New Zealand's Continental Shelf Project

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Abstract

In August 1996, the New Zealand Government ratified the United Nations Convention on the Law of the Sea (UNCLOS). As a party to the convention and under Article 76, New Zealand is required to determine the outer limits of its legal continental shelf, and lodge its submission with the United Nations by August 2006.

Initially the then Ministry of Commerce was charged with responsibility for New Zealand's Continental Shelf Project. This responsibility transferred to Land Information New Zealand (LINZ) in mid-1997. LINZ's role is to manage the survey programme, data collection, analysis and interpretation of the survey data, and in conjunction with the Ministry of Foreign Affairs and Trade, the presentation of NZ's submission.

The ten-year timeframe for NZ to make its submission, interpretative nature of Article 76, costs of vessel hire and weather dependant nature of surveying mean that there are significant risks surrounding the project. To manage these risks LINZ has developed and put in place a risk management strategy to monitor, manage and where possible mitigate the risks.

In addition LINZ, in 1997, commissioned a joint venture team of scientists from the National Institute of Water & Atmospheric Research (NIWA) and the Institute of Geological & Nuclear Sciences (GNS) to conduct a Desktop Study of NZ's marine seismic and bathymetric data sources. The NZ Desktop Study, which was completed in 1998, is a unique approach to minimising scope creep and any potential blowout in survey costs. The study identified areas of potential outer legal continental shelf, assessed areas where existing data met the requirements of Article 76, and proposed further survey work where gaps in the data existed.

Excellent progress has been achieved with the survey programme to date. Once the majority of the surveying has been completed the final processing and interpretation of data, development of the data presentation system, and the negotiations and submission phases of the project will begin.

Introduction

In November 1994 the United Nations Convention on the Law of the Sea (UNCLOS) came into force after being ratified by 60 countries. Under the Convention, states who satisfy the provisions of Article 76 may extend their jurisdiction over certain areas of the seabed beyond their Exclusive Economic Zone (EEZ) to the outer limit of their legal continental shelf.

New Zealand ratified UNCLOS in 1996. As a party to the Convention, New Zealand is required to determine the outer limits of its legal continental shelf and lodge its submission with the United Nations (UN) by August 2006. New Zealand stands to gain a huge potentially legal continental shelf that extends from three to nine times the area of its landmass.

In early 1999 the Government approved a budget of $44 million to gather and process seismic and bathymetric data in order to substantiate NZ's submission to the UN. Land Information New Zealand (LINZ), as the government agency responsible for the administration of the New Zealand Continental Shelf Project (NZCSP) contracted the country's leading geophysical and marine survey scientists to undertake a Desktop Study of NZ's existing marine information resources. The work programme and budget are based on the findings of the Desktop Study which was peer-reviewed by eminent NZ and international experts. Due to the uncertainties surrounding the management of the NZCSP, LINZ has established a comprehensive risk management strategy to reduce the potential for time and cost overruns.

Background

Under Article 76 and Annex II of the 1982 Convention, the United Nations established the Commission on the Limits of the Continental Shelf to hear the submissions from states. The Commission was established by elections held in March 1997. Members are elected for a period of five years. The

Commission comprises five members from the African States Group; five from the Asian States Group (including Pacific Island countries); two from the Eastern European Group; four from the Latin American and Caribbean States Group and five from the Western European and Other States Group (which includes New Zealand).

The principal roles of the Commission are to consider the submissions of member states and to provide scientific and technical advice on Article 76. New Zealand is fortunate to have Iain Lamont, of the Royal New Zealand Navy's (RNZN) Hydrographic Office, as a member of the Commission. The Commission published a final set of Scientific and Technical Guidelines in May 1999. The Guidelines are the Commission's interpretation of Article 76 and are designed to assist states with their submissions.

The Legal Continental Shelf as defined in Article 76 consists of "the submerged prolongation of the land mass of the coastal state", specifically excluding the deep ocean floor with its oceanic ridges. The key factors which affect the limits of a potential claim beyond the 200 nautical mile (M) EEZ are the 2500 metre (m) isobath, the base of the continental shelf and the sediment thickness beyond the base of slope. A claim cannot exceed 350 M from the baselines of the territorial sea or 100 M from the 2500 m isobath.

Within these limits, the Legal Continental Shelf can extend up to 60 M beyond the base of the continental slope (the Hedberg Limit), or to where the sediment thickness is at least 1% of the shortest distance to the base of the slope (see Figure 1).

A state may elect which criteria it satisfies in any particular area in order to maximise its claim, but it must indicate which criteria it is invoking. States have many problems in applying such simplistic rules to complex geomorphology. The crustal origin of material embedded in the continental margin may be oceanic, having migrated through tectonic processes. There are also questions over the continuity of submarine ridges, the 1% sediment rule where sediment distributions and thickness are highly irregular, and the accurate location of the foot of the continental slope.

The Commission's aim in releasing the Scientific and Technical Guidelines was to provide some clarity around these questions and to give some guidance as to the Commission's thinking on what would and wouldn't be acceptable. Unfortunately the guidelines have tended to increase confusion in some areas and it will not be until the Commission is required to rule on a submission that states can expect greater clarity.

