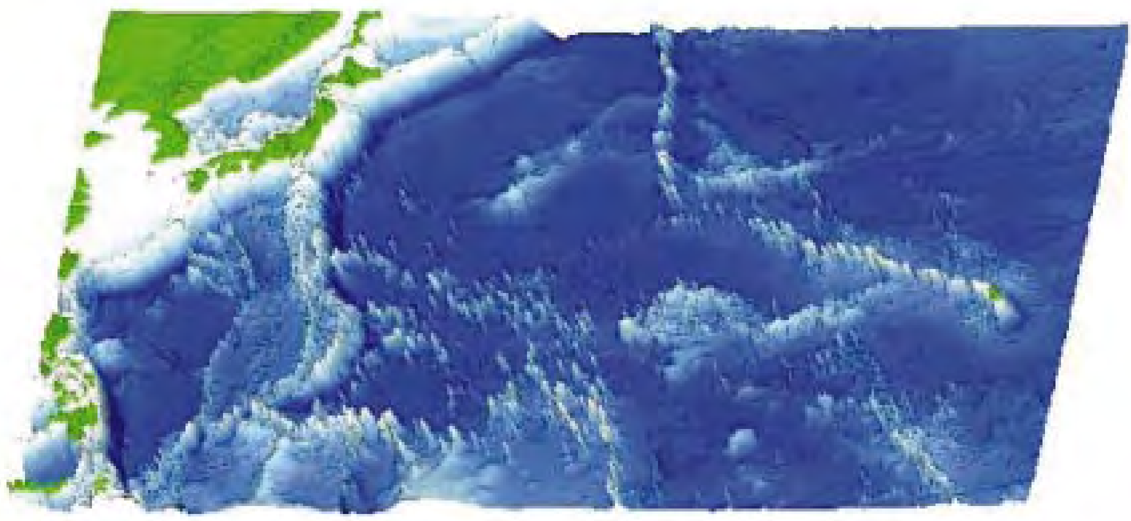
The Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles
- Its international circumstances, and its scientific and technical aspects -



Source: Japan Ocean Data Center, Japan Coast Guard

Ocean Policy Research Foundation

In cooperation with the Ministry of Foreign Affairs of Japan,
United Nations University and Japan Coast Guard

The Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles

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Foreword

Masahiro Akiyama
Chairman,
Ocean Policy Research Foundation, Japan

The 1982 United Nations Convention on the Law of the Sea (UNCLOS) created a new regime in ocean affairs. In particular, it is notable that Article 76 in Part VI states that coastal States shall delineate the outer limits of their continental shelf. The establishment of the outer limits of the continental shelf beyond 200 nautical miles has therefore been a great concern among lawyers as well as scientists around the world.

In March 2006, leading lawyers, scientists, eminent academics, and others involved in the establishment of the outer limits of their continental shelves assembled in Tokyo on the occasion of the two-day 'International Symposium on Scientific and Technical Aspects of the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles,' organized by the Ministry of Foreign Affairs of Japan and the United Nations University. Immediately afterwards, the Japan Coast Guard and the Ocean Policy Research Foundation (OPRF) hosted a two-day-training programme, entitled the 'Expert Meeting on Technical Matters regarding the Outer Continental Shelf' (these two meetings are hereafter referred to as "ISEM"). The Programme consisted of lectures and intensive training in Desktop study for specialists from South Pacific countries with the support of the Ministry of Foreign Affairs of Japan and The Nippon Foundation.

Reflecting the great success of ISEM, enthusiastic wishes for publication of a proceedings volume were expressed by many of the ISEM participants, as well as those unable to attend. OPRF, in consultation with the Ministry of Foreign Affairs of Japan and the United Nations University, therefore decided to take up their requests and publish a combined proceedings.

As such is the background of the publication, OPRF intends to include the presentation slides and transcribed text of the lectures in the proceedings, to reproduce the ISEM experience as far as possible.

I would like to express sincere thanks to all the presenters who made substantial contributions to the publishing of this work. It would be a pleasure to know that many more can now appreciate the positive atmosphere of ISEM and become familiar with the latest information on these subjects as of March 2006.

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Section 4 Support by International Organizations

Chapter 3 Updated Scientific Investigations relevant to the Continental Shelf

Section 1 Updated Scientific Investigations relevant to Active Margins

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The most of the presentations were carried out by PowerPoint presentations in 'International Symposium on Scientific and Technical Aspects of the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles', as well as 'Expert Meeting on Technical Matters regarding the Outer Continental Shelf'. An accompanying CD that is found at the back of this book allowed for the inclusion of many full-color presentations in Pdf files with the consent by the presenters.

Chapter 1

General Outline of Establishment of the Outer Limits of the Continental Shelf

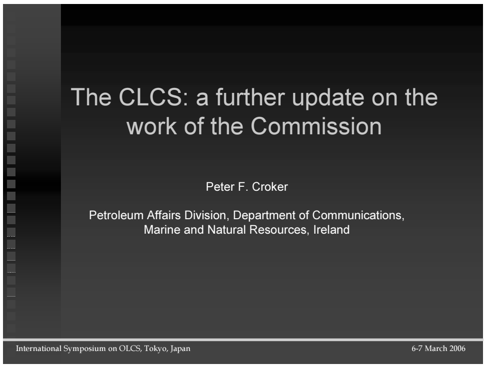
The CLCS: a Further Update on the Work of the Commission[1]

Mr. Peter F. Croker

Petroleum Affairs Division, Department of Communications, Marine and Natural Resources, Ireland

Slide 1.

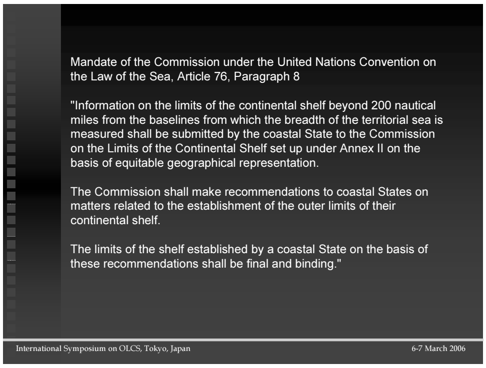
Good morning distinguished delegates, ladies and gentlemen. Let me first of all say that while I am currently the chairman of the Commission, I'm talking to you this morning in my personal capacity, and any opinions or views that I might express during the course of this presentation are my own solely and do not represent the views of the Commission.



Slide 2.

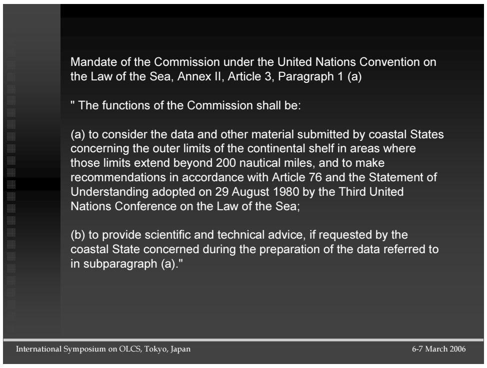
Just to remind ourselves by way of background, the mandate of the Commission is embodied in Article 76, paragraph 8 of the Convention, which states that information on the limits of the continental shelf beyond 200 nautical miles from the baselines shall be submitted by the coastal State to the Commission on the Limits of the Continental Shelf, set up under Annex II on the basis of equitable geographical representation. The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf. And finally, the limits of the shelf established by a coastal State on the basis of these recommendations shall be final and binding.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.



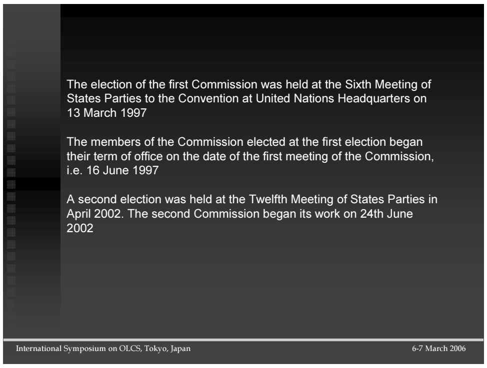
Slide 3.

Annex II then goes on to define in more detail the functions of the Commission to be a) to consider the data and other material submitted by coastal States concerning the outer limits of the continental shelf in areas where those limits extend beyond 200 nautical miles, and to make recommendations in accordance with Article 76 and the Statement of Understanding. And secondly (b), to provide scientific and technical advice, if requested by the coastal State concerned during the preparation of the data referred to in sub-paragraph (a).



Slide 4.

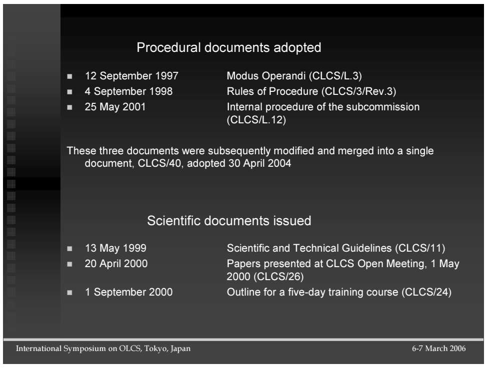
So the election of the first Commission was held at the sixth Meeting of States Parties at the UN in March of 1997, and the members of the Commission elected at that first election began their term of office in June of 1997. Members serve for a period of five years, and so the second election was held at the twelfth Meeting of States Parties in April 2002 and that second Commission began its work in June 2002.



Slide 5.

Now during the first four years that the Commission was in existence, we didn't receive any submissions from coastal States. So we spent that time really developing our procedures and our documents. Three procedural documents were adopted during that period - our *Modus Operandi,* our Rules of Procedure, and the Internal Procedure of the sub-commission. These three documents were subsequently modified somewhat and merged into a single document (CLCS/40), which was adopted on the 30th of April 2004. And that single document really encapsulates all the procedures of the Commission.

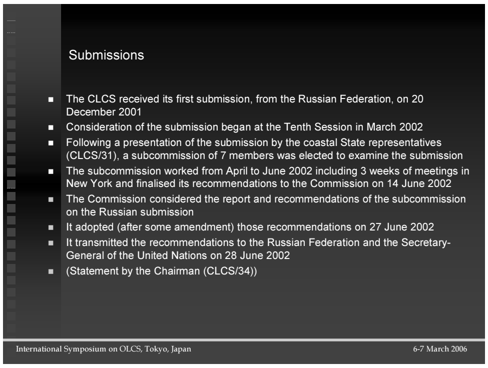
In terms of scientific documents, our first major document of course was the Scientific and Technical Guidelines (CLCS/11), which was adopted in May of 1999. There are two additional documents which I will just refer to briefly. There was an Open Meeting at the UN in New York in May 2000 and the presentations which formed part of that meeting are contained in document CLCS/26. And then finally there is an outline for a five-day training course - CLCS/24.



Slide 6.

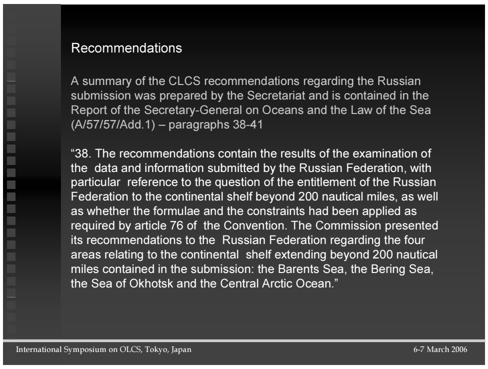
We received our first submission, from the Russian Federation, in December 2001. Consideration of that submission began at the 10th session in March 2002. Following a presentation on the submission, a sub-commission of seven members was elected to examine the submission. That sub-commission worked from April to June 2002, which included three weeks of meetings in New York, and finalized its recommendations to the Commission on the 14th of June.

The Commission then considered the report and the recommendations of the sub-commission on the Russian submission and it adopted, after some amendment, those recommendations on the 27th of June. It transmitted the recommendations to the Russian Federation and to the Secretary-General of the United Nations on the 28th of June. Those details are just taken from the Statement by the Chairman, and those Statements by the Chairman really summarize the activities of the Commission at each of its sessions.



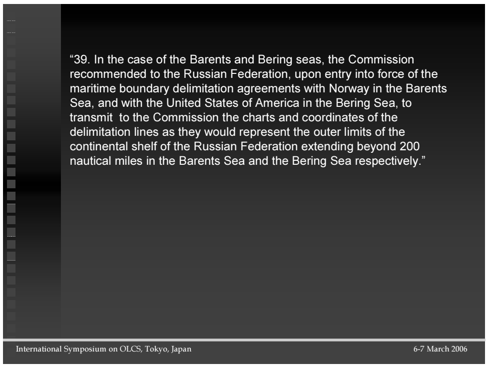
Slide 7.

A summary of the recommendations regarding the Russian submission was prepared by the Secretariat and was contained in the Report of the Secretary-General on Oceans and the Law of the Sea, A/57/57/Add.1, paragraphs 38 to 41. To summarize, the Commission presented its recommendations to the Russian Federation regarding the four areas relating to the continental shelf extending beyond 200 nautical miles contained in the submission - the Barents Sea, the Bering Sea, the Sea of Okhotsk and the Central Arctic Ocean.



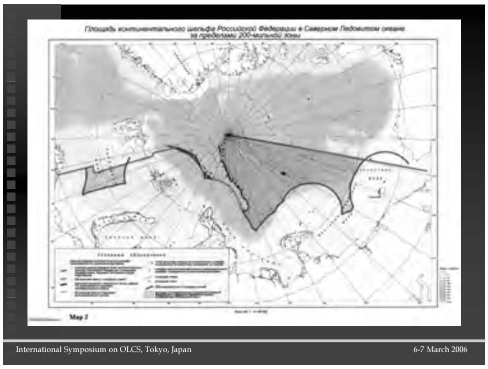
Slide 8.

In the case of the Barents and Bering seas, the Commission recommended to the Russian Federation, upon entry into force of the maritime boundary delimitation agreements with Norway in the Barents Sea, and with the United States of America in the Bering Sea, to transmit to the Commission the charts and coordinates of the delimitation lines as they would represent the outer limits of the continental shelf of the Russian Federation extending beyond 200 nautical miles in the Barents Sea and the Bering Sea respectively.



