

Safer Charting for Antarctic Navigation

Compiling Antarctic charts for New Zealand

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Introduction

Multi-beam survey data, ancient track soundings, satellite imagery and dated topographic maps, sensational photography provide for an interesting mix of source data when compiling charts in Antarctica. Data holes, spot soundings protection zones and a sense of the unknown, not to mention the liability issues, add to the complexity of depicting reality to a myriad of potential chart users in a fairly inhospitable region of the Earth. Five new charts of the Western Ross Sea region of Antarctica have been compiled by HSA Systems Ltd. utilising the 2001 hydrographic surveys conducted by the NZ-based NIWA organisation (refer to the March 2002 edition of Hydro INTERNATIONAL). NIWA is currently in the region to fill in data holes and extend the coverage.

HSA Systems Ltd, under contract to Land Information New Zealand (LINZ) has compiled the first large/medium scale Antarctic charts for New Zealand. By June 2004, five charts will have been published. Compilation using data from numerous sources of varying quality posed an interesting challenge for depicting “reality” to the mariner.

New Zealand’s Hydrographic Obligations

New Zealand has several existing hydrographic and bathymetric obligations that have been committed to through international agreements, specific International Hydrographic Organisation (IHO) agreements, tripartite arrangements with military allies or previous relationships with the British Admiralty and the Royal Australian Navy Hydrographic Service. These obligations include:

- Coverage of the Exclusive Economic Zone (EEZ);
- Coverage of New Zealand’s search and rescue area;
- Coverage of New Zealand’s radio navigation warnings (NAVAREA XIV);
- Area of hydrographic charting responsibility;
- Area of bathymetric (GEBCO) charting responsibility.

The hydrographic charts published by LINZ support navigation, the safety of mariners, environmental protection, resource management, emergency services, search and rescue operations, territorial integrity and regional security.

Antarctica’s Significance

Antarctica is a regulator of the world's climate and is a natural scientific laboratory, thus providing keys to global environmental processes and insights into extra-terrestrial processes. It contains 90% of the world's ice, and locks up a great proportion of the world's freshwater. Effective stewardship and wise management of Antarctica are in the global interest.

New Zealand has exercised jurisdiction in the Ross Dependency in Antarctica since 1923. Following signature of the Antarctic Treaty in December 1959, New Zealand assumed the wide range of obligations in that Treaty and embarked upon a substantial and continuing programme of scientific research in the Ross Dependency.

In addition to scientific discovery, tourism is a relatively recent activity in the Ross Sea region. The numbers of expeditions and tourists have been relatively small compared to the Antarctic Peninsular region. Activities have included ship-based or airborne commercial tourism, adventure tourism (yachting, mountaineering or polar walks) and other non-governmental expeditions (e.g. Greenpeace). During 2001 in the Ross Sea region, tourism constituted 5 vessels, 8 expeditions and 510 passengers.

The environmental effects of a maritime casualty could be serious, especially if it resulted in an oil spill. The potential will always exist in Antarctic waters for ships to ground or be holed by ice. There are two records of sinkings in the Ross Sea region in the last 20 years. With most of the region's coastal areas inadequately surveyed, the risk of grounding or vessels being holed is very real. It is not uncommon for ships to locate previously unknown reefs and rocks – sometimes by physical contact. Also islands and reefs have been found to be incorrectly positioned or even absent from charts (refer to Figure 1).



Figure 1. A breaking reef 3 Nm off the Balleny Islands

The risk of a maritime incident is considered a key issue within a major report prepared by the NZ Antarctic Institute in 2001, whereby attention is drawn to:

- The lack of detailed and recent hydrographic surveys and charts,
- No agreed codes or standards for shipping operators (e.g. ice-strengthened hulls, anchoring, landing and near-shore speed limits)
- No regional based contingency planning for marine fuel spills or incidents,
- No agreement on liability for environmental damage.

Surveying the Western Ross Sea

In 2001, LINZ contracted the NZ-based National Institute of Water and Atmospheric Research (NIWA) to conduct a hydrographic survey of the Balleny Islands, Cape Hallett and the Possession Islands in the Western Ross Sea. The Antarctic environment provided some unique problems, but also brought the reward of vastly improving the existing nautical charts of the area.

Many of the previous ship-borne surveys in the area have been undertaken by a variety of nations comprising mainly the US, UK and Russia. Most existing charts, which are compilations of various ships' echo-sounder tracks dating back to the 1800's, are basically reconnaissance charts.

The aim of the survey was to prove a safe shipping route and anchorages from Cape Adare to Cape Hallett (refer to Figure 2) for the various commercial cruise ventures that are visiting the region in ever-increasing numbers, in particular the historic and wildlife sites dotted along the coast. Having only short operating seasons to work with, the survey coverage will be completed over the next few years.