NZ's Continental Shelf Project

Initially, the then Ministry of Commerce (MOC) was charged with responsibility for the New Zealand Continental Shelf

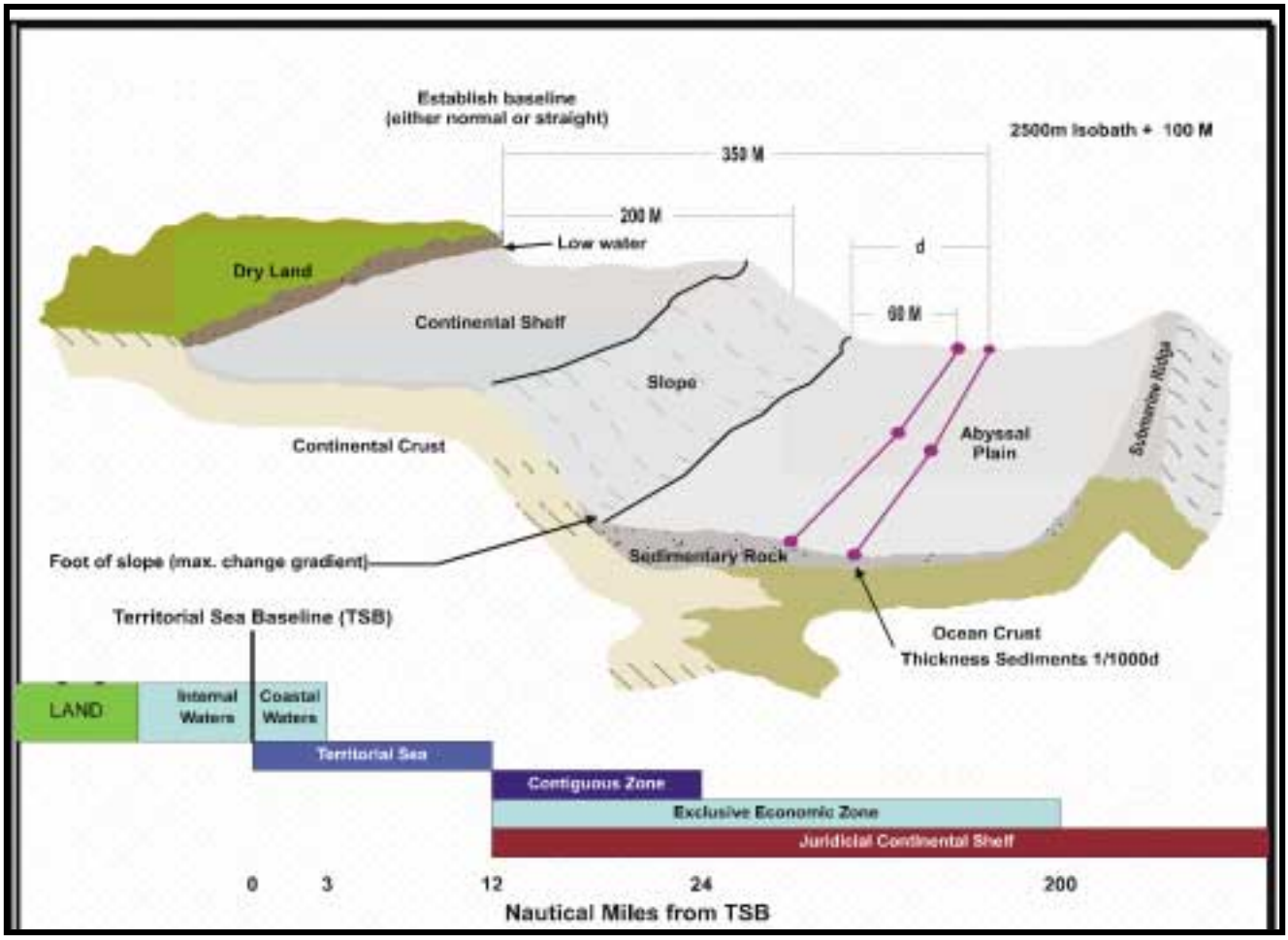

Figure 1: UNCLOS Criteria.

Project. Land Information New Zealand, also a department of state, assumed responsibility for the NZCSP in July 1997. Since its formation in 1996 LINZ has worked co-operatively with MOC in the development of a philosophy for the technical progression of the Project. Three phases were identified.

The first phase called the "Desktop Study" revolved around an assessment of existing data and evaluation of its usefulness in supporting a submission in a certain area. This assessment included consideration of the age and accuracy of the data. The Desktop Study also identified the need for gathering additional data, the number and position of seismic and bathymetric survey lines and the collection of other supporting information. The second phase was the strategic phase when a peer review panel independently assessed the recommendations in the Desktop Study and a prioritisation of survey requirements was made. Funding for the NZCSP was also secured at this point. The third or current phase of the Project is the assessment of industry capability, tendering of contracts, the active gathering and processing of the additional survey data (see Figure 2).

Management of the NZCSP is controlled through the department's normal reporting mechanism including the annual purchase agreement with the Minister and an inter-departmental Advisory Committee. In addition, LINZ has established a technical working group to provide the department with scientific and technical advice. Seismic and bathymetric surveys will be contracted through an open tender process. However, where benchmark information indicates that a government-owned research vessel or a "vessel of opportunity" which presents itself is very competitive based on low mobilisation costs and is within the budget then that vessel may be chartered. This will not happen with the more expensive deep-penetration seismic surveys as preparations for a formal tender process are well advanced and there is no known NZ capability.