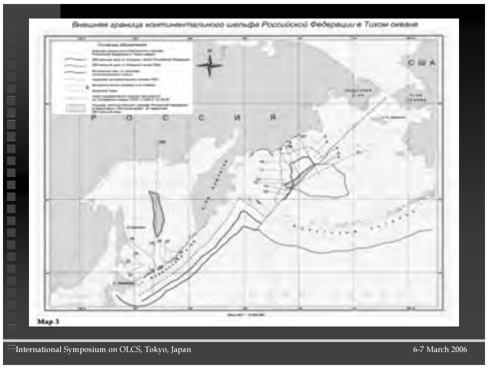
Slide 9.

That relates to the hatched area in the Barents Sea (west of Novaya Zemlya).



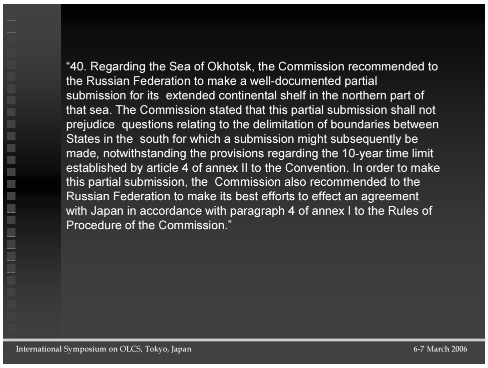
Slide 10.

And it also relates to the hatched area in the Bering Sea (east of the Kamchatka Peninsula).



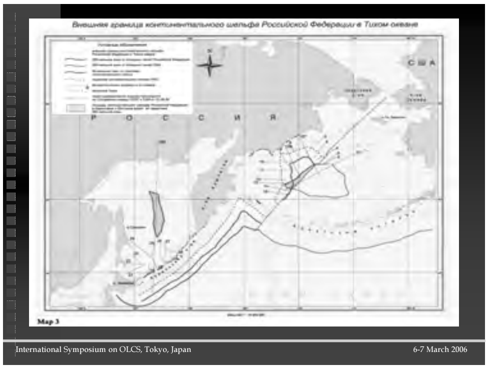
Slide 11.

Regarding the Sea of Okhotsk, the Commission recommended to the Russian Federation to make a well-documented partial submission for its extended continental shelf in the northern part of that sea. The Commission stated that this partial submission shall not prejudice questions relating to the delimitation of boundaries between States in the south for which a submission might subsequently be made, notwithstanding the provisions regarding the 10-year time limit established by Article 4 of Annex II to the Convention. In order to make this partial submission, the Commission also recommended to the Russian Federation to make its best efforts to effect an agreement with Japan in accordance with paragraph 4 of Annex I to the Rules of Procedure of the Commission (paragraph 4 of Annex I deals with joint or separate submissions).



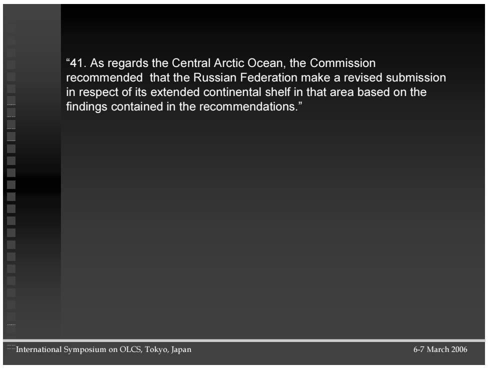
Slide 12.

That recommendation refers to the hatched area in the Sea of Okhotsk.



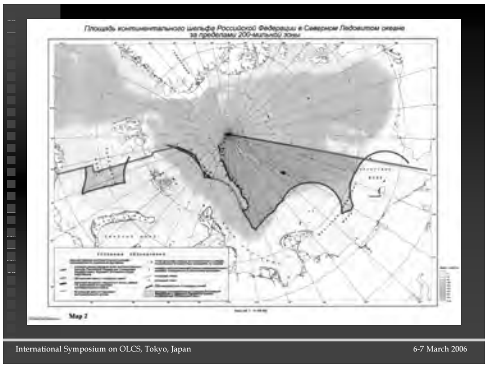
Slide 13.

And then finally, as regards the Central Arctic Ocean the Commission recommended that the Russian Federation make a revised submission in respect of its extended continental shelf in that area based on the findings contained in the recommendations.



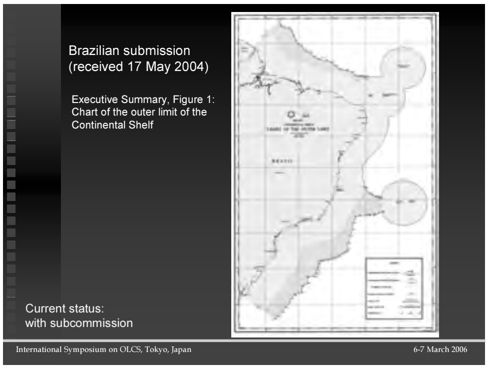
Slide 14.

That recommendation relates to the large hatched area in the Arctic Ocean.



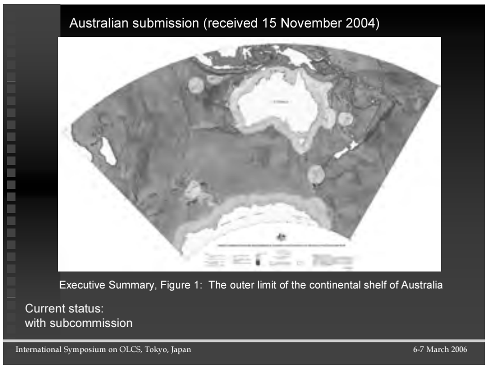
Slide 15.

We received our next submission from Brazil in May 2004, and this is a figure taken from the Executive Summary which shows the outer limits of the extended shelf in the areas to the north and to the southeast of the country (in darker green). The current status of that submission is that it is still with the sub-commission dealing with it.



Slide 16.

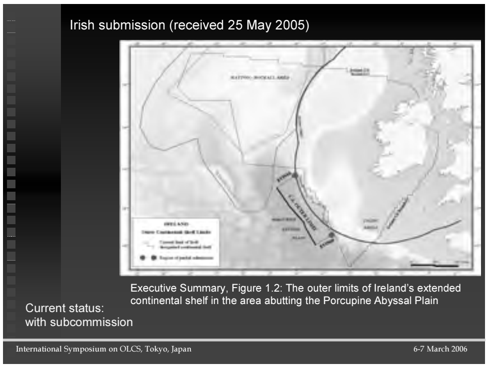
Later that year we received a submission from Australia (in November 2004). Again, this is a figure from the Executive Summary of that submission. You can see that it deals with Australia and various islands but also includes extended shelf along the coast of Antarctica, but the government of Australia requested that the Commission not consider that part of the submission. Again the current status of that submission is that it is still with the sub-commission which is examining it at present.



Slide 17.

Finally, the third submission which we are currently considering is that received from Ireland in May of 2005. Again, this is a figure from the Executive Summary. This is a partial submission and just relates to the area of extended continental shelf in the Porcupine Abyssal

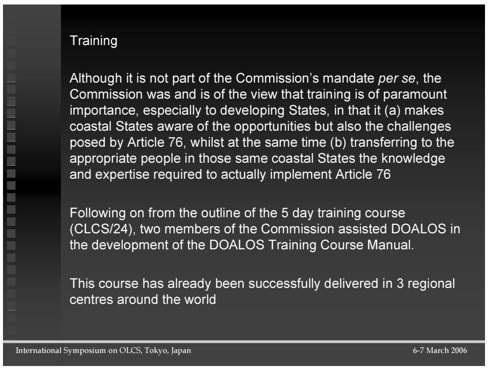
Plain. Again it is currently under consideration by a sub-commission. So those are the submissions that we have in hand at the moment.



Slide 18.

Let me go on then to mention training, and although it is not part of the Commission's mandate *per se*, the Commission was and still is of the view that training is of paramount importance, especially to developing States (which is one of the subjects of this conference), in that it makes coastal States aware of the opportunities but also the challenges posed by Article 76, whilst at the same time transferring to the appropriate people in those same coastal States the knowledge and expertise required to actually implement Article 76.

Following on from the outline of the five-day training course (CLCS/24), two members of the Commission - Dr. Galo Carrera and Mr. Harald Brekke - assisted DOALOS in the development of the DOALOS training course manual. This course has already been successfully delivered in three regional centers around the world.

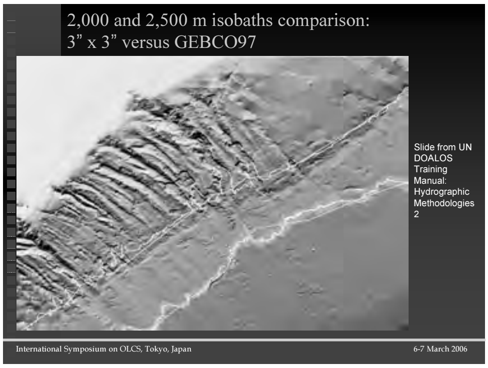


Slide 19.

The first course was held in Fiji in March of last year; covering the Pacific States; then in May of last year it was held in Sri Lanka, covering the Indian Ocean; and in December it was held in Ghana for the African Atlantic States. And the next course is scheduled for Argentina in May of this year for South American and Caribbean States.

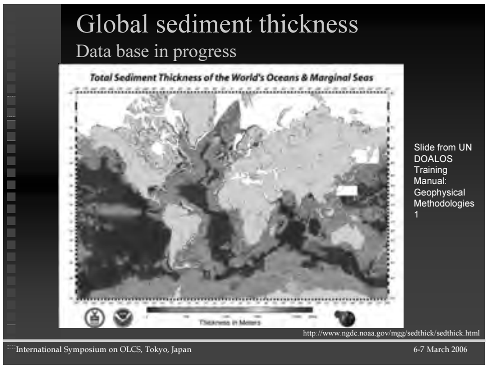
Slide 20.

I'll just show two slides from that training course. The first is from the Hydrographic Methodologies II module and it's a comparison between GEBCO97 contours which are the straighter yellow lines - the 2000 metre contour and the 2500 metre contour. Compare those contours with the white contours derived from a three-second by three-second (c.90m) multi-beam data grid. This data comparison comes from off the northeast coast of the United States and you can see that here there is really quite a good match between the two. I will show another example of this type of comparison later, from a very different area.



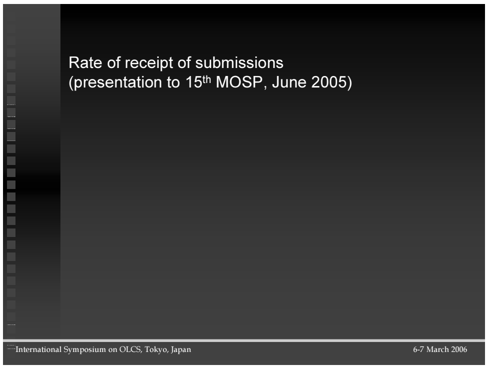
Slide 21.

Another slide from the training manual and this is from the Geophysical Methodologies I module and shows the global sediment thickness map which is being compiled by David Divins at NGDC. Although it's a work in progress you can see that a large part of the global coverage is completed. There are gaps in the Arctic obviously, and also two gaps in the Western Pacific.



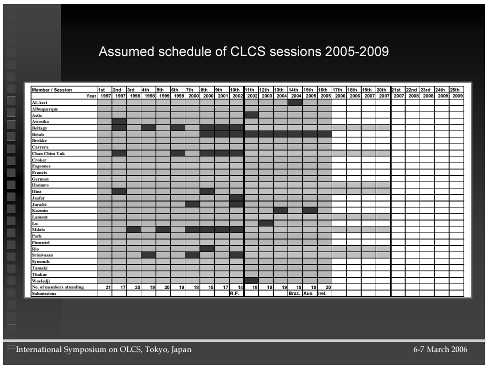
Slide 22.

Now I would like to address one of the areas of concern, which is the rate of receipt of submissions, which is considerably less than had been anticipated. The following set of slides is taken from a presentation I made last June to the 15th meeting of States Parties.



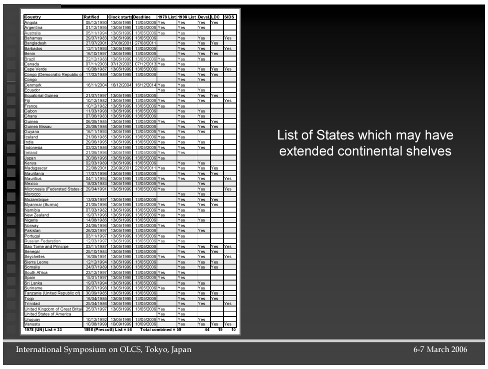
Slide 23.

This first slide is the schedule of CLCS sessions that I have assumed will take place between now and 2009. May 2009 is the ten-year deadline for the majority of coastal States (the origin of that date comes from the date of adoption of our Scientific and Technical Guidelines in May 1999). I have assumed that we are going to have two sessions in 2006, three in 2007, two in 2008, and a further two in 2009 which brings us up to the August 2009 session which would be the one at which we will be considering submissions made up to May 2009. So that's our schedule of sessions.



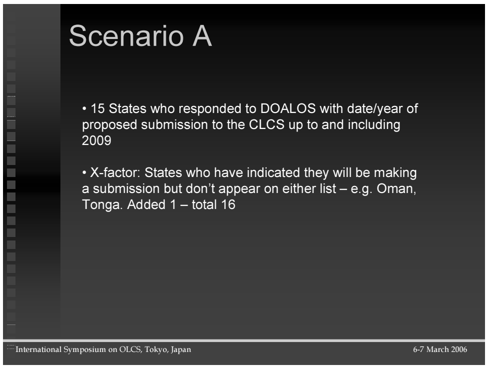
Slide 24.

I looked then at the number of States which may have extended continental shelves based on two lists. First of all there is a 1978 list which was drawn up at the time of the Third Conference by the UN Secretariat. This list contains 33 names. And secondly there is a list which was published by Victor Prescott in 1998 which contains 56 names. The total combined list is 59 coastal States.



