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PART 3

INVITED PRESENTATIONS

Canadian Hydrographic Service
Beaufort Sea Activities

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1.0 Background

Hydrographic efforts in the Beaufort Sea began in the 1950's when the U.S. ship "Storis" conducted surveys in support of the DEW Line Project. During the early 1960's, several CHS personnel accompanied both U.S. and Canadian Coast Guard icebreakers operating in the area. Soundings taken on the vessel's track were recorded at every opportunity, but this sort of data gathering falls far short of what is required to make a completed and accurate chart. Further endeavours included spot soundings taken through the ice during the winter and finally, some small rigorous surveys were undertaken from the 65 foot "Richardson" from 1962 to 1969. The Richardson remained in Tuktoyaktuk for most of these winters.

More extensive surveys were made in the 1970's with the four-launch ship "Parizeau". Each July, the ship made the passage from Victoria through the Bering Sea and fought the ice along Alaska's north slope to arrive in the Beaufort Sea survey areas near the first of August. Six or seven weeks of intensive work followed which the launches sounded 16 hours per day. Often the Atlantic Geoscience Centre would undertake a limited program at the end of the season before the Parizeau began her southern mid-September passage.

Hydrographic ships "Hudson" and "Baffin" have worked in the Beaufort, the most notable being the first survey of a portion of the shipping corridor in 1981. A number of other surveys were carried out from the chartered vessels "Pandora" and "Polar Circle" in the 1970's and 1980's and in many cases, there was a multi-disciplinary aspect to these projects. A contract was let in 1984 to a private survey company, Cansite Surveys, using the Banksland Surveyor for work along the Yukon coast from the 141st meridian to Herschel Island. the new government ship "Tully" has spent three seasons in the Beaufort since 1985.

2.0 Survey Characteristics

All of these surveys presented some problems for the CHS. The cost of operating in the Beaufort is high. Ships based in Victoria spent a month or more in transit to and from the survey area and only a limited amount of useful data was gathered on these passages. Ice in the survey area was frequently encountered and on some days, the seas were too rough for launch sounding.

Positioning systems, including Decca, Minifix, Argo and Syledis, were expensive to deploy and recover and in the early years before satellite positioning, there were sizeable distortions in the geodetic framework. Positioning accuracy of some of these systems was always a source of worry.

A characteristic of most of this work is the limited detail resulting from the wide line spacing associated with 100,000 scale resource mapping. Not until the 1981 corridor survey did the line spacing decrease to 100 m. Most of the recent work has been completed with this density. The line spacing, while suitable for charting and reconnaissance, will likely not be sufficient for pipeline or artificial island construction.

Accurate tidal data throughout the Beaufort is difficult to come by. The rule used in the first surveys was to substract two feet from all the soundings since little was known about the datums. Later, a permanent gauge was installed in Tuk Harbour and tides were extrapolated into the survey area. More recently, temporary gauges were installed closer to the survey areas and this data was used for the reduction of soundings and comparisons to the Tuk gauge data.

Coastline data shown on most charts throughout the Beaufort Sea comes from the NTS series of maps. Most of these maps were compiled from 1950's aerial photography and the effects of wind, seas and ice have been responsible for substantial changes in the last 30 or 40 years. More up-to-date photography is now becoming available and contracts have been let to Stewart Weir; however, it will not be incorporated until new chart editions are published.

3.0 New Methods and Technology

The short period of operation, expense of deploying positioning systems and uncertainty of ice coverage, among other factors, led the Hydrographic Service to explore other cost effective methods of acquiring soundings.

In the early 1960's, some data was gathered with hovercraft. This platform worked well in shallow waters, but was limited by fuel consumption. Stern tow fish, similar to mine sweeping gear, were deployed in 1983 with the Polar Circle. These fish, fitted with transducers and a positioning beacon, permitted three profiles to be gathered at once. Unfortunately, the cables frayed prematurely and the system was not an entire success.

3.1 Larsen

A system, not used in the Beaufort but showing great promise in other parts of the arctic where the water is not muddied by the Mackenzie River, is the Larsen system. This hardware operated by Terra Surveys consists of an airborne laser which produces pulses in the blue-green and infrared spectrums. The blue-green light penetrates the water and is reflected off the bottom, while the infrared is reflected from the surface. Depths can be calculated from the time difference of the returning pulses. Soundings can be obtained to 50 m or more in ideal conditions. The laser, currently operating at 20 Hz, provides a swath of nine spot soundings 25 to 30 m apart. Photogrammetric work is often carried out from the same aircraft.