The NZCSP will ultimately provide the supporting technical evidence and this information will be submitted to the United Nations by the Ministry of Foreign Affairs and Trade (MFAT). MFAT will also use this information in any bilateral negotiations it enters into with neighbouring states who have common boundaries with New Zealand.

Survey programme[1]

The marine surveys detailed in the Desktop Study require a mixture of deep penetration high-fold multi-channel seismic data (to image crustal structure and prolongation, sediment thickness, and foot of slope positions), shallow penetration low-fold multi-channel seismic data (to image sediment thickness and establish foot of slope positions), and bathymetric profile data (to establish foot of slope positions).

The entire work programme therefore requires vessels with survey capabilities of deep-penetration seismic reflection, shallow penetration seismic reflection, multi-beam echo sounder swath mapping and single-beam echo-sounder profiler. Acquisition of routine gravity and magnetic data, deployment of sonobouys where relevant, and capability of rock dredging to water-depths of 4000 m are also requirements of surveys.

The four survey areas are the Northern, Eastern, Southern, and Western regions, with five different vessel activities in each region: deep-penetration multi-channel seismic surveys, shallow-penetration multi-channel seismic surveys, multi-beam bathymetry surveys, single-beam bathymetry surveys and rock dredging.

The Desktop Study had the survey work programmed to be completed by 2004 in order to allow two years to interpret the data and develop the presentation system. However, the 1999 Australian-New Zealand Joint Prime Ministerial Agreement to have negotiations on overlapping continental shelf areas settled by 2003 has required the bulk of the surveying programme to be carried out over the next two years.

Northern Region

The Desktop Study identified three areas requiring additional survey data in the Northern Region. There is a significant requirement for all types of surveys on the western flanks of the Colville Ridge and the eastern/northeastern flanks of Three Kings Ridge[2]. As well as single-beam bathymetry and a deep penetration multi-channel seismic line along the Louisville Seamount Chain.

Eastern Region

The Eastern Region contains a significant portion of the overall survey programme, especially the deep penetration multi-channel seismic survey work. The survey work is located along the edge of the Hikurangi Plateau and Chatham Rise, as well as a multi-beam bathymetry survey along the Wishbone Spur.

Southern Region

The Southern Region has the largest geographical area of the programme in which surveying is required. The surveying programme is predominately bathymetric data collection, with an area of single-beam and multi-beam bathymetry surveying across the Bollons Seamount and single-beam bathymetry on the edge of the Campbell Plateau.

Western Region

The Western Region represents the smallest area of the programme and includes a multi-beam bathymetry survey along Resolution Ridge[3], as well as single-beam bathymetry and deep penetration multi-channel seismic survey on Macquarie Ridge. The final survey area within the Western

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[1] Refer to Figure 3 for a plan of the survey programme.

[2] All survey requirements except for the deep penetration multi-channel seismic lines were completed by the NIWA *RV Tangaroa* voyage in October 1999, discussed later in the paper.

[3] The multi-beam bathymetry survey along Resolution Ridge was recently completed (Feb 2000) by the French vessel *L'Atalante*, discussed later in the paper.