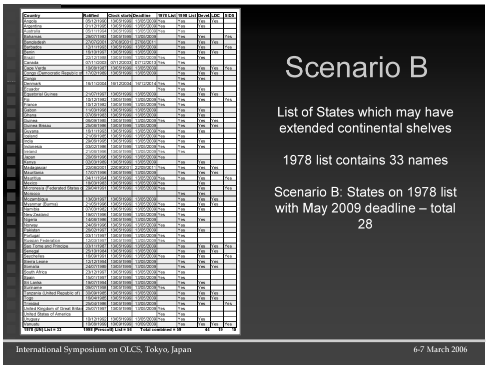
Slide 25.

I've looked at three different scenarios - I call them A, B and C. A couple of years ago DOALOS sent out letters to all coastal States which may have extended continental shelves and invited them to advise the Secretariat as to when they might be making their submissions. Fifteen coastal States responded to DOALOS with a date or year of their proposed submission to the Commission up to and including 2009. I have also included what I call the X-factor because there are some States who have indicated that they will be making a submission, but they don't appear on either of the lists that I mentioned previously, for example Oman and Tonga. So to account for that additional unknown factor, I added one extra coastal State. So we have a total of sixteen States under Scenario A.



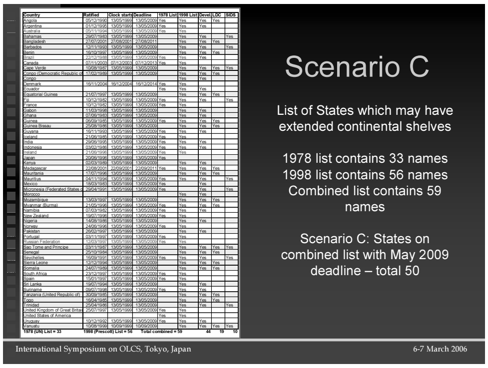
Slide 26.

Scenario B looks at the 1978 list of 33 names. Of those, a total of 28 have deadlines of May 2009.



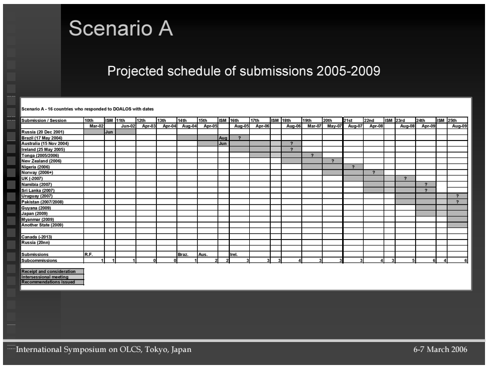
Slide 27.

And Scenario C looks at the combined list of 59 names of which a total of 50 coastal States have a deadline of May 2009.



Slide 28.

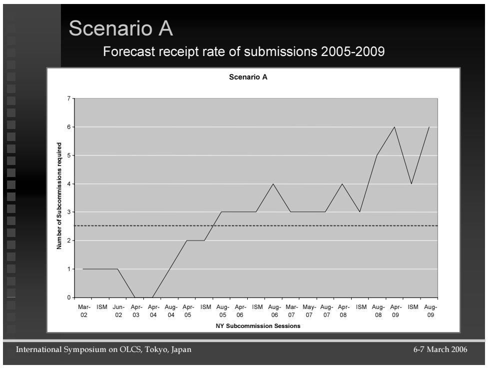
This is the projected schedule of submissions under Scenario A. In fact, this slide is now out of date regarding the submission of Brazil. I have had to make assumptions as to how long each submission would take to be dealt with by the Commission.



Submission / Session	10th	ISM	11th	12th	13th	14th	15th	ISM	16th	17th	ISM	18th	19th	20th	21st	22nd	ISM	23rd	24th	ISM	25th
	Mar-02		Jun-02	Apr-03	Apr-04	Aug-04	Apr-05		Aug-05	Apr-06		Aug-06	Mar-07	May-07	Aug-07	Apr-08		Aug-08	Apr-09		Aug-09
Russia (20 Dec 2001)		Jun																			
Brazil (17 May 2004)								Aug	?												
Australia (15 Nov 2004)								Jun				?									
Ireland (25 May 2005)												?									
Tonga (2005/2006)													?								
New Zealand (2006)														?							
Nigeria (2006)															?						
Norway (2006+)																?					
UK (-2007)																		?			
Namibia (2007)																			?		
Sri Lanka (2007)																			?		
Uruguay (2007)																					?
Pakistan (2007/2008)																					?
Guyana (2009)																					
Japan (2009)																					
Myanmar (2009)																					
Another State (2009)																					
Canada (-2013)																					
Russia (20nn)																					
Submissions	R.F.					Braz.	Aus.		Irel.												
Subcommissions	1	1	1	0	0	1	2	2	3	3	3	4	3	3	3	4	3	5	6	4	6

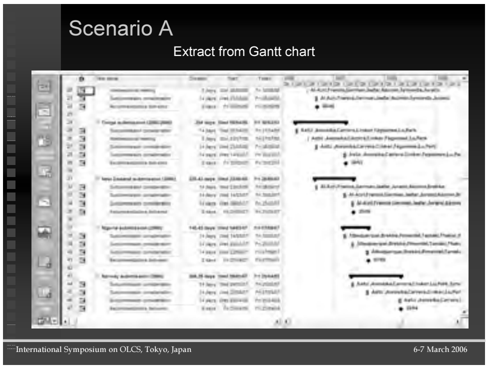
Slide 29.

If you graph that then on the Y-axis you have the number of sub-commissions that are required and on the X-axis the time or sessions. And you can see initially we're around about the level of three sub-commissions. Having 21 members and seven-member sub-commissions the Commission can run three sub-commissions simultaneously. In fact, because there may be issues with some members who are ineligible for one reason or another to serve in certain sub-commissions, some overlapping memberships are generally required to run even three sub-commissions.



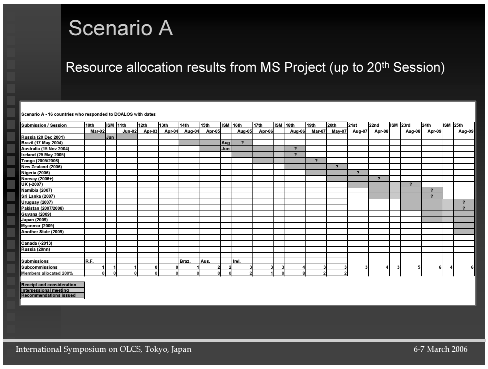
Slide 30.

For the period up to the 20th session I looked at names that I could put down against sub-commissions just to see how the manpower resources would work out, and this is just an extract from a Gantt chart I prepared.



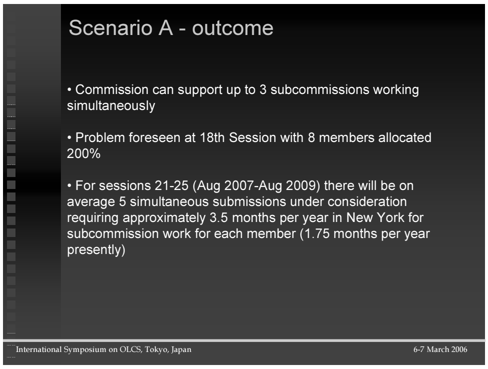
Slide 31.

This summarizes the results of that resource allocation up to the 20th session and shows the number of sub-commissions which are generally around three but then rising up to six and shows that there will be a problem at the 18th session where eight members are allocated 200%, i.e. eight of our members are on two sub-commissions simultaneously.



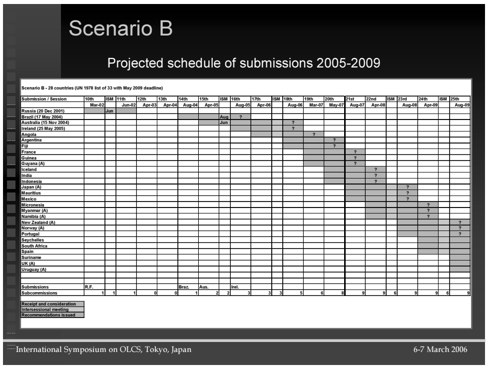
Slide 32.

To summarize then, the Scenario A outcome is that the Commission can support up to three sub-commissions working simultaneously. There is a problem foreseen at the 18th session with eight members allocated 200%; and for sessions 21 to 25 which is August 2007 through to August 2009, there will be on average five simultaneous submissions under consideration, requiring approximately three-and-half months per year in New York for sub-commission work for each member. The current work-load is about one half of that, 1.75 months per year.



Slide 33.

This is Scenario B. I just ordered the States in alphabetical order and again made the same sort of assumptions as to how long each submission would take to be examined.



Scenario B - 28 countries (UN 1978 list of 33 with May 2009 deadline)

Submission / Session	10th	ISM	11th	12th	13th	14th	15th	ISM	16th	17th	ISM	18th	19th	20th	21st	22nd	ISM	23rd	24th	ISM	25th
	Mar-02		Jun-02	Apr-03	Apr-04	Aug-04	Apr-05		Aug-05	Apr-06		Aug-06	Mar-07	May-07	Aug-07	Apr-08		Aug-08	Apr-09		Aug-09
Russia (20 Dec 2001)		Jun																			
Brazil (17 May 2004)								Aug	?												
Australia (15 Nov 2004)								Jun				?									
Ireland (25 May 2005)												?									
Angola													?								
Argentina														?							
Fiji														?							
France															?						
Guinea															?						
Guyana (A)															?						
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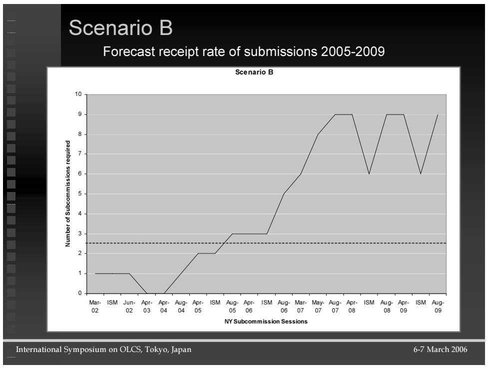
Spain																					
Suriname																					
UK (A)																					
Uruguay (A)																					
Submissions	R.F.					Braz.	Aus.		Irel.												
Subcommissions	1	1	1	0	0	1	2	2	3	3	3	5	6	8	9	9	6	9	9	6	9

Receipt and consideration
Intersessional meeting
Recommendations issued

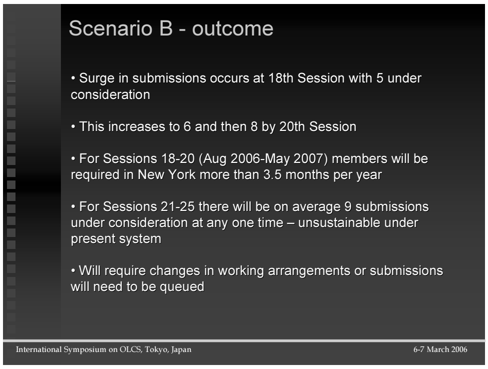
Slide 34.

Graphing that forecast receipt rate, you can see that the slope gets very steep in 2006. We were running at three in 2005 and it very rapidly rises to nine.



Slide 35.

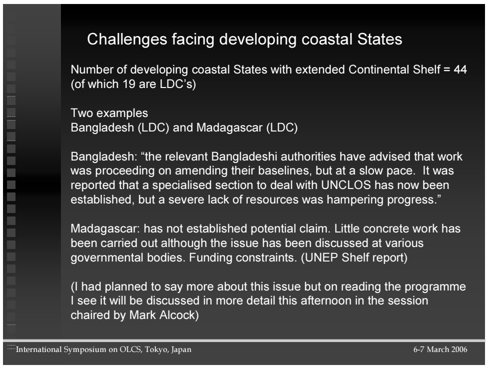
The Scenario B outcome, then, is that there will be a surge in submissions from the 18th session onwards with 5 under consideration going up to six and then eight; and for sessions 18 to 20 from August 2006 to May 2007, members will be required in New York for at least three-and-half months per year; and for sessions 21 through to 25, there will be on average nine submissions under consideration at any one time, which is frankly unsustainable under the present system. And so the conclusion from that was that we would require changes in our working arrangements or else submissions would need to be queued. Now those numbers are just for Scenario B. For Scenario C, I haven’t gone into that level of detail because I could already see from Scenario B that we were running into serious problems.



Slide 36.

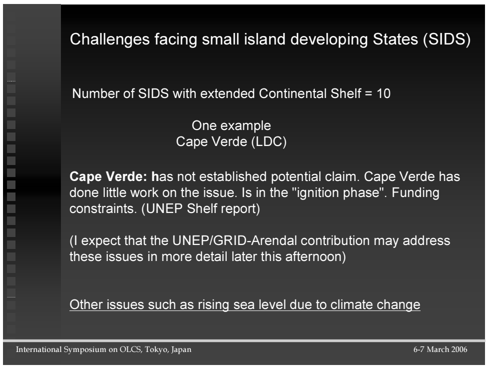
Now I just want to briefly talk about challenges facing developing coastal States. If you look at the number of developing coastal States with extended continental shelf, there are 44 of them of which 19 are least developed countries (LDCs). And I just took two examples at random, Bangladesh and Madagascar. They are both LDCs. I recently received a report which said that the relevant Bangladeshi authorities have advised that work was proceeding on amending their baselines, but at a slow pace. It was reported that a specialized section to deal with UNCLOS has now been established, but a severe lack of resources was hampering progress.

And regarding Madagascar, quoting from a UNEP Shelf report which said that it has not established a potential claim. Little concrete work has been carried out although the issue has been discussed at various governmental bodies but there are funding constraints. Now I had planned to say more about this issue but on reading the program yesterday, I see it’s going to be discussed in more detail this afternoon in the session chaired by Mark Alcock.



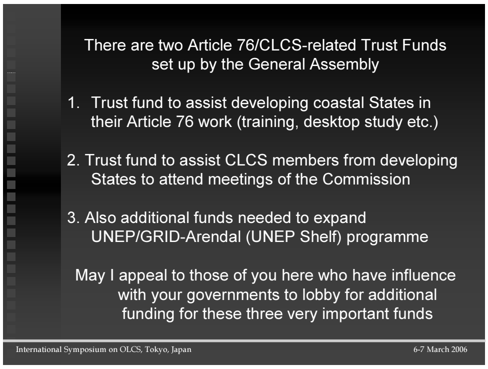
Slide 37.