3.2 TIBS

Another system, being used in its first production survey in Pelly Bay this winter, is TIBS, an acronym for "Through the Ice Bathymeter System". This equipment was developed in part by Geotech Limited in Markham, Ontario from techniques used in the mining industry for locating ore bodies. The electromagnetic system measures the amplitude and phase shift of a secondary magnetic field induced by transmitting coils in the bottom sediment. Translating these measurements to soundings is not straightforward and much of the development effort has focused on this data processing aspect. The equipment, which includes a large bird slung from an A-Star helicopter, is flown over the ice at 60 knots and produces continuous profiles. Sounding accuracies decrease with depth; however, acoustic quality can usually be realized in depths up to 50 m. Water clarity, bottom reflectivity and cloud cover do not affect the system. Depths to 100 m can be measured but, as with the Larsen system, ground truthing and calibration are extremely important.

3.3 Dolphin

Dolphin (Deep Ocean Logging Platform with Hydrographic Instrumentation and Navigation) is a semi-submersible intended for bathymetric surveying in off-shore waters. It is unmanned and remote controlled, designed to operate in up to 4 m swells at speeds

up to 15 knots. With a number of these vehicles abreast of a mother ship, a swath of dat can be gathered with multi-beam echo sounders. The hazards of people working in small boats is avoided as well.

These vehicles, designed and built by International Submarine Engineering in Port Moody, B.C., are controlled through a radio link to the mother ship. The quality of the acoustic data is first rate and since the transducers are mounted in a semi-submersible heave is less of a problem. Applications for this system include mine countermeasures and route surveys for cables and pipelines, as well as general bathymetry. A major hurdle with the Dolphin is a ship handling system that can be used for easy deployment and recovery. Recently, a Newfoundland company, Georesources, has been contracted to carry out further development.

3.4 Global Positioning System (GPS)

The Global Positioning System is having a profound effect on the entire Hydrographic Service. Virtually every platform used to acquire data can now be positioned to better than 5 m in real time using differential techniques. The high costs of deploying radio positioning are avoided and the flexibility of choosing ice free survey areas is extremely attractive. Receivers are being purchased currently and work is now underway building radio links for the application of differential corrections.

The CHS has been following the progress of GPS over the last ten years. A number of contracts have been let to Nortech Surveys Ltd. for R & D in hydrographic kinematic applications. One of the deliverables of this work was software known as Hydrostar, whose function it is to take any receiver's signals and compute positions. This generic software has become the tool to compare receiver performance, determine differential corrections and log raw data. Other software capabilities include real-time error estimates and heave compensation.

3.5 Swath Sounders

Surveying in the Beaufort Sea is complicated by the ice pack and shallow water. Traditional methods are slow and generally lead to less than 3% of the bottom being ensonified. To maximize the benefit of the multi-disciplinary approach, total bottom coverage is desirable since this allows profile data from oceanographic and geophysical measurements to be interpolated with the greatest degree of certainty. Security of navigation in hazardous areas is, of course, increased with complete bottom coverage. There have been no CHS swath sounding surveys in the Beaufort to date.

Four Simrad EM100 sounders have been purchased by the CHS and are all currently deployed on east coast vessels. These systems operate at 95 kHz, giving maximum slant ranges to 550 m. Fans of 32 beams can be stabilized for ship motions and the swath widths can be up to 1.7 times the depth.

One characteristic of all swath sounders is the large volume of data they can produce in comparatively short periods of time. Powerful computers are needed to process and store the data and although a number of production surveys have been completed with these instruments, data management and processing techniques are still under development.

4.0 Trends in the Hydrographic Service

Fisheries and Oceans, Pacific Region, lost one of their major vessels, the Parizeau, to the east coast. Consequently, ship time is scarce and the CHS surveys must compete for vessel usage with all the other marine science projects on this coast.

As a result of the Brander-Smith Inquiry, electronic charts have taken on a greater significance in the CHS. The vast majority of our data exists on paper and a large job lies ahead to get this data into digital form and build an infrastructure to deal with it. About 50% of the Beaufort surveys exist in digital form.

There is a general move into the digital domain throughout the CHS. The lack of equipment and software tailored to hydrographic needs has made this a long drawn out process. Almost all survey data is now acquired and processed digitally and charts are directly constructed from these files with Universal Systems CARIS software.

5.0 Outlook for CHS Beaufort Sea Involvement

The Hydrographic Service's first priority is to provide adequate charting for safe navigation throughout Canadian waters. A substantial survey effort was made in the Beaufort Sea in the 1970's and 1980's when there was a distinct possibility that world oil prices would push the Beaufort resources into production and large oil tankers of the famed "Manhatten"'s size would be plying these waters. Since that time, there has been a reduction in Beaufort activity and the CHS has shifted their focus to other portions of the southern Northwest Passage.

The most recent work is a Larsen survey of Dolphin and Union Strait and small surveys conducted in conjunction with the Coast Guard for a suggested barge landing site in the Hamlet of Coppermine and site plan for Echo Bay Mines. These last surveys were funded by the clients.

Surveys of Victoria and James Ross Strait have a high priority for the future.