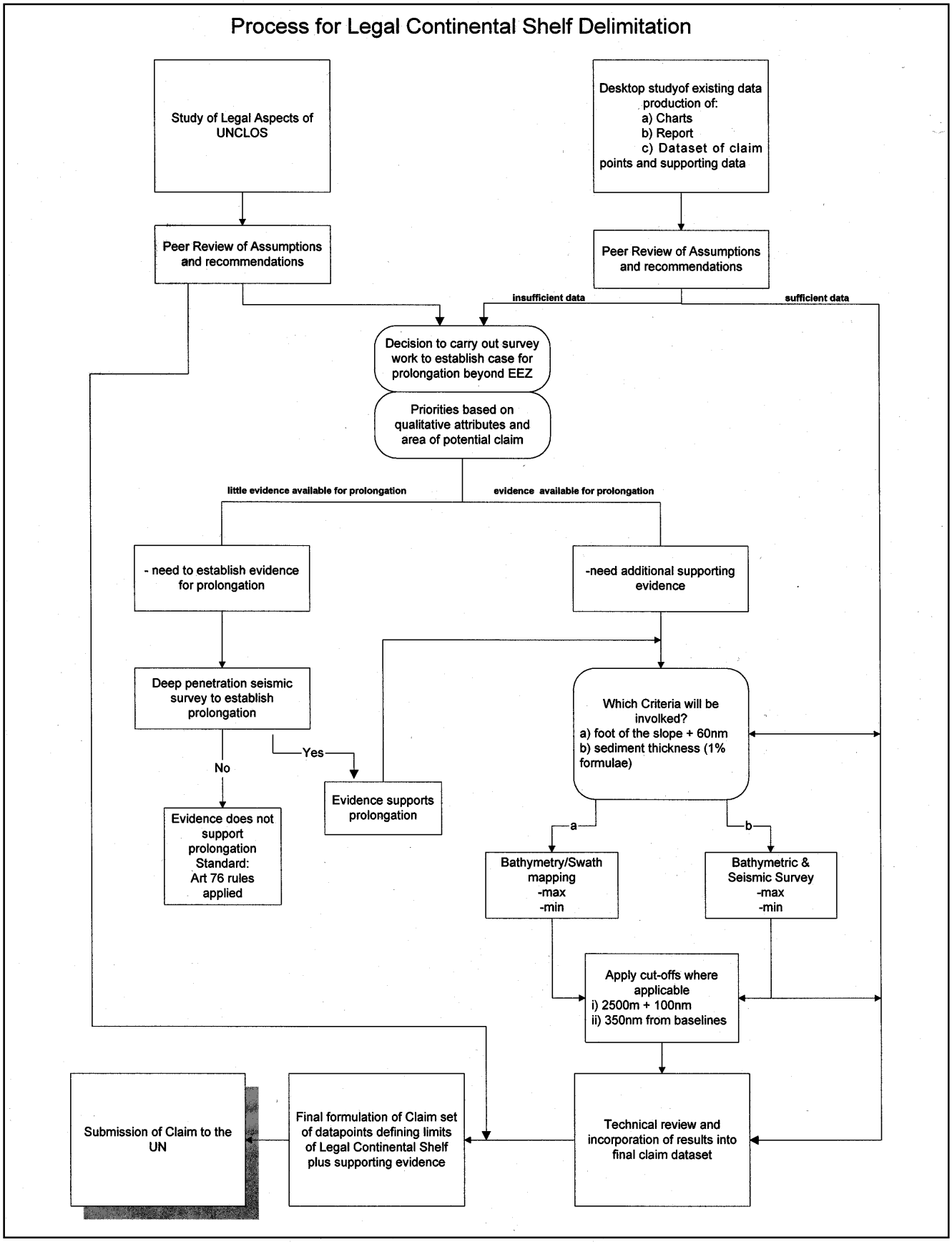


Figure 2: Process for the evaluation of survey data.

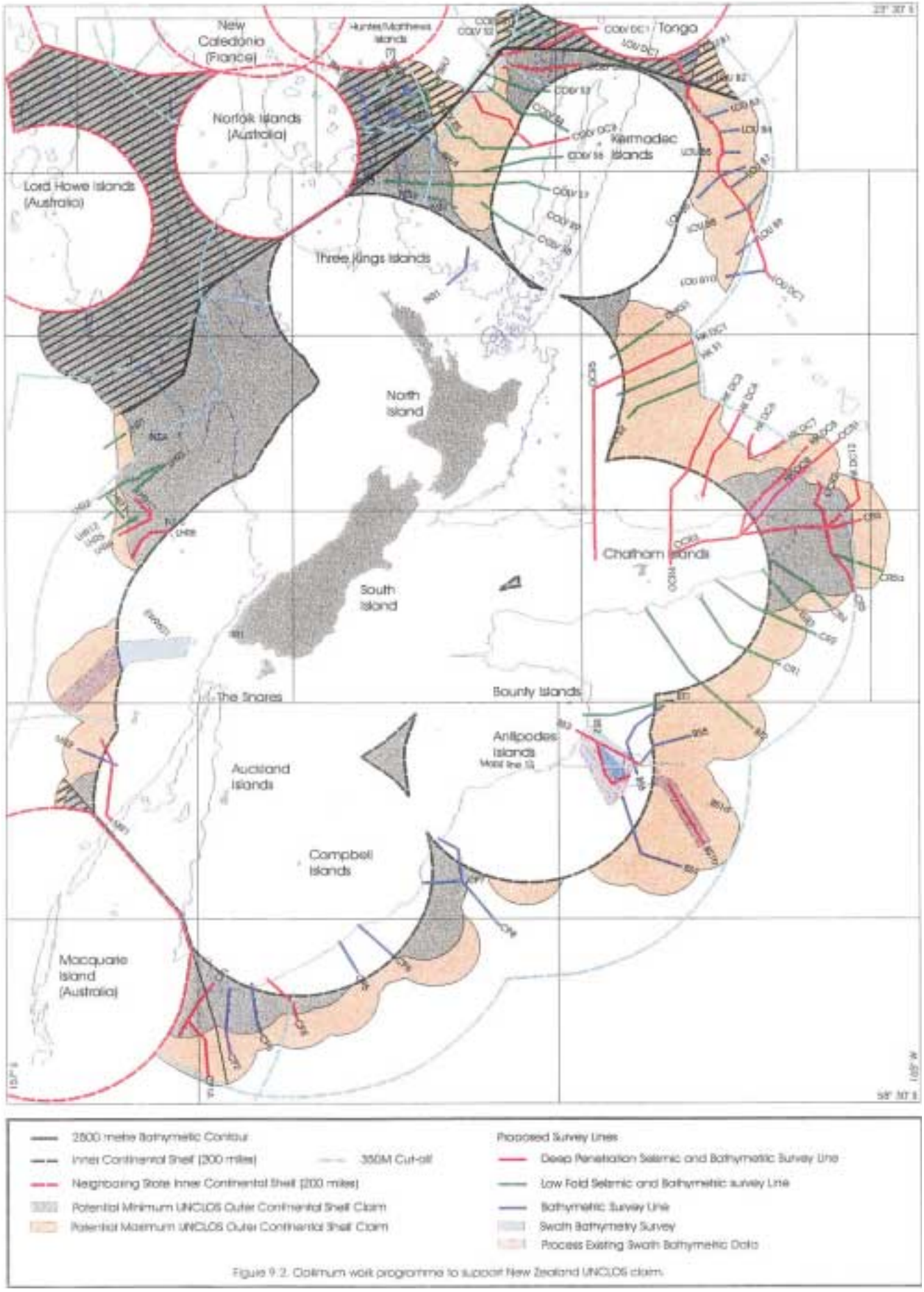


Figure 3: Survey programme.