Similarly, there are challenges facing small island developing States (SIDs). There are 10 of these with potential extended continental shelves, and I just looked at one example – Cape Verde - which is also an LDC. It hasn't yet established a potential claim. It has done little work on the issue, because again there are funding constraints. That again is a quotation from a UNEP Shelf report. And I expect that the presentation from UNEP/GRID-Arendal this afternoon may address these issues in more detail. Of course there are other issues out there for coastal States. And just one of them is rising sea level due to climate change. And this is a sort of 'creeping process' if I may put it like that. Bangladesh again comes to mind with regard to rising sea level.



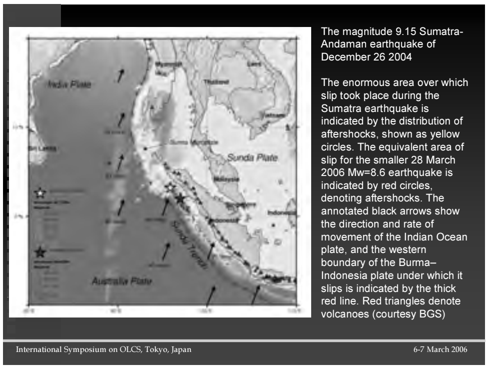
Slide 38.

Now this is the 'commercial'. There are two Article 76 and CLCS-related Trust Funds which have been set up by the General Assembly; the first one, to assist developing coastal States in their Article 76 work – training, desktop studies and the like; the second one to assist CLCS members from developing States to attend meetings of the Commission. And additional funds are also needed to expand the very important work that UNEP/GRID-Arendal and the UNEP Shelf Programme is planning. So may I appeal to those of you here who have influence with your governments to lobby for additional funding for these three very important funds. In my own case, Ireland has committed to multi-year support for both Trust Funds, and I have also requested additional funding or matching funding for UNEP/GRID-Arendal over the next few years.



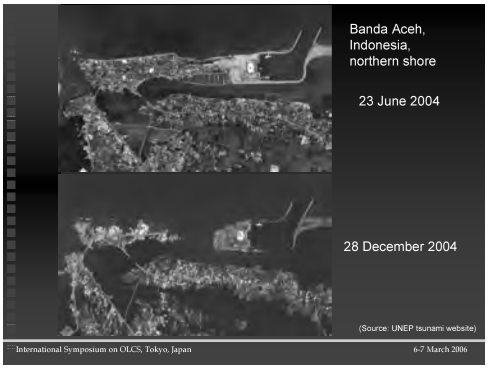
Slide 39.

Now apart from the creeping issues that I mentioned such as climate change and global sea level rise, there are of course also catastrophic processes. And the magnitude 9.15 Sumatra-Andaman earthquake of December 2004 immediately comes to mind. This map shows the enormous area over which displacement took place (shown by the yellow circles) - over 1000 kilometres. The tsunami generated by that earthquake caused an appaling loss of life – some 200-300,000 people - and destruction of coastal areas in many countries around the Indian Ocean.



Slide 40.

This slide shows satellite views of Banda Aceh in Indonesia before and after the tsunami. You can see the total devastation of the coastal areas and the infrastructure that has occurred.

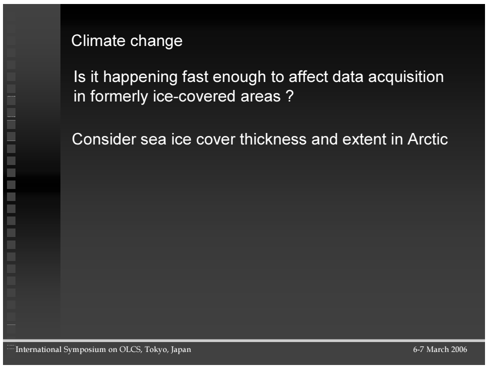


Slide 41.

Similarly, here are two shots from before and after the tsunami - these are IKONOS satellite images of an area in Thailand which shows the amount of coastal erosion/destruction due to the tsunami.

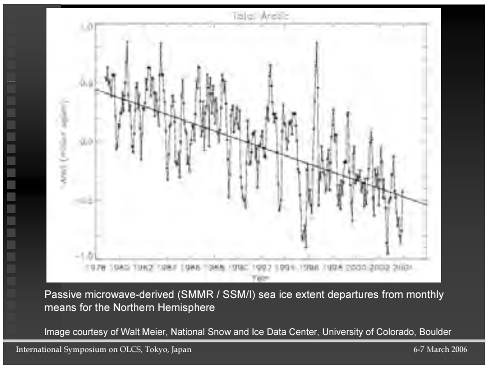
Slide 42.

Again, returning to the issue of climate change, is it happening fast enough to affect data acquisition in formerly ice-covered areas ? It's a question I've been thinking about over the last while. Some States which may have extended continental shelves in the Arctic have some time before they need to make submissions. Canada's deadline, for example, is 2013; Greenland/Denmark is 2014; and the United States which has not yet ratified has at least till 2016. I am going to show some examples of both multi-beam acquisition and drilling in ice-covered areas. Consider the sea ice cover thickness and extent in the Arctic.



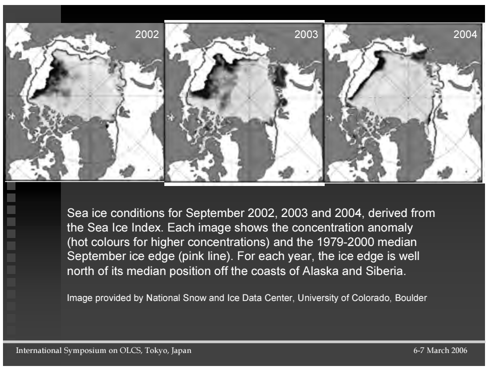
Slide 43.

This graph shows the changes in sea ice extent over the last 25 years. And you can see that since around 2000 there have been significant reductions in total sea ice extent.



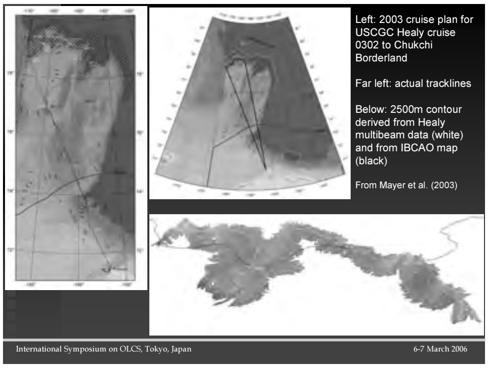
Slide 44.

Just looking at three years - 2002, 2003 and 2004 - the pink line shows the 1979 to 2000 average September ice edge on each of the images. And you can see that for each of these three years, the September ice edge is well north of its median position off the coasts of Alaska and eastern Siberia.



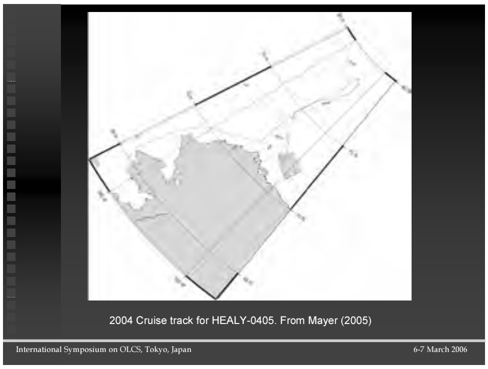
Slide 45.

In 2003 the US initiated a survey into the Chukchi Borderland and these are some images from the report of that cruise by Larry Mayer (who is with us and will be speaking later in the symposium). The left panel shows the cruise tracks along the 2500-metre isobath in the north Chukchi area. And the lower right image shows a comparison between the 2500-metre contour derived from the multi-beam data, which is the white line, compared to the 2500 metre contour from the IBCAO map, which is the International Bathymetric Chart of the Arctic Ocean which was published in 2001; obviously, some significant differences between the two.



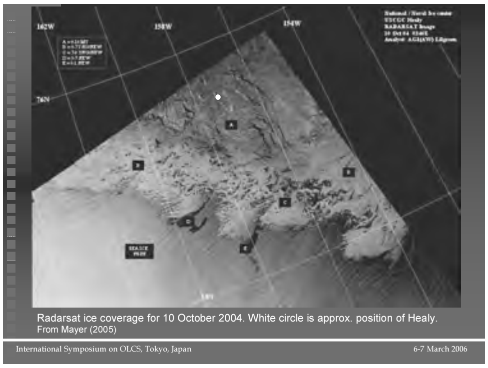
Slide 46.

The U.S. also ran a cruise in the Arctic in 2004 and again went up north of Alaska to the Chukchi area. The cruise track shows them tracking the 2500 metre isobath in the north. They were also doing some foot of slope work down to the south.



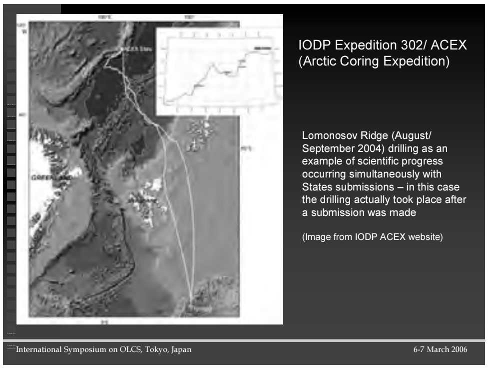
Slide 47.

This image is little too dark, but it shows the extent of ice coverage at the time. The area in the southwest is free of sea ice, while to the northeast ice thickens. The white dot shows the position of the Healy on that particular day as the ship was steaming north at 4-5 knots collecting multi-beam data.



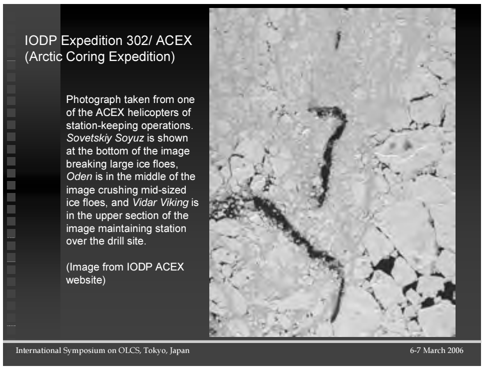
Slide 48.

Finally, to drilling. In 2004 IODP undertook drilling on the Lomonosov Ridge, and I just quote this as an example of scientific progress which is continuous and occurring simultaneously while coastal States are making their submissions. In this case, the drilling actually took place after a submission had been made. The drilling site is to the top of the map.



Slide 49.

This shows three vessels; near the bottom is the "Sovetskiy Soyuz" icebreaker, the Swedish icebreaker Oden in the middle, and the drill-ship Vidar Viking at the top. The two icebreakers are breaking large and mid-size ice floes which might threaten the drill-ship. The general drift of the ice is to the top of the image.



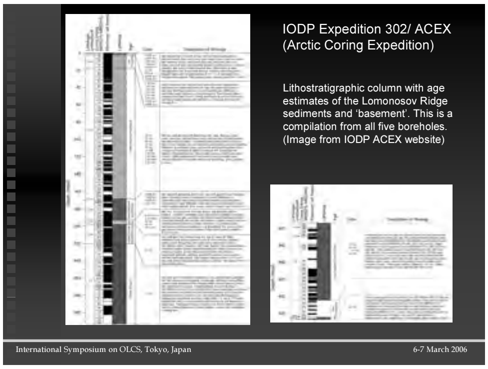
Slide 50.

Here is a more conventional view showing the three ships. This was a tremendous scientific achievement to undertake coring operations in this type of environment.

Slide 51.

Finally then, this shows the lithostratigraphic column at the site - it's a composite in fact of the five sites that were drilled and shows that they succeeded in coring over 400 metres, penetrating the entire Tertiary section and bottoming in the Upper Cretaceous.

With that I would like to conclude. I would like to thank the Ministry of Foreign Affairs of Japan and the United Nations University for sponsoring this event and inviting me and my fellow Commissioners to participate and I look forward to a stimulating programme over the next two days.



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http://www.ccom.unh.edu/index.php?p=114|121|181&page=unclos/lots_reports.php

Mayer, L.A. (2005) 'Cruise Report, USCGC Icebreaker Healy (WAGB-2), U.S. Law of the Sea cruise to map the foot of the slope and 2500-m isobath of the US Arctic Ocean margin. CRUISE HE-0405, October 6 to October 26, 2004, Nome, AK to Barrow, AK '
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IODP ACEX
http://www.rcom.marum.de/English/IODP.html

Division for Ocean Affairs and the Law of the Sea, United Nations
http://www.un.org/Depts/los/clcs_new/submissions_files/rus01/RUS_CLCS_01_2001_LOS_2.jpg
http://www.un.org/Depts/los/clcs_new/submissions_files/rus01/RUS_CLCS_01_2001_LOS_3.jpg
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http://www.un.org/Depts/los/clcs_new/submissions_files/irl05/irl_exec_sum.pdf

Meier, W. http://nsidc.org/sotc/sea_ice.html

United Nations Environment Programme
http://www.unep.org/tsunami/Banda_Aceh_Tsunami_Damage.pdf

National University of Singapore
http://www.crisp.nus.edu.sg/tsunami/Khao_Lak_20041229_20030113/Khao_Lak_20041229_20030113.html

Introduction and Status Report from DOALOS[1]

Dr. Vladimir Golitsyn

Director, Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs,

United Nations Secretariat

Distinguished participants, ladies and gentlemen, since the previous speaker, the Chairman of the Commission on the Limits of the Continental Shelf (the Commission) has described in detail the nature and functioning of the Commission, I will confine myself to noting that unlike the two other bodies established under the United Nations Convention on the Law of the Sea, namely the International Tribunal for the Law of the Sea and International Seabed Authority, the Commission does not have a secretariat of its own. Article 2, paragraph 5 of annex of the Convention establishes that *the secretariat of the Commission shall be provided by the Secretary-General of the United Nations*. This provision was rendered operational by General Assembly resolutions 49/28 and 52/26on the Law of the Sea. Within the United Nations Secretariat, it is the Division for Ocean Affairs and the Law of the Sea (the Division) that provides secretariat functions to the Commission. My presentation aims at describing the activities carried out by the Division in this connection.

