelf and slope, are available and have been used to provide stratigraphic control, but have not been used directly by the ECS program for establishing outer limit points.

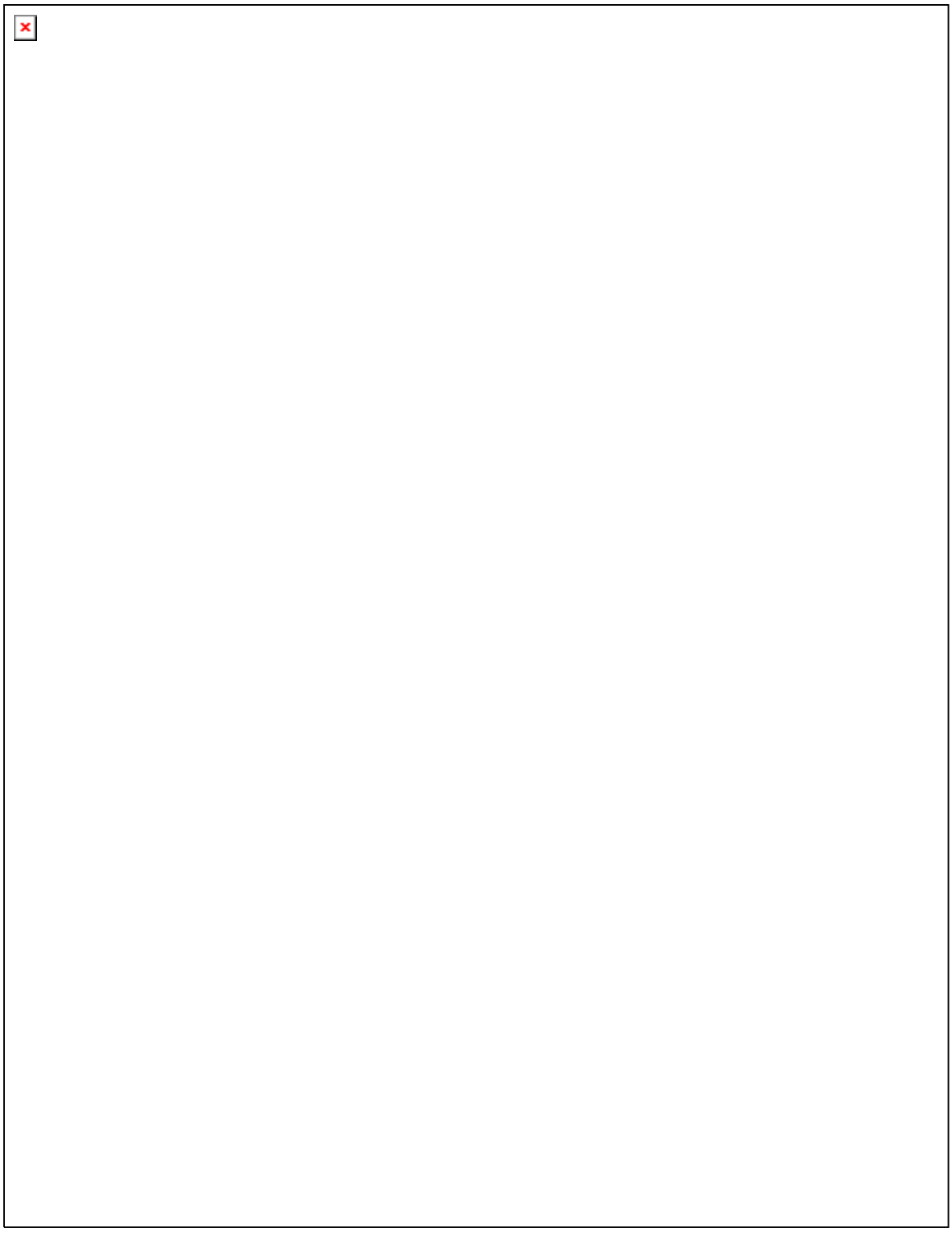

Figure 4: Multichannel seismic reflection surveys used by the ECS program on the Atlantic margin, coloured by originating agency.

4 PROJECT STATUS

Less than two years remain before Canada must submit its ECS proposal to the United Nations. As all major data collection operations are completed, it is now time to focus on calculating the final outer limits of the ECS and preparing the submission to the CLCS in New York.

As of the time of writing (Spring 2012), with close collaboration among DFAIT, DFO, and NRCan, large sections of the Atlantic submission have been completed to the draft stage. The team is on target to have a final draft ready by the end of 2012, leaving time in the following year for editing and correction.

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BIOGRAPHICAL NOTES

Kevin DesRoches is a geologist with the Geological Survey of Canada, based at the Bedford Institute of Oceanography in Dartmouth, NS. He has been working on the UNCLOS extended continental shelf program since 2005. Before coming to the GSC Kevin did contract work with the Canadian Hydrographic Service on various projects including the early stage work on UNCLOS.

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