Region is on the southern end of Lord Howe Rise and the Gilbert Seamount.

Risk management strategy[4]

At the commencement of the NZ Continental Shelf Project there was a realisation that significant risks were inherent in the nature of the Project and that they would need to be managed if a successful outcome was to be achieved. It was considered that the risk management strategy should provide a mechanism that would anticipate the major downside events likely to be encountered. It should also provide the Project with a degree of resilience when or if an expected or unexpected risk event occurred (i.e. it needed to be both an anticipatory and resilient focused risk management strategy).

In line with the above thinking it was also considered that the NZCSP's budget should be closely aligned with the risk profile over the timeframe of the Project. In this way the financial impact of a high-risk event occurring (e.g. bad surveying weather causing the costs of the survey to exceed budget), could be offset by the funding available.

The risk management model adopted was adapted from LINZ's Landonline project and initially followed a fairly standard five-step process:

1. Risk event identification;
2. Financial and non-financial consequences of event occurring;
3. Risk control tactics;
4. Probability of event occurring after control tactics put in-place; and
5. Absolute rating of risk.

Risk identification

The risks were initially identified through brainstorming sessions by the Project team, subsequently input was then sought and gained from the various other parties involved in the Project i.e. scientific and technical experts as well as other Government agencies. During the collation of the results there was a realisation that many of the risks were similar in nature. It was therefore possible to group the risks under eight key risk areas, as follows:

1. Vessels – the possible lack of vessel availability to undertake this type of work due to other commitments. Potential significant cost increases over budget and delays in the work programme due to increased demand for vessels. Cost overruns and delays due to adverse surveying weather;
2. Scientific & Technical Advice – the lack of suitably qualified and independent scientific/hydrographic/technical advisors in NZ to act as client representatives or for analysis and interpretation or peer review and quality assurance. There were also concerns that the quality and adequacy of the advice could be substandard;
3. Data Management – concerns that insufficient data will be collected and or poorly maintained. The possibility that the UNCLOS presentation system adopted is overly complex or inadequate to meet the requirements of the UN Commission;
4. Data Analysis & Interpretation – potential deficiencies in the quality and consistency of supporting evidence affects the submission. Unknowns and inaccuracies in the Desktop Study result in redundant surveying work being undertaken;
5. United Nations (UNCLOS) Rulings – changes to the guidelines by the UN Commission result in additional surveying work being required, or lack of monitoring when they do change results in redundant data being collected;
6. Australian, Tonga, Fiji, New Caledonia negotiations – the potential that additional surveys are required to support negotiations. Possible delays in negotiations while additional survey funding is sought.
7. Presentation of legal boundary evidence before UN Commission - NZ interpretation of Article 76 inaccurate resulting in significant portions of the submission being made invalid; and
8. Project Management – Adverse publicity or mis-information to Ministers etc. due to LINZ not supplying adequate information to key stakeholders. Poorly undertaken tender process results in cost overruns or litigation. Management deficiencies affecting the costs, quality and timeliness of the Project.