I will provide an overview of the relevant provisions contained in the Convention and in the rules of procedure of the Commission, and I will then focus in particular on the depositary and due publicity functions of the secretariat, as well as on the organization and servicing of the Commission. In doing so, I'll pay special attention to the efforts carried out by the Division in order to facilitate the work of the Commission in the context of the projected increase in its workload.

There are four main functions that are performed by the Division as a Secretariat of the United Nations. These are depositary functions, due publicity functions, organization of elections of the members of the Commission, and representation and providing services to the Commission.

As far as the depositary functions are concerned, they are a special part of the Division's

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1 This was presented as the first presentation in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

activities, and they focus on maritime spaces where the Division plays a vital role. The Division discharges the functions of the Secretary-General as the depositary of nautical charts and listing of graphical coordinates provided for in the Convention. With specific regard to the continental shelf, article 76 and 84, as well as annex II to the Convention, envisage specific depositary functions that have to be discharged by the Secretary-General in connection with both the submissions made by coastal States to the Commission and the recommendations issued by the Commission.

In the case of extended continental shelves going beyond 200 miles, the rules of procedure of the Commission contain an operational framework for the discharge by the Secretary-General of his functions as a depositary. Upon entry into force of the Convention, and as reconfirmed by General Assembly resolution 52/26 of 26 November 1997, the Secretary-General is requested to develop and maintain the appropriate facilities for the deposit by States of charts and geographical coordinates concerning maritime zones including lines of delimitation and to give due publicity thereto.

The objective of the Convention's provisions in this regard is clear: the international community and the users of the seas and oceans need to know the limits of the maritime zones in which a coastal State exercises its sovereignty, or sovereign rights and jurisdiction, in view of the different legal regimes applicable in this regard.

Acting upon the requests contained in the respective General Assembly resolutions, the Division has established facilities for the custody of charts and lists of geographical coordinates deposited, and for the dissemination of such information in order to assist States in complying with their due publicity obligations. In this connection, States Parties are encouraged to deposit lists of geographical coordinates in World Geodetic System 84 (WGS84), or to provide all the necessary information for conversion of the submitted geographical coordinates from the regional datum into WGS84.

Finally, and according to article 84 of the Convention, in the case of delimitation of the continental shelves between States with opposite or adjacent coasts, charts and/or coordinates describing lines of delimitation drawn in accordance with article 83 of the Convention shall be deposited with the Secretary-General of the United Nations. The Secretary-General is required to give due publicity to such charts, and relevant information including geodetic data permanently describing the outer limits of the continental shelf submitted to the Commission.
I would now like to focus on the work carried out by the Secretariat with regard to the election of the members of the Commission, who are elected by the meeting of States Parties

for a term of five years. In this connection, the Secretary-General, who convenes the meeting of States Parties every year, plays a preparatory role for the election at least three months before its date. The Secretary-General addresses a letter to States Parties inviting the submission of nominations after appropriate regional consultations and within three months. The Secretary-General then prepares a list, in alphabetical order, of all persons nominated and submits this list to States Parties. The election then takes place during a meeting of States Parties which is also serviced by the Division.

Finally, I come to a particularly important function performed by the Division, namely the provision of services to the Commission. As required by the Convention, the Secretary-General of the United Nations plays a particularly crucial role with regard to the preparation, convening, and servicing of the sessions and meetings of the Commission. Since the Commission does not have its own secretariat, as I have mentioned before, all the necessary administrative and logistical arrangements are carried-out by the secretariat, through the Division. In doing so, the secretariat provides continuity to the work of the Commission, which itself convenes only during the sessions. It also acts as interface between the submitting States and the Commission.

Article 76 of the Convention does not regulate the functioning of the Commission in detail. Rather, it confines itself to describing the role of the Commission in the process of the establishment of the outer limit of the continental shelf. Annex II contains more detailed provisions. However, these do not cover the particulars on the organization of the daily work of the Commission, and for the purpose of this presentation, by the Secretary-General. This is not surprising, as international instruments do not always provide detailed provisions regarding the operation of the bodies established by them. These are laid out in separate documents which are adopted by the bodies concerned after the entry into force of the international instrument. This was the case also for the Commission. Again, as the Chairman of the Commission described in detail the work of the Commission on the preparation of its rules, I will not spend time on this subject.

According to the rules of procedure adopted by the Commission, the Secretary-General records and acknowledges receipt of submissions and any subsequent editions. Similarly, the Secretary-General receives and keeps custody of the recommendations presented by the sub-commissions for the consideration by the Commission. Once the whole process of delineation of the outer limit of the continental shelf is completed, the Secretary-General has a depositary role with regard to the charts and relevant information, including geodetic data permanently describing the outer limit of the continental shelf. This situation has not yet occurred. However, when it does occur, the Secretary General will receive and keep custody of charts and information in the same manner as s/he does with regard to the other charts and coordinates which the Secretary-General is mandated to receive under the Convention.

The aspects of the work of the Secretary-General that are regulated in most detail within the rules of procedure of the Commission are those pertaining to the organization and servicing of the Commission sessions and meetings. These activities include the notification of upcoming sessions of the Commission to its members and to the submitting States, if any; the preparation of the agenda of the session; the arrangements related to the session, including interpretation services, conference services, documents translation; and liaison functions among the Commission, its sub-commissions and delegations of the submitting States.

Another important aspect of the support provided by the Division to the Commission is the preparation of documents upon the request of the Commission. For instance, in order to facilitate the work of the Commission, recently the Division was involved in background studies concerning the existence of guidelines for the conduct of members of bodies established by multilateral treaties as well as the revision of the rules of procedure of the Commission.

Needless to say, if the increase in the projected number of submissions will pose a serious burden on the Commission, it will create a comparable, if not proportionately bigger, strain on the work of the Division. Our Division, in fact, carries out a number of additional and growing activities.

The projections concerning the workload of the Commission provided to you by its Chairman are such that in the coming years they will start to place an impossible strain on the Division's staff who are assigned to assist the work of the Commission. These individuals have to be involved with the Commission on a full-time basis, while they also have other responsibilities. Under the current logistics and budgetary scenarios, this poses a serious burden on the Division and its capacity to carry out its mandates in an effective manner. The increased budgetary constraints of the United Nations of course renders the situation particularly complex. However, up to this point the Division has been able to meet its mandate within the limits of the existing resources and personnel available. Even though the Commission is purely a technical body, its work has obvious legal aspects which can be of both procedural and substantive in nature.

Besides the day-to-day assistance provided on this issue by the Division during the sessions of the Commission, at times the Legal Counsel of the United Nations has responded to requests for legal opinions by the Commission; and in this respect, he is also assisted by the Division. The legal opinions have covered substantive issues such as the applicability of the Convention on the Privilege and Immunities of the United Nations to the members of the Commission. This legal opinion was issued on 11 March 1992.

All procedural matters in the latest opinion of 7 September 2005 touch upon the question of whether it is admissible under the Convention and the rules of procedure of the Commission for a coastal State which has made a submission to the Commission in accordance with article 76 of the Convention to provide to the Commission, and because of recognition by it of its submission, additional material and information relating to the limits of its continental shelf or substantive part thereof which constitute a significant departure from the original limits and formula lines that were given due publicity by the Secretary-General in accordance with rule 50 of the rules of procedure of the Commission.

It should be noted that in the work of the Commission, we are moving from a first phase, which was mostly dedicated to its setting-up and its internal organization, to a second phase where the Commission is increasingly involved in the substantive consideration of submissions, and that changes the nature of the services provided by the Division.

I have already mentioned that the Secretary-General is required to give due publicity to the various notifications regarding coordinates that the Secretary-General receives from States. In accordance with the rules of procedure of the Commission, the Secretary-General and the Division are also required to inform States Parties to the Convention of the deposit of the submissions received by the Commission, substantive additions to them, and comments by States to the content of the executive summary of the submissions received. The Division does so through the so-called continental shelf zone notifications. This type of notification is sent to all States members of the United Nations in order to maximize the circulation of information about the developments which are of great importance for all activities carried out at sea. This information is also made public through the Commission's website, which is maintained by the Division. The website contains the executive summary of the submission including maps, as well as any subsequent changes to it, and the comments made by States. And we just received an edition by Brazil to its original submission, which is already posted on our website.

The Division currently has 10 staff members who are engaged in providing assistance to the Commission. Each sub-commission has one staff is assigned as Secretary of the Commission, another as Deputy-Secretary and another one as GIS officer, in addition to support staff. Both during the session of the Commission and intersessionally, GIS officers carry out the technical work required for each submission by the sub-commissions that are established to examine a particular submission. The projected increase in the workload of the Commission, which has been mentioned on several occasions, including by the Chairman, will pose a challenge to the Division in particular with respect to personnel. The likelihood of having three sub-commissions working at the same time will become a constraint feature in the future. The 16th session of the Commission showed that this means that some members of the Division will have to be assigned to multiple sub- commissions and the same applies to the GIS officers.

I would like to say a couple of words about the administration of the trust funds. The Division administers seven trust funds, two of which relate directly to the work of the Commission, and one indirectly.

One of these trust funds enables the Division to provide assistance to the developing States in preparing their submissions, and I will speak about this trust fund this afternoon.

The other trust fund of direct relevance to the work of the Commission was established to assist developing States in defraying the costs of participation of members of the Commission that they nominated. This decision was taken by the General Assembly in 2000. This trust fund currently has an approximate balance of US$ 40,000; and the Division has a commitment from the Government of Ireland to provide Euro 50,000 in 2006 and in 2007. It should be noted that the Government of Ireland already provided Euro 50,000 in 2005. Unless additional contributions to this trust fund are received, the Division will only be able to support the participation of the relevant members of the Commission during this spring session, as it costs approximately $60,000 to support the participation of these members. Therefore, there will be no money left for the full session, and thus I appeal to you to consider making contributions to the trust fund.

As I mentioned previously, there is a third trust fund which is indirectly related to the work of the Commission, and which I wish to draw your attention to. This is the trust fund agreement between the United Nations and The Nippon Foundation of Japan for the provision of capacity-building and human resource development to developing coastal States Parties and non-Parties to the Convention through the UN-Nippon Fellowship Programme. With the generous support of The Nippon Foundation of Japan, the Division has been in a position to provide twenty fellowships over the last two years to highly qualified civil servants working in ocean affairs and the law of the sea fields, and we are currently in the process of accepting applications for another ten awards next year. I mention this Fellowship Programme as it has afforded opportunity to several fellows in each of the past years to undertake advanced research in the area of extended continental shelf delineation, including the preparation of submissions to the Commission, and the work of the Commission. Thus, although other fellows undertake research in the many aspects of ocean affairs and the law of the sea, the Fellowship has also proved invaluable in assisting States Parties to fulfill their obligations with respect to the delineation of the extended continental shelf.

Coming back to the work of the Commission, it must be noted that during its fall session in 2005, and for the first time, three sub-commissions simultaneously analyzed submissions; namely those made by Australia, Brazil, and Ireland. The existing facilities proved inadequate to accommodate three sub-commissions without significantly delaying the work of each. Therefore, the Division has undertaken significant efforts in increasing its capacity to service the meetings of the Commission. We have purchased additional hardware and software, and have obtained the services of an additional GIS officer.

In summary, for the spring session, the Division will provide the Commission with three fully equipped GIS laboratories, one of which has the dual role of a conference room and GIS laboratory. This will allow the Commission to hold three simultaneous sub-commission meetings. Thus, it is evident that servicing the Commission is a demanding task which is further complicated by many unknown factors which can only be discovered through the actual analysis of new submissions. Nevertheless, the Division remains committed to continue to provide support to the work of the Commission.

I would like to thank you for your attention.

Marine Mineral Resources[1]

Prof. Akira Usui
Department of Geology, Faculty of Science, Kochi University, Japan

Thank you very much for your kind introduction. As the Senior Vice Minister for Foreign Affairs of Japan has mentioned in his opening remark, very significant intentions of understanding the deep ocean floors is in fact out of the limits of the continental shelf. What are the "mineral resources" that lie in the seabed? As a researcher from a university, I would like to add some substance from scientific points of view to give you a more realistic dimension and material for further discussion, which I believe is my role that I need to fulfill.

I believe in these sessions tomorrow will cover a truly scientific research. I would like to give an overview based on my experience of 20 to 30 years in the ocean. You may assume that we have seen advancements and research regarding mineral resources for these decades. However, I have quite a candid feeling that regarding maritime mineral resources we are not blessed yet with the full substance under dimension of the resources. There are high expectations and there are also extremes that rule out mineral resources as unrealistic. I believe this is because we don't have a confidential data which can be well trusted from mineral resource surveys. I believe my role is to deliver some dimension of that, to give the material for discussions. As in the acknowledgments, the metal mining agency of Japan as well as others and their cooperation that has been rendered will be presented within my presentation. I need to stress that I would like to provide my personal viewpoints in my presentation.

With regards to continental shelves and its extensions, of course you know well of the mineral deposits. And as you see, marine mining, as you see to the left, 50 or 60 years back from now, of plate tectonics and new findings from oceans have started to become active since that period. And utilization of marine mineral resources is an idea that came up from that period; which was mentioned in a famous publication, submarine robots or exploration vessels in fact have come into reality having being proposed a long time ago. Now, we have these tools. We are ready to describe more realistic views of marine mineral resources to their fullest dimension, using this technological advancements that we have made in the last decades.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

To give you grounds for discussions of course, there were divided views on this point. Marine mining in a number of ways is profitable and/or is it sustainable in its given form is the question that I think we should be asking ourselves. We will see a depletion of land-based metal resources in the event, eventually which is turning more into a reality. Therefore it provides an alternative to this for accounting measure, to expand the frontiers, and also to introduce new technologies; further in addition to this, to explore a number of solutions amongst which important is to expand our frontiers. The largest target amongst the frontiers as you will acknowledge is the sea.

In going forward, though we do not have a time table precisely laid in developing marine mining, in the coming decades we need to prepare ourselves in a number of areas. Having said so, we will in fact present data on the Northwest Pacific. A number of questions of what it embeds and what are the interests that are attached to the resources is what I will cover.