Figure 2. A portion of NZ14900 requiring larger scale charts

As a result of the surveys, HSA Systems Ltd was contracted by LINZ to produce five new charts of the Western Ross Sea and Balleny Islands regions. The five charts are as follows:

- NZ149006 – Cape Adare and Cape Hallett – four plans
- NZ149007 – Possession Islands – coastal chart (1:60,000)
- NZ149008 – Cape Adare to Cape Daniell - coastal chart (1:200,000)
- NZ14909 – Cape Hooker to Coulman Island - ocean passage chart (1:500,000).
- NZ14912 – Balleny Islands - coastal chart (1:300,000)

Chart Production Process

At the commencement of the charting project, the source data is reviewed in terms of its usefulness to the chart, priority, clarity for use, etc. The main difficulty with Antarctic charting is that the data comes from various sources of differing spatial coverage, quality, age, scale and hence usefulness: the essential charting exercise. Table 1 outlines the source data used in the production of the charts:

Data Type and Source	Source Date	Scale
Coastline, Ice Limits and general Topographic Data		
<i>LINZ hydrographic surveys</i>	2001	15,000 – 200,000
<i>Landcare Research NZ satellite images</i>	1997	50,000 – 200,000
<i>USGS maps</i>	1968	250,000
Hydrographic Data		
<i>LINZ hydrographic surveys</i>	2001	15,000 – 200,000
<i>US Naval Oceanographic Office (USNOO) charts</i>	1956-1970	25,000 – 111,754
<i>LINZ chart NZ14900</i>	1998	2,000,000
<i>Russian charts</i>	1984-1992	500,000 -2,000,000
<i>Bathymetric and Ocean Sounding plotting sheets</i>	various	Small scale
<i>US charts</i>	1995/96	500,000 - 1,500,000
Associated Documents		
<i>LINZ Report of Survey, photo data pack, tidal data and Sailing Directions</i>	2001	

Table 1. Source Data used During Compilation

Chart Depiction

In an area like Antarctica, where the source data is sparse, old, and often at a smaller scale than the final product, the chart depiction must reflect the variable quality of the data in a manner that the user can appreciate. Where the charts used the 2001 survey data, detailed soundings are shown in italic numerals, firm depth contour lines and solid blue fill colour in shallow areas. Outside of the surveyed area, only sparse sounding coverage exists and soundings are shown in upright notation, contours are minimal and pecked and depth areas are not colour-filled. Even the coastline is pecked indicating that its positioning did not meet the required survey specifications. Every effort is made to depict the reality of the source data in order for the user to make an informed decision on how they use the chart for their purpose (refer to Figure 3). Unlike many forms of maps, a hydrographic chart is a legal document and if a grounding does occur, the producing Hydrographic Authority may be found liable if information recorded on a survey is not included on the chart.

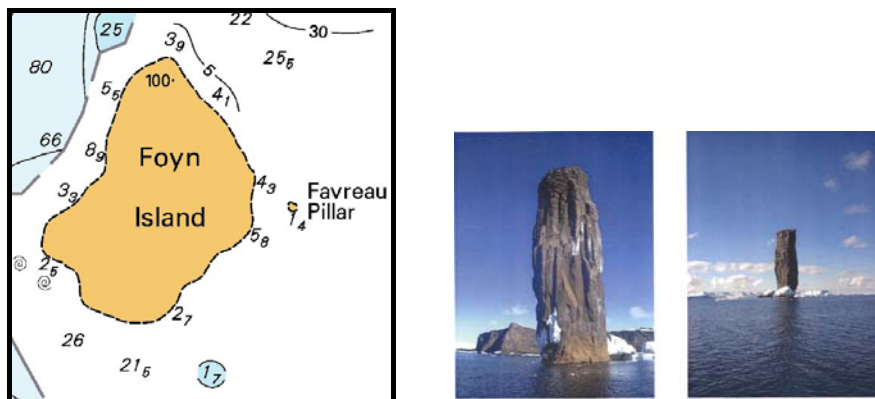


Figure 3. Favreau Pillar – reality and chart depiction

Conclusions

The surveying and charting of such a region presents very real physical challenges – operationally in the field and in the way that the data can be depicted to the user of the chart product. The fragile nature of the environment and the current extent of the unknowns, will require a continuing and dedicated effort by those countries with interests in Antarctica to provide ongoing hydrographic survey and charting services. The risk of a maritime incident in Antarctica grows as more ships visit the area. Even with the sinking of two vessels to date, the impacts of spillage and contamination are not fully known. LINZ's commitment to surveying and charting Antarctica is an ongoing process.

All manner of people need to get to and from the Antarctic – safely – mostly by ship. Thus, better charting, is essential. New Zealand's experience is a strong reminder of the need for us all to appreciate the skill and effort that goes into modern charting. It is time for many other data users who seek to use charts for many reasons to appreciate more fully the strengths and sometimes limitations of charts.

Biographies:

Ian Halls is the Director of Spatial Services for HSA Systems Pty Ltd in Wollongong Australia. Ian has cartography and surveying qualifications and with 25 years experience in nautical cartography is responsible for managing HSA's digital chart production programs.

Kevin Smith is the Manager of New Zealand Operations for HSA Systems Ltd in Wellington New Zealand. He provides technical consulting services and operations management to HSA's chart production and chart warehousing services.

Michael Farrell is the Hydrographic Information Advisor at Land Information New Zealand (LINZ). He is responsible for implementing new charting products such as RNCs and ENC's, the management, maintenance and distribution of hydrographic information and contributes towards the strategic direction of hydrography in New Zealand.

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