Financial and non-financial consequences of risk events occurring

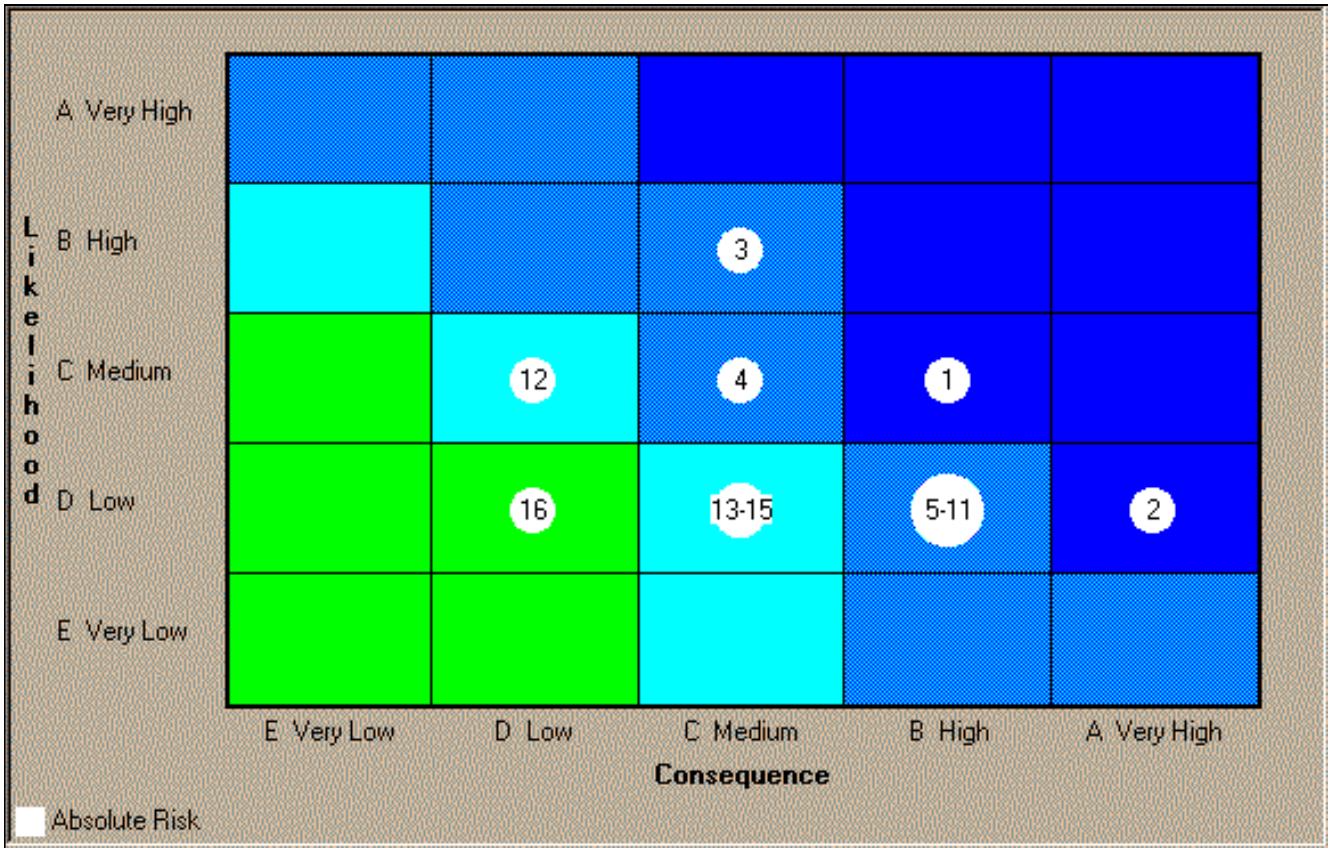
Similar to other projects the potential consequences of the downside risk events occurring are not only financial; accordingly, the risk model built in scheduling, performance, and political related consequences.

From a financial perspective, the consequence of a bad patch of weather occurring during a deep seismic survey could cost several million dollars more than the budgeted amount if it had to be completed at a later stage.

The initial view was that the timeframe for having the surveying, interpretation and presentation system phases of the Project completed prior to the deadline of August 2006 would easily accommodate any time or scheduling related consequences. However, the 1999 Australian-New Zealand Joint Prime Ministerial Agreement to have negotiations on overlapping continental shelf areas settled by 2003 has resulted in the bulk of the surveying programme being brought forward, subsequently, time has become a significant risk consequence.

There was a realisation that the uncertainties surrounding the Desktop Study and during collection and interpretation of

[4] Refer Figure 4 for the NZCSP Risk Model Framework.



New Zealand Continental Shelf project risk rating diagram.

#	Name	Cons.	Like.	Abs.
8.2	Poor tender process	B High	C Medium	12
1.1	Vessel Availability	A Very High	D Low	10
5.1	Changes to Guidelines	C Medium	B High	12
2.1	Lack of qualified advisors	C Medium	C Medium	9
3.3	Presentation System	B High	D Low	8
4.1	Quality of Supporting Evidence	B High	D Low	8
8.3	Management Deficiencies	B High	D Low	8
3.1	Insufficient Data	B High	D Low	8
3.2	Arguments over data	B High	D Low	8
8.1	Adverse publicity/misinformation	B High	D Low	8
6.2	Treaty Obligations	B High	D Low	8
1.3	Adverse Weather Conditions	D Low	C Medium	6
6.1	Delays in Negotiations	C Medium	D Low	6
2.2	Substandard technical advice	C Medium	D Low	6
7.1	Delays in Negotiations (UN)	C Medium	D Low	6
1.2	Costs Exceed Budget	D Low	D Low	4

Figure 4: Risk management framework.

data could have a significant impact on the overall outcome. On this basis a performance related consequence scale was incorporated in to the risk management model.

The fourth consequence scale was political. An acknowledgment of the environment in which the NZCSP is taking place and the number of stakeholders involved in the

Project. With the number of government or quasi-government agencies involved as well as private sector organisations bidding and carrying-out Project related work there is a real possibility of undesirable political consequences occurring, such as a Ministerial Enquiry which would impact on a desirable outcome for the Project.

To provide a mechanism for indicating the extent of each of the four broad areas of potential consequence, a scale was developed which would rank the consequence of each risk event taking place. For example, the financial impact of having to wait an additional year to carryout a survey due to vessel availability may be minimal, however, the delay could put in jeopardy the crucial 2003 AUS-NZ negotiations deadline and therefore its performance consequence impact is significant.

Risk control tactics

A two-pronged approach was taken to identification and placement of the control systems, which would manage, minimise and where possible mitigate the risks that had been identified. Firstly, where possible the controls needed to anticipate and individually address the specific risks identified and, secondly, the Project needed to have a degree of resilience and robustness should any unexpected risks occur.