In this slide, this is not scaled to its image that it presents. We have the coastal states as well as in the seabed. There are a number of types of mineral resources at sea that are deposited and that have been already developed. We won’t talk about hydrocarbon resources today. There are some commercially developed resources. Extending how the continental shelf, this shows setting aside the economics what rests in the extensions or exploration? The deep sea in the scientific sense is not the vehicle-defined seabed, the oxidic manganese like crusts, there’s nodules as well as -- in fact we believe there were three major materials that are of volcanic nature and so forth that I would like to address.

There were a number of developmental stages in each segment. Setting aside whether it’s feasible or not, the ultimate goal is mining. However, going to that, we have scientific research, or exploration, or plant building. So in that developmental dimension for manganese nodules, stage 3 is the current status quo for the two that I had mentioned here. The remaining two are still in the stage 2. The idea of economic properties of manganese nodule deposits goes back 40 years, and the remaining two have only been explored for the last 20 years.

What attracts us to these resources is their huge volume of the three types of minerals that I have mentioned. This table shows the total metal volumes of the sea in comparison with on land deposits of Ni Co, Cu, Pt, Au. It is about five times as much for cobalt. It may be sometimes overestimated, but this is the first element that needs to be recognized.

Next, the important parameter is the grade. We will examine the content or concentration or ore grade. The metal concentration in each type of ore, which compares them to or greater than the average land-based mines for many metals. The sea based minerals, manganese nodules and manganese crusts, and sulfide deposits are usually enriched. Say coastally copper, 1% or less is the ore concentration. The marine resources a number of them as well as the similar can be said for platinum. Therefore by viewing the minerals if there are land-based there would be no doubt valuable, which will not be argued by anyone.

Of course these minerals are attractive which were explained with the reasons summarized here. The scientific aspects, I think I must note this, that for each ore, the geological history as well as the origins are very important in relation to earth and ocean evolution. But I will just focus on economics in this presentation. Manganese nodules and crusts are compared as low-grade massive ores. On the other hand massive hydrothermal sulfides are similar to land-based ores.

I would like to stress this point. The massive sulfide, the hot springs as well as volcanic activity has yielded, concentrates copper as well as silver and gold. However their volume and dimensions of deposits are yet to be fully identified. The distribution of this on a regional scale is known. It is not to say that they are found in each of the areas covered, but it is to say that in the white areas of this map you are not likely to find a distribution. So this is just the general distribution. The deposit is not distributed randomly but in an appropriate setting as well as the rocks as well as the sediments and also where they align with the regional settings, which is an important thing to mention.

In the Pacific, we have idea of where they are; however, we would like to focus and pinpoint further. I would like to just briefly introduce you the Northwestern Pacific area which includes the waters around Japan. This is history -- or there were a top number of topics since late 1970s, and the 1960s were the age of development of research vessels; a number of them have been launched. A number of devices of research and sampling have advanced in a number of ways since unexpectedly we have discovered mass deposits. To give you a few examples, the Northwestern Pacific is geologically very complex. Marine mineral resources are in fact accordingly complex with the geological history and oceanographic natures.

Therefore compared to other seas or areas in fact it is rich in abundance of these elements. What we had expected in this area are the two types that are mentioned here for the last 10 years. As a conclusion, we have not expected much from others because it is a geologically active area. Therefore the manganese nodules and crusts as well as sulfides were not expected much and there is no lift gates so called. The spreading center, we provide with any hydrothermal effects of which we generally did not assume in the area. However for the last decade, we have advanced researches in the number of ways, which have unveiled more detailed and focused postures.

Small local scales as well as long time changes have also been incorporated into the findings. This is an example. In the USA Geological Survey map in the 90s around Japanese waters, we don't have many minerals that are distributed.

In the map, the yellow part and orange part shows the sign or evidence of mineralization. The boundary of the plate and the geological structure which is very complex, you can see they are scattered. From here I did not go into details, but I talked about the mineral resources can be divided into two groups; one is I would like to talk about how they were formulated and perhaps I should have mentioned these earlier, ferromanganese crusts or manganese nodules actually exist on the seabed and at the top of the seamounts. When they were produced in the history, they are very at a slow rate and from the sea water they were produced. Their growth rate is some millimeters per million year. The manganese deposits are sedimentary rocks dispersed over the submerged seamounts or seabed.

The rare metals which are not common on land ,are often contained in seabed minerals. And also what is very important is that there is a change with locations, and there is difference in within the samples, from sample to sample. Why this exists in the sea bed? This is not very unique in Japanese waters but common in world oceans. This is probably related with change of geological environments of past millions of years. So the rationally, the mineral resource, the grade has to be discussed with scientific aspects.

For instance in the mid-Pacific, there was a difference in the grade and so we are able to identify this. But for instance within a scale of one kilometer for instance, the ferromanganese or the crust and also sulfide; the story is not that simple because even you look at one mountain which was a emerged volcano, then eroded, reef-built, and then submerged. Each area has its own history. And therefore the way of formation is different.

And this seamount is half of Mount Fuji in size, and then cut into half. Though it looks quiet simple, if you have a close-up of the picture sedimentary rock, you find how they accumulated and the detailed topography differs from one to the other. And therefore depending upon the location, distribution of the mineral resources is quit different. This is just one of the examples. And this is not the active volcano but old volcano. According to the gradient and natures of the slope, you can observe the complicated distribution of the mineral resources.

The composition of mineral resources also differs with location. And if we take these as sedimentary rocks, they are not homogenous and when they were created depending upon the timing. Rare metal grade differs by two times to three times. So, if you observe them closely at this smaller scale, there are rather changes and very difficult for us to identify the horizontal or the link among them.

And secondly, I would like to talk about formation of polymetallic massive sulfide resulting from the hydrothermal activity. As you can see, the chart indicates how they are created. In 1980 - around 1980 for the first time, from when the active massive sulfide was discovered, only 20 years have passed. The deposit - hydrothermal deposit discovery has increased over the last 20 years. From the submarine volcanoes we have seen a lot of the sulfides. So, it’s no surprise anymore. Also around Japanese islands, this kind of natural resource has been discovered at more than 10 sites. The time doesn’t allow me to go into how they are created, but there is the rupture of certain scale coming from volcanoes. The requirement is unlike land, the ground at the certain depth and the sea water must be circulated.

And in many active volcanoes, the polymetallic massive sulfide is likely to be created at around Japan. A scale is uncertain or unknown, but we are able to see the sign of this discovery in various environments. Not only in Japan but around New Zealand, from active volcanoes, we have seen submerged evidences. You can see - from all of the active volcanoes, you can see the mineral or the resources. You can see not only spreading center but other subduction of plate, and there is the volcanic chain. So in the subduction zone there is the metal with different composition. For example, in the Okinawa trough, you can see these submarine volcanoes, indicating exhalation of 300 degree hydrothermal waters, which yields gold, silver etc.

Around this area various research which should be carried out is ongoing. Active volcanoes beneath 1000-m water depths and similar geological setting are observed anywhere, but this may be the massive sulfide covering almost one meter. There is a great economic potential, but we do not know of continuity. There must be horizontal continuity that we can check, but we do not know how deep are the deposits beneath the floor. And mineral deposit, whether they can preserve for long time, that is the question, but we have very little knowledge about that.

So I have been rather discussing the details about the mineral resources and finally there are four important points. Firstly, at the larger scale, the sea bottom ores are as good as that on land, in terms of volume and quality as mineral ore. Secondly the current knowledge -- the detailed data have come to be made available to us, and there is a very little data to compare that to the geological or the process. Correct knowledge has not reached the level to enable us to have the realistic economic value analysis.

Thirdly, those mineral resources are actually alive based on the current seabeds. Therefore by so doing we are, by looking at the nature of the ore, able to have a good access to the current condition of the environment in the ocean. And then the science data enable us to rectify our over and under estimation in long term. The practical and continuous mining is what we aim at. The science is of great importance. That I have been feeling very strongly recently. And with this I would like to conclude my presentation. I thank you very much for your attention.

Chapter 2

Preparation for Submissions

Section 1

Issues Facing Developing States-National Reports-

National Report- Fiji[1]

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Principal Scientific Officer, Mineral Resources Department, Fiji

Article 76 for an extension to the continental shelf of coastal states wherever the criteria was met presents an opportunity for small island countries like Fiji which has only approximately 18,000km^2. Fiji, like many coastal nations missed out on the initial 10 year time frame for submission and as for some other coastal nations has been given another five years to make a submission, which is due in May 2009.

For Fiji, the continental shelf project is coordinated by the Maritime Affairs Committee (MACC) which is under the Ministry of Foreign Affairs. A MACC Cabinet sub-committee which includes Ministers: Attorney General, Minister of Lands, Minister of Foreign Affairs (chair), Minister of Transport and Civil Aviation, Minister of Home Affairs and Minister of Fisheries and Forests. Through this sub-committee, a budgetary proposal for resurveying the base points, setting up of an office and existing data gathering was submitted to Cabinet, but the Ministry of Finance can not provide the necessary funding.

Tests of appurtenance by the Mineral Resources Department and SOPAC in the mid nineties and lately by UNEP Grid and a Commonwealth Secretariat consultant have all shown that Fiji has a potential claim in the high seas of the southern Lau Ridge. New Zealand and Tonga both have potential claims in the same area. To date, Fiji has had a meeting with New Zealand in regards to data accessibility. After reviewing that New Zealand's data set, Fiji realised that we need to gather about 800 line kilometres of new data to maximise the FOS. Regular contacts have been made to establish ships of opportunity that are planning to work close to the area and counterparts in United States of America who will be doing research just north of the potential area and have shown willingness to assist. Again, the constraint is funding for the three days multibeam work. Interpretation of the New Zealand's data have shown that the sediment thickness is less then 1%, so we are concentrating on one formula line evidence only, hence the need for more multibeam data.

We have about three years to make a claim, and it is a bother for our technical working group as time is closing in fast. Fiji's main constraint is funding and if no solution is found soon, we

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

are liable to loose out on about 100,000 km^2 of sea area and all the benefits in terms of living and non living resources.

National Report – Indonesia[1]

Mr. Haris Djoko Nugroho
Head of Veriffication, Chart Division, Hydro-Oceanographic Office, Indonesia

According to the provision of the article 76 on United Nations Convention on the Law of the Sea established in 1982 and Rules of Procedure of the Commission on the Limits of the Continental Shelf, and also UN DOALOS, has announced to all member states, that a member state has a right to propose a claim referred to the continental shelf limit till 2009. A coastal state has a right to claim the continental shelf beyond 200 nautical miles if its seabed as region has certain requirements, such as the foot of the continental slope plus 60 nautical miles formula, the foot of the continental slope to 1% sediment thickness, 100 nautical miles from the depth of 2,500 meters and 350 nautical miles from the baselines.

Therefore, as its member the continental shelf party of Republic Indonesia together with Hydro-Oceanic Office Indonesia (Dishidros TNI AL) will then continually analyze and discuss the possibility of it. Provisionally it is estimated there are three locations which have the possibility to be claimed by Indonesia, namely in the west of Sumatera island on Indian Ocean Region, in the North of Papua island on the Pacific Ocean Region and in the South of Sumba island waters.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

National Report –Maldives[1]

Captain Ibrahim Hilmy
Assistant to the Director General, National Security Service, Coast Guard, Maldives

Maldives is a chain of 1190 little coral islands scattered across the Indian Ocean that forms the archipelago of the Maldives in 80-120 km wide, stretching 860 km from latitude 7 degrees 6 min north to zero degree 41 min south and lying between 72 degrees 32 min and 73 degrees 45 east. The Maldives straddles the equator and has a tropical climate. Maldives comprises of 26 geographical atolls. An atoll is best visualized as a series of concentric layers. The outermost layer of the atoll is a strong reef composed of coral debris and living coral. Maldives is an archipelagic state and thus maritime boundaries are delaminated as per United Nations Convention on the Law of the Sea (UNCLOS) and the Maritime Zones of Maldives act 6/96. Maldives has drawn its straight archipelagic base line with 37 archipelagic baseline points joining the outer most islands. The 12-nautical mile territorial sea limit is measured from the archipelagic straight baselines established in this law. Act Number 6/96 also establishes a 24-nautical mile contiguous zone, extending 12 nautical miles seaward from the 12-nautical mile territorial sea limit. Maldives EEZ extends up to 200 nautical miles from the archipelagic baseline. However, exclusive economic zone of Maldives has not been demarcated with geographical co-ordinates. Detailed scientific study on Maldives continental shelf has not been done. The admiralty charts shows the average depth of exclusive economic zone varying in depth between 2,000-4,000 metres. The eight degree channel north of Maldives has an average depth of 1,500 metres and shares boundary with India. There are two shallow areas of 50 metres and 443 metres around seven and half degrees latitude, north of Maldives. The north east side of Maldives where Maldives, India and Sri Lanka share the maritime boundary is having a varying depth of 2,000-2,500 metres. However, the other areas are having a depth of more than 3,000 metres. At this point, it can be concluded that even if Maldives continental shelf does not go beyond 200 nautical miles, the sea bed and subsoil within 200 nautical miles from the baseline from which the breadth of the territorial sea is measured is the continental shelf of Maldives as mentioned in the article 76 of UNCLOS.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

National Report – Federated States of Micronesia[1]

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Introduction

The Federated States of Micronesia (FSM) is the 46th State and 2nd Pacific Island coastal State (PcS) to ratify United Nations Convention on the Law of the Sea (UNCLOS) on April 29, 1991; Fiji being the first. The FSM subsequently ratified Part XI of UNCLOS on September 6, 1995.

The FSM is also a member of the Pacific Island Applied Geoscience Commission (SOPAC), which is currently assisting its Pacific Island members, including the FSM, in the delimitation of their maritime boundaries and in charting a way forward in the implementation of Article 76 of UNCLOS relating to extended Continental Shelf.

The FSM is one of the few Pacific Island coastal States identified to have a potential extended Continental Shelf. Thus, the FSM considers the issue of extended Continental Shelf a high priority.

Equally important as the issue on extended Continental Shelf is the maritime boundary delimitation. Delimiting the baselines of 607 islands and atolls spread across an ocean area (Exclusive Economic Zone) of approximately 1 million square miles is an awesome challenge but a task that has to be done. The FSM has decided to tackle first the issue of maritime boundary delimitation to get the process moving and consequently carry the momentum into the implementation of Article 76.