The controls ranged from the establishment of a Technical Experts Working Group made up of representatives of the National Institute of Water and Atmospheric Research (NIWA), the Institute of Geological and Nuclear Sciences (GNS), LINZ, MFAT and the RNZN's Hydrographic Office. Its purpose was to provide expert advice, guidance and support to LINZ on the scientific and technical aspects of the NZCSP.

An Advisory Committee made up of officials from key government departments was also established. Its role is to provide advice and guidance to the Chief Executive of LINZ and the Programme Manager on the management of the NZCSP and to ensure there is a consistent understanding within government on the progress of the Project.

One of the major resilience strategies of the Project had been to include a contingency fund in the Project's budget. While this was originally aligned with the underlying budget, as a result of the risk model it was reallocated to reflect the risk profile of the Project. In this way a risk event which has a significant financial consequence and a medium or higher probability of occurring (e.g. demand for vessels increasing resulting in cost of surveying to exceed budget) is controlled.

The Project has a strong focus on maintaining quality because its success will be determined by the quality of the data collected and the professional advice given. From a risk control perspective, each facet of the Project has a quality assurance component. This includes the development and use of specialist Standards throughout the Project. All survey contracts include the Standard applicable to the area and type of surveying being undertaken (e.g. for the recent Northern Region survey a set of low-fold seismic and bathymetry standards were developed and included in the contract).

Additionally, all surveys will have at least two LINZ client representatives who are responsible for monitoring the contractor's daily operations with the objective of maximising the output from the survey for the NZ Continental Shelf Project.

Probability scale

While the risk framework identified the risks and gave indications of the consequences, there was a need to determine the likelihood of an individual risk occurring. In this way, resources could be targeted more efficiently at the risks with a greater likelihood of occurring. The probability scale was designed to accentuate any events that are expected to happen i.e. those with a likelihood greater or equal to 50% in the estimate of the assessors. The assessment is made after risk management control tactics have been put in-place.

Absolute risk rating

The combination of the above steps enabled an absolute risk rating to be matched against each risk in order to highlight those which either need further remedial action or need to be routinely monitored.

Progress to date

Surveying completed

In 1996 the then MOC undertook a co-operative survey with Australia around the Lord Howe and Norfolk Island Islands using the *RV Rig Seismic*. This joint survey shot deep penetration seismic lines aimed at collecting information regarding the nature and likely origin of the submarine geological structure in the area. The primary advantages of this work was based around the reduced cost of the joint survey and the shared data set upon which bilateral boundary negotiations will be based.

In October 1999 LINZ chartered NIWA's research vessel *RV Tangaroa* to undertake the low-fold seismic, single-beam bathymetry, rock dredging in the Northern Region (Louisville Seamount Chain excepted). The thirty-four day survey was undertaken along the western flanks of Colville Ridge and the eastern/northeastern flanks of Three Kings Ridge. The work was completed within time and under budget. The data acquisition and onboard processing during the survey was undertaken to high standard and adequately identified "foot of slope" positions and sedimentary thickness in accordance with UNCLOS requirements. The information gathered will provide a significant contribution to the overall project.

Request for information

A Request for Information (RFI) was sent out in December 1999 to potential NZ and international service providers. The primary purpose was to obtain:

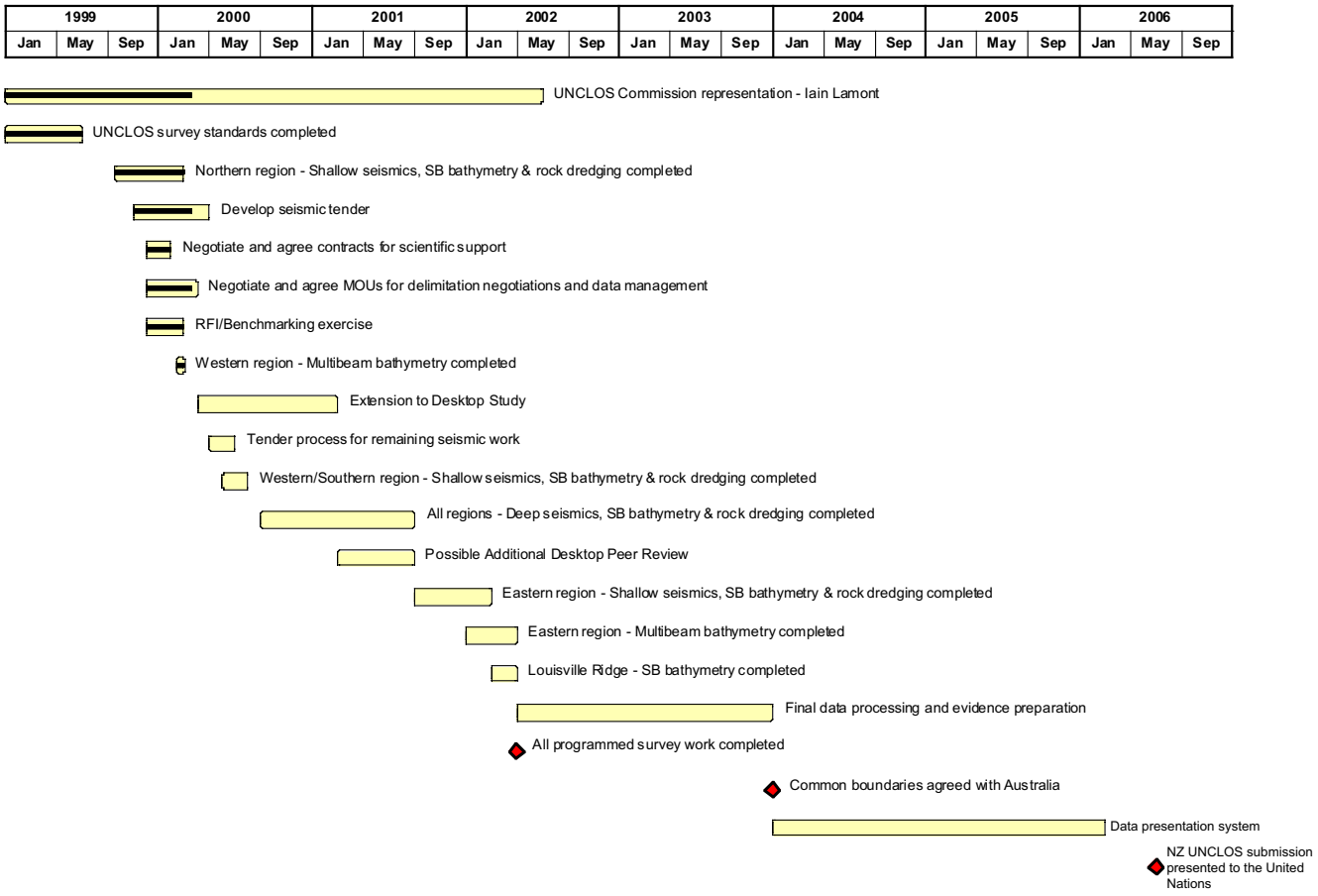


Figure 5: Continental shelf project work programme.

- expressions of interest from organisations capable of undertaking NZCSP work;
- advice on how the survey programme could be most efficiently implemented;
- details on the availability of suitable vessels over the next three years; and
- details on the likely range of costs that can be expected for the survey programme.

This was the first phase of ensuring that interested organisations have the greatest flexibility and opportunity to bid for NZCSP survey work. It also gave the Project team an opportunity to develop an understanding of these organisations surveying capabilities and availability.

Timing of surveys

Following on from the analysis of the information received during the RFI, the intention is to let the NZCSP deep penetration multi-channel seismic surveying as one contract. We are presently putting together the tender specifications with the intention to go out to open tender in late April or May with the successful contractor notified by late June early July. This would enable the bulk of the surveying to be carried out in the 2000/2001 financial year. While a decision has not yet been made whether to include the post voyage data processing as a separate contract, we are hopeful that the processing can be completed by early 2002.

In February of this year the availability of the French research vessel *L'Atalante* to undertake a multi-beam survey along Resolution Ridge in the Southern Region was seen as a vessel of opportunity. The vessel was under contract to the Australians to undertake some of their Law of the Sea project multi-beam requirements and LINZ took the opportunity to survey Resolution Ridge during its transit return to Noumea. Operationally it was a successful voyage with excellent sailing weather enabling the survey to completed within time and the work well within budget. Additional valuable data at no extra cost was also collected around the Norfolk/Three Kings area during the transit back to Noumea.

The next steps

The next focus of LINZ is to complete preparations for the deep seismic tender which will be released in April/May 2000. The work programme in Figure 5 shows the proposed timeline until the end of the NZCSP.

As mentioned previously in the paper the intention is to offer one contract for the deep-penetration seismic surveys. LINZ expects bidding contractors to partner or sub-contract seismic data processing companies in their tenders. However, if this

does not appear practical LINZ will consider two separate contracts. At this stage the intention is to offer the deep seismic work starting from the beginning of the 2000/2001 financial year (July).

Once the deep seismic work is underway LINZ will turn its attention to the presentation system. There are many options in presenting the submission, however, evidence must be based on paper charts so the role of Graphical Information Systems needs to be evaluated. It may be that such tools are more valuable in the boundary negotiations than they are in the actual presentation of submissions.

New Zealand has much to gain from its continental shelf submission and this paper has aimed to provide the petroleum industry with a insight into challenges faced by LINZ and the systems being used to ensure an optimal outcome is achieved.

References

Integrated Procedures for Determining the Outer limit of the Judicial Continental Shelf Beyond 200 Nautical Miles, November 1999, Robert van de Poll, Graduate Seminar, University of New Brunswick, New Brunswick.

Scientific and Technical Guidelines of the Commission on the Limits of the Continental Shelf, 13 May 1999, New York, Adopted by the Commission at its fifth session.

The Law of the Sea, Definition of the Continental Shelf, 1993, New York, Division for Ocean Affairs and the Law of the Sea, Publication No. E.93.V.16, United Nations.

The South Pacific and Article 76 of the Law of the Sea, 1996, Fiji, Boyes G, Larue M, report prepared for the South Pacific Applied Geoscience Commission, SOPAC miscellaneous report 227.

The United Nations Convention on the Law of the Sea, 1997, New York, Publication No.E97.V10, United Nations.

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