The report will provide an overview and status of the two UNCLOS projects in the FSM:
(1) Maritime Boundary Delimitation (MBD) and (2) Extended Continental Shelf (ECS). This document reports significant progress in MBD over the past 6 months. On the contrary, ECS has not progressed much. The report will first highlight the institutional and policy framework and identify the relevant national legislations. It will then conclude by

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[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

pinpointing some of the major challenges facing the FSM in completing its maritime boundary and especially the extended Continental Shelf.

Institutional and policy framework

The Executive Branch of the Government of the FSM is responsible for the implementation of the UNCLOS, including maritime boundary delimitation and negotiation and implementation of Article 76. When the initial deadline for Extended Continental Shelf was extended to May 2009, the FSM President on 17 October 2000 established a Presidential Committee on Maritime Boundary Delimitation and extended Continental Shelf (Committee). The Committee includes the National Oceanic Resource Management Authority (NORMA), the Department of Economic Affairs, the Department of Justice, the Department of Transportation, Communication and Infrastructure, and the Department of Foreign Affairs.
During the recent 2005 Presidential Summit held in Palau, the three Presidents of the FSM, the Republic of Palau and the Republic of the Marshall Islands reaffirmed the need to progress the delimitation of shared maritime boundaries. The President of the FSM has directed the Executive to finalize a treaty with Palau and with Marshall in 2006. The Presidential directive has given momentum to the delimitation of maritime boundary and consequently is progressing quite well.

Legislative framework

The advent of the UNCLOS gave impetus to the drafting of the various FSM maritime codes. With the rights provided under the UNCLOS, the FSM joined other coastal States to give legal effects to their new rights. The statute establishing the maritime zones, including the seabed and subsoil, of the FSM is Title 18 of the Code of the FSM, last updated in the late 1980s. Related legislation includes Title 24, newly amended in 2002, which establishes the government agency responsible for, and guidelines with respect to, conservation, management and development of the living resources in the FSM EEZ. Title 19 pertains to ships and shipping.

A recent review of Title 18 has been completed and appropriate amendments have been proposed in order to align the law with the technical aspects of the maritime boundary delimitation requirements under the UNCLOS and Scientific and Technical Guidelines for Article 76.

Implementation of Article 76: Extended Continental Shelf

In the mid 1990s, Grant Boyes and Michel Larue undertook a preliminary desktop study to identify those zones of the PcS of potential continental shelf extensions.[2] The study identified FSM as one of the PcS having a potential extended Continental Shelf claim. Based on this finding, the FSM has placed Article 76 on its agenda of high national priority.

However, lack of resources and expertise has been a major obstacle. Since the establishment of the Committee in 2000 to undertake the implementation of Article 76, very little, if any, has been achieved. The FSM is yet to develop an integrated and coordinated strategy and identify technical resource to advance the tasks required.

For this reason, NORMA, a Member of the Committee, is in the process of revitalizing work on extended Continental Shelf. The order of business and priority is to complete the delimitation of the baselines, which are relevant for potential extended Continental Shelf claims and then focus on extended Continental Shelf. Some progress however, has been made in the identification of funding sources for a desktop study and for technical assistance. The data that led to the indication that FSM has a potential claim is being requested and other data sources are being compiled. In essence, FSM is underway in a desktop study.

The FSM is still committed and determined to investigate further the potential areas for an extended Continental Shelf Claim. It is clear however that FSM could not implement Article 76 without the assistance of its development partners, the research institutes, regional organizations like SOPAC, and FSM's PcS neighbors.

Maritime Boundary delimitation

As of August 2005, there was nobody in the FSM working specifically on the MBD project and no baselines had been determined. An outside consultant did the last work toward completion of baselines in the late 1990's by collecting Global Positioning System (GPS) field data. Nothing was done with that ground control data. Additionally, SOPAC held a series of workshops to assist member countries with the MBD project but progress was limited due to the lack of data and availability of software and other necessary equipment. The FSM then hired a GIS Specialist in August 2005 to prepare a desktop study and work towards completion of determining baselines for all Islands and Atolls in the FSM. The desktop study revealed that data available for establishing baselines was scattered throughout

[2] The results were published as SOPAC Miscellaneous Report 227 (1996) titled; *The South pacific and Article of the Law of the Sea.*

many FSM agencies across the country and outside sources. The collection and organization of data was not only a major undertaking in and of itself but also determination of what data was most useful proved to be another major challenge.

Presently, the most useful data includes hard copy topographic maps and nautical charts, scanned maps/charts, Global Positioning System (GPS) ground control data, satellite imagery, aerial photography and field survey information, among other sources. The FSM used the above mentioned data to make significant progress in baseline delimitation in a relatively short period of time (6 months) and expects to continue with forward progress in the coming months. To date the FSM has finalized baselines for 19 of an estimated 46 baselines required for mapping Territorial Seas, Contiguous Zones, and the Exclusive Economic Zone (EEZ). Of the 46 Island and Atoll groups in the FSM, 25 are expected to affect the delimitation of the EEZ and the 21 remaining groups will be zoned for Territorial Seas and Contiguous Zones.

The FSM shares boundaries with four neighboring states and the status of boundary negotiations is as follows:

Papua New Guinea: FSM and PNG signed a Treaty on July 29, 1991, which was ratified on November 25, 1991. Some errors in the geographic coordinates have been identified but the technical work to correct the geographic coordinates is yet to be completed. The two countries have yet to agree to meet to formalize the amendments required.

Palau: The two countries are pursuing a bottom up approach at this stage, whereby technical people from both sides have formed a working group to work with the available data to establish the treaty line. This approach is favored because it will allow sharing of resources and also minimize the need for negotiation. NORMA and the Palau technical staff's desktop study identified data gaps, which were needed to complete computation of an equidistant boundary line between the FSM and Palau in August 2005. Those data gaps were filled, baselines were completed and a provisional equidistant line was completed in February 2006. A comparison analysis and validation of the provisional equidistant boundary is now being tested.

Republic of the Marshall Islands: The desktop study for RMI is ongoing to find out what information is available (mainly for RMI). Although the FSM's priority is to first finalize the treaty between the FSM and Palau and then commence work with RMI, informal meetings have taken place and RMI officials have been informed of the FSM's methodology for determining baselines.

USA (Guam): Some data have been collected for this area but the data is yet to be further reviewed and validated. The FSM has established contact with NOAA's Office of Coast Survey and the State Department, which chairs the U.S. Baseline Committee.

The FSM tentatively plans to finalize the work on the shared maritime boundaries with Palau and with RMI by June 2006.

Challenges

The FSM faces a number of challenges in the maritime boundary delimitation and extended Continental Shelf, some of which are:

Geography: The FSM has an extensive area to delimit boundaries, which stretch across multiple states and multiple UTM zones. Access to hundreds of small islands scattered across the FSM is both costly and time consuming. With respect to extended Continental Shelf, the two identified potential areas are distantly situated from one another and far from areas targeted by researching institutes undertaking bathymetric surveys.

Data: Data needed to establish baselines including nautical charts, topographic maps, aerial photographs, or satellite imagery is unavailable for some areas in the FSM. There is also a lack of metadata for existing GPS files, a lack of geodetic information needed for georeferencing historic nautical charts or topographic maps (e.g. Ngulu Astro Datum to WGS84), and a lack of proper ground control positions (GCP) for georeferencing remote sensing imagery (aerial photos, satellite imagery). Although some data may be available, collection is bureaucratic and burdensome as it depends on coordinating with multiple agencies in the four States of the FSM.

Expertise and equipment: Although there are some long term professional personnel working in the government, many technical experts and legal counsel are short term expatriates. Experts in maritime boundary delimitation are typically teams of legal and technical experts who have been working together for many years. The government of the FSM has yet to identify and assemble a team of experts including Hydrographers, Geophysicists, and legal personnel assigned specifically to maritime boundary and extended Continental Shelf issues. The government also has yet to acquire enough essential equipment such as GPS receivers, large format scanners, and GIS software. While there have been some consultancies in the area of maritime boundary delimitation, there has been none in the area of extended Continental Shelf. The lack of technical expertise and committed personnel contributes significantly to the slow progress in identifying available data or sources for extended

Continental Shelf. Without the expertise in the various disciplines, it is difficult even to know what and where to look for the relevant data, needless to say, developing a strategic plan.

Committee on Extended Continental Shelf: Despite the formation of the Presidential Committee, it lacks members or advisers who are technically capable and are at the level of working class, who would actually carry out the work necessary. The complexity of the issue on extended Continental Shelf may have also contributed to the Committee inability to start somewhere.

Code of the Federated States of Micronesia

Title 18 Chapter 1: Territorial Boundaries and Economic Zones

§ 101. Baseline system defined. A baseline is a continuous line which encircles an island or atoll. The baseline from which the zones designated in this chapter are to be measured is as follows:

(1) The baseline of an island or portion of an island lacking a barrier reef, fringing reef, or other reef system is the low water line of the island as marked on large-scale charts officially recognized by the Government of the Federated States of Micronesia.

(2) The baseline of an atoll or island or portion of an island having a barrier reef, fringing reef, or other reef system is a line following the contour of the seaward edge of the reef system, which line connects those outermost elevations of the reef which are above water at low tide, and which line exists as marked on large-scale charts officially recognized by the Government of the Federated States of Micronesia.

§ 102. Territorial Sea and internal waters - Defined.

(1) There is hereby established a Territorial Sea of 12 nautical miles breadth. The inner boundary of the Territorial Sea of each island or atoll is the baseline as defined in section 101 of this chapter. The outer boundary is a line, every point of which is 12 nautical miles seaward of the nearest point of the baseline.

(2) Waters landward of the baseline, including the lagoons of atolls or islands, are internal waters.

§ 103. Territorial Sea and internal waters - Sovereignty. The sovereignty of the Federated States of Micronesia extends to its internal waters and Territorial Sea, including sovereign rights over the living and nonliving resources in the Territorial Sea and internal waters and in the airspace above the Territorial Sea and internal waters as well as its bed and subsoil.

§ 104. Exclusive economic zone - Defined. There is hereby established an exclusive economic zone contiguous to the Territorial Sea. The inner boundary of the exclusive economic zone of each island or atoll is the seaward boundary of the Territorial Sea, and the outer boundary is a line, every point of which is 200 nautical miles seaward of the nearest point on the baseline as defined in section 101 of this chapter.

§ 105. Exclusive economic zone - Regulation. Within the exclusive economic zone, the National Government of the Federated States of Micronesia shall have:

(1) Sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or nonliving, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone;

(2) Jurisdiction with regard to the establishment and use of artificial islands, installations, and structures; marine scientific research; and the protection and preservation of the marine environment; and

(3) Other rights and duties provided for in international law.

National Report- Palau[1]

Mrs. Vernice M. Stefano
National GIS Director, Ministry of Resources and Development, Palau

INTRODUCTION:

UNCLOS, Article 76 states that some states may have rights to continental shelf territory beyond the 200 nautical miles, Exclusive Economic Zone (EEZ). Palau is researching whether it is one of those states.

CONTINENTAL SHELF HISTORY:

Though the Permanent Mission of Palau to the United Nations, Palau requested for a preliminary study of the Continental Shelf through the assistance of the UNEP-Shelf Programme (GRID-Arendal) based on Norway. The UNEP-Shelf Programme prepared a "Scanning Phase Study" for the South Pacific Applied Geoscience Commission (SOPAC) in June 2005 and met with Palauan leaders in July of 2005 to discuss this and partnership opportunities for the next phase of the process, the Desktop Study.

CURRENT PALAU CLAIMS AND LEGISLATION AFFECTING THE CONTINENTAL SHELF DELIMITATION PROJECT:

- Palau Constitution claims sovereignty and jurisdiction out to 200 nautical miles from a straight archipelagic baselines. The Constitution allows for the expansion of Palau's territory.
- Palau claims a 200 nautical miles EEZ.
- Pending legislation has been created to claim its Seas and begin to delineate its extended continental shelf.

CONTINENTAL SHELF OVERVIEW:

Briefly, Palau asserts its right and duty as a party to UNCLOS to evaluate its chances for the extended Continental Shelf. The process requires huge amounts of funding and rigorous study. This study involves scientific and technical expertise in the fields of geology, geophysics and hydrography, all of which are sciences. This fledgling nation does not yet have the capability to provide.

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[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

As such Palau must look to friendly nations like the Japan government, the US government, the United Nations, partnership with the UNEP Shelf Programme, and SOPAC for regional synergies in pursuing this project.

National Report-Papua New Guinea[1]

Mr. Joseph Kunda
Manager, Hydrographic Services, National Maritime and Safety Authority,
Papua New Guinea

Papua New Guinea consists of the East half of the island of New Guinea and many offshore islands including New Britain, New Ireland and Bougainville; the territory extends from 1° S to 12° S latitude and from 141° E to 156° E longitude. PNG though is a biggest Island nation state not much has been done on claiming outer limits of the continental shelf. For about 30 years PNG Maritime Boundary has incompletely demarcated due to its maritime topography and other natural conditions associated with the cost involved. After the ratification of the United Nations Convention on the Law of the Sea in early 2000, the progress of the was very slow in get something done when the United Nations through the Commonwealth Secretariat provided some component in assist the PNG government by some advice and finance on the issue of claiming our outer limits of the continental shelf beyond 200 nautical miles and desktop study. With that push the Papua New Guinea government has set up committee through the office of Attorney General as chairman to oversee the project. The committee did all it can to organize meetings with relevant organization, unfortunately the government does not have the budget for the logistic and infrastructure to carry out the project as budgeted. The country has until 2009 to furbish the research and submit the final report. This is where Papua New Guinea is in the desperate need for assistant from other developed commonwealth countries to carry out survey, research data and technical assistant in establishing outer limits of the continental shelf beyond 200 Nautical Miles.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

National Report-Philippines[1]

Captain Audie A.Ventirez
Director I, Coast and Geodetic Survey Department,
National Mapping and Resource Information Authority, Philippines

INTRODUCTION:

The Philippines as an archipelagic state has been preparing its maritime boundary claims in accordance with UNCLOS since its ratification on 8 May 1984. Prior to the ratification of the UNCLOS, the Philippines has its own maritime boundary legislation based on the Treaty of Paris 1898 as contained within Republic Act No. 3046 dated 17 June 1961 as amended by Republic Act No.5446 dated 18 September 1968.

ISSUES AND CONCERNS:

- Additional Seismic survey requires in preparation to our claims for an extended Continental Shelf.
- Legal issues.

Necessary preparation of maritime boundary claims before the May 2009 deadline of submission.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

Chapter 2

Preparation for Submissions

Section 2

Desktop Study as the first step to the submission

Ideas to support coastal states with problems in Article 76 case preparation -‘ Helping to Fix it’[1]

Dr. Lindsay Parson
Head of the UNCLOS Group, National Oceanography Centre, United Kingdom

Thank you Mr. Chairman. Thank you Shin, and good afternoon distinguished delegates, ladies and gentlemen. I would like to just take a few moments to thank the various organs of the Japanese government for the invitation to present at this meeting and also to congratulate them on providing this opportunity for so many of us to get together and talk about this very, very important and potentially gloomy subject. I believe there is a saying that if you are a pessimist, you never get disappointed, but I am not afraid to state publicly that I am approaching this rather as an optimist. In that vein, I would like to try and spend a few moments showing you some slides illustrating how I think we can get ourselves into a position where the submission deadline (that is just over three years away for some of the coastal states that have made presentations to us today) may in fact be achievable, whereas some might consider it impossible.

I’ll break this talk into four sections, as illustrated in my first slide (Slide 1). Following this is a summary of my ‘top 10’ potential impediments to a coastal state’s progress with a case under Article 76 of UNCLOS (Slide 2). These are problems that I believe are restricting or can potentially restrict progress with achieving a successful Extended Continental Shelf submission. I hope, and not too arrogantly so, that the second and main part of my talk today will involve detailed discussion of some of the most critical of those problems and provide a selection of solutions or possible solutions to them.

I apologise for the number of words on this slide (Slide 3). There are no graphics or photographs to illustrate my points, but I hope we can proceed through these issues without them. Here are 10 aspects of the process that could potentially hamper our progress through an ‘Article 76 submission’. The first of these, the availability of suitable expertise, has been mentioned earlier, but I think we recognize that even within the most developed states, there is a limited amount of technical expertise and in any case, not everybody can necessarily devote themselves full-time to the process. Some of the developing states also may have dedicated staff –but which almost certainly also have other responsibilities. The sourcing of

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

staff for this project needs to be robust, long-term and at the appropriate level, and while we have had some estimates presented already today, for the purposes of case preparation we should not lose sight of the fact that very few, if any, of the forthcoming submissions will be of the magnitude of some of those (for example, Australia) that we have had described.

I think one of the other ‘slow-flowing’ processes is an agreement in coordination between the stakeholders. And by stakeholders, we include the various government ministries that have to be involved, such as defense, lands and energy, mining, and the Attorney General’s office. We need to combine these into a resource. Again, a key thing to aim for is a clearly coordinated strategy for the next three years up to submission; some coastal states have got that organized already and have moved on, but those that haven’t need to speed up to allow them to develop a plan and a strategy to move forward.

Some of that impetus may be not there because of an unawareness of the resource potential that was mentioned in an earlier session this morning. Some assessment of that provides a ‘driver’, the incentive start the exercise, or in case preparation, to keep up the momentum. There is an unsubstantiated expectation or perhaps, even optimistic assumption of a further delay beyond May 2009 deadline, but we must not be deflected from the timing of the task in hand. The longer we buy into such a possibility the more inertia we build into the system, resulting in further slowing down, and lack of motivation to finish.

We also have potential problems with neighbours - adjacent or opposite states involving overlapping or disputed territories. These need not be something that hinders the process from the outset, providing a dialogue between adjacent, opposite or interested states is opened. There may be other issues, such as timing constraints, and possibly political decisions to be assessed in terms of when a claim should be made. The significance of timing constraints, however, really have to be critically reviewed considering the very short time interval that we have left to deal with our submissions; financial constraints are naturally an important factor, the estimation and setting of a budget, and how that budget is to be allocated over the years up to submission and through the years during the examination of the case by the Sub-Commission. During this conference, we have already talked about funding but we need to establish how the whole expenditure needs to be dealt with by the appropriate ministry/ministries. And finally we will reach a point where we deal with potentially the most expensive component of the programme - the acquisition of data. We will reach a point where we need to access the vessels, the equipment, the instruments and the specialist staff for this purpose. The world markets in oil and gas have an affect on our ability to complete this part of the exercise - the high price of oil means that many vessels are being moblised for hydrocarbon-industry related tasks, and many of these platforms become either unavailable or priced way out of easy reach of continental shelf programmes.

Returning to my summary ‘top 10’ slide, I will select a couple of these for closer attention and discuss them with you in some detail. The lack of a full compliment of dedicated in-house technical expertise may not be so difficult to address, as there is usually opportunity and technical ability within coastal states and just needs to be directed or developed (Slide 4). We have heard that some issues can be addressed by using a consultant or a consultant group of some kind. It’s generally a very expensive option, however, and it is necessary to find one with the right skills and experience, someone you can trust and if possible comes with ‘references’ from states that they have worked with. On its downside, of course, engaging external consultants is a process which is not particularly state empowering, or effective capacity building. You can reduce cost by liaising/coordinating such engagement with neighbors in a regional sense, provided there are not significant dispute issues involved.

The commission itself has a mandate to provide technical support if so requested by a coastal state. I don’t believe that the opportunity offered by the commission has actually taken up, I would imagine largely because the coastal state has to fund that process itself. One methodology that may be useful to think about is to develop the services of an external project ‘shepherd’ or QA/QC resource to oversee the work and progress of the Technical Expert Team. This might sound somewhat like other words for the engagement of a consultant, but it may be more appropriate to consider this input as very much a part time advisor or a monitor of one’s coastal state’s own progress, and something that should reduce over time as that self-analytical ability develops within the coastal states’ capacity themselves.

And finally, I think it is important to say here that while training in its traditional sense is needed it is no longer appropriate to adopt a blanket scattergun approach to its delivery. Focused training, specific to a coastal state’s needs has to go into the region, just in the way that DOALOS has been doing, but even more so. So the available funding needs to be focused, applied and delivered to the region, to the state, and to the technical committees and their developing experts. This has been mentioned in some way by just about every speaker up to now, and I think that as we continue to consider options up to 2009, there will be some further possible approaches we might develop.

First of all, before we proceed further, we need to recognize the likely magnitude of a coastal state’s extended continental shelf programm Budgeting those costs over phase one, two, and three (that’s desk-top study, data acquisition, case preparation and submission, respectively) is a critical and strategic process. The desktop study of phase one will predict for you what's going to happen in phases two and three. So you are unable to fully establish your budget for phase two and three until phase one is complete. So, on a broader discussion level on the 'Number 2 Issue' of our top ten, that is, 'sourcing available funding for the project', here are some ideas for possible solutions (Slide 5). The World Bank is at the top of this list not because they have probably got the most money but because they actually have on a number of occasions informally expressed interest in the project regarding the extended continental shelf. But –despite understanding that representations are made to them at very high level it is not clear to me that they fully grasp the concept of what is required, and when. They don't deal in projects unless they have some critical magnitude – but they do seem to be sympathetic to the process. Perhaps we need a concerted effort from colleagues in highest places, perhaps the UN, to make directed approaches to the most suitable points of contact.

DOALOS is next on our list of potential funders, and we've heard that this trust fund is available to coastal state applications. However, to the independent external observer, the process of accessing and benefiting from the DOALOS trust fund/funds is a long and complicated bureaucratic nightmare – often, in the past, fraught with frustrating delays and red tape. Furthermore, due to the physical scale of the needs of coastal states as they approach the 2009 deadline, DOALOS is physically unable to deliver as much as it would like to. But it still remains an opportunity to consider (except of course, with regard to data acquisition, which cannot be supported by the fund. Another potential source of support could be the oil 'Super Majors', comprising the largest of the international hydrocarbon corporations. Majors and Super Majors have their own interests in developing new frontier areas of the world continental margins, and we should be inventive in our ways of persuading them to support establishment of Continental Shelf (eCS)-configured surveys, for instance, in conjunction with granting licenses for exploration within 200 nautical miles. In any case, as is fully understood, much data acquired within 200 nautical miles can be of exceptional value to eCS projects themselves.

The access to state oil companies and their data acquisition programmes both within and beyond Exclusive Economic Zone areas provides another model for supporting eCS work that's already operating in a number of parts of the world. The Commonwealth Secretariat Special Advisory section is another agency which I think needs to have approaches put to it – and they, too are already working with a number of states on their eCS projects. The next option on my list here is the United Nations Environment Programme (UNEP). Regarding the contribution that UNEP may be able to make to the process, I think we've heard a tremendous opportunity exists now before us to have a guiding organization that will be able to deliver organizational and advisory support, on behalf of the coastal state/states or region, in a way that the DOALOS and the commission have to step back from. I think there is a real opportunity here, that we must recognize, appreciate, and nurture. But that opportunity has to be openly embraced now, not in a few months - but now.

My final suggestion in a list of potential funding sources may prove a little sinister, at first view. The major, globally operating geophysical survey companies acquire speculative seismic (and other) geophysical data in the course of developing the exploration/exploitation potential of a possible petroleum-rich region. These companies may provide data on demand, in a pre-assigned area of along a set of eCS-significant survey tracks, but as there is no such thing as a ‘free lunch’, they will want some return for their investment. Venture capitalists may also have some interest in securing licensing or acreage concessions in exchange for providing some data up front, and in time for the submission deadline. Nonetheless, the greatest of care needs to be exercised in these ‘deals’ so as to minimize the risk of any significant diminishing of resource base.

My next slide (Slide 6) recalls the need for a ‘joined up’ approach to the eCS programme on the part of the government ministries. The government ‘stakeholders’ synergy, is something that will undoubtedly have some long-term benefits. These parts of the government system need to be informed and effectively signed-up for any funding program and also on hand for the endorsement and delivery of the submission in its legal framework. Finally, this slide re-emphasizes the fact that the legal advisors to these governments are as important to the process as any, and they form an integral component of the preparation and presentation of the case.

A background to the strategy to kick-start the eCS process is here outlined in my next slide (Slide 7), and there is nothing of greater importance than to have a robust and comprehensively skilled technical and legal team. This is key to the whole operation. Perhaps we are unable to achieve a 100% complement exactly according to these guidelines, but we do have to have essential skills, key skills within that. And I think unless that is done within any country/coastal state even if it is –approaching the process on a very limited basis. The strategy to achieve the eCS objective needs to be structured, and developed within a timetable with benchmarks and key time-lines. Every case is going to be different, but we need to keep aware of all of the potential issues involved in order to be able to address them as necessary.

This combination of experts as illustrated in my next slide (Slide 8) is an example of a really ‘stripped-down’, minimal team – without any fall-back, or back up staff to support. It is only the start of building the full technical and legal team, which could be as small as four or five, but is more likely to be closer to ten persons in total. Any such team is going to have to have a champion, a project director. The director will be the point of contact and he is going to need the support of the key skilled experts in the relevant fields. The project needs to have to its geoscientists as bathymetry experts, as seismic experts. They will need to be available to participate on any data acquisition program, to be onboard any survey vessel during fieldwork, in order to fully appreciate the collection and data handling processes.

A hydrographer is an essential player in the team, as we've seen particularly in the Western Pacific examples discussed earlier today. Critical requirements are to accurately identify baselines and boundaries within the particular geodetic and modern datum that is being worked with. If the project involves the development of a geographical information system (a GIS), they can be an integral part of that, their skills can be incorporated into data management, data archive, perhaps combined with the cartographer, or the process documenter. As well as the technical staff, there is naturally a requirement for some legal or diplomatic component. Finally, in order to ensure that there is an independent monitoring of the balance of effort and a progress, you may need an advisor or part-time consultant in the eCS team.

But while that allocation of staff time is appropriate, is unlikely to be 100% of anyone's time. Every staff member will no doubt have other responsibilities. So the effort needs to be apportioned, monitored and managed as a task within a coastal state's needs. My next slide (Slide 9) shows an example of an early Gantt chart of the eCS projects for the UK, combining several partial submissions and indicating the necessary steps to be taken in the whole project. Such an exercise can be carried out using simple spreadsheet software, if necessary, and is an excellent way of communicating levels of progress to all of the entities involved.

With respect to an assessment of the importance of the resource potential, we have already had some excellent presentations this morning. In my opinion, getting some idea of what material value there may be to the resource which characterizes the eCS as opposed to just succeeding in a territorial gain is important to persuade our ministers that this is a worthwhile exercise. It's even more important, if possible, to provide some form of semi-quantitative, cost benefit analysis for the project, to be completed relatively, possibly using the sort of scanning exercises that UNEP had introduced some years ago. Realistically, a more robust analysis should fall within the remit of the phase one desktop study. That task can be allocated to, and can be achieved by one of the member of the task team, if necessary.

The need for integrated legal diplomatic side supported by technical components in a context where opposite and adjacent states interests in similar extended shelf areas is not new to anybody. Bi- or multilateral meetings should engage both the legal and technical sides. And we have heard earlier on today, joint data gathering, or collaborative collection of data, on an area of overlap or non-statutory boundary between yourself and your next-door neighbor is an excellent way to progress. If it’s not possible to enter a collaborative data-gathering exercise, the establishment of data-exchange in an agreed ‘buffer zone’ provides a perfect opportunity to enhance relations between the two adjacent states.

So can I just finish with a slide that really points out the issues that I think are probably most critical at each stage of the Article 76 process? Firstly, within or before phase one has been completed, a Task Force Team needs to be well defined, tasks and responsibilities recognised - and regularly reviewed. That task team may evolve, grow and change with time. But there should be one, close link between it and the legal team – and again between them and the ministerial level responsible for maritime territorial issues, for the process to move fast enough to meet our challenging deadline(s). These highest-level stakeholders are the ones that are ultimately responsible for the submissions, they are the ones that will support the funding, and also they will be the ones that will support the presentation as a legal document with technical presentation at the submission stage. Most critically, the schedule of the coastal state’s program of work for the continental shelf work under Article 76 should be established, publicized, and regularly reviewed. All should be able to have a degree of ‘ownership’ and responsibility for the project. Thank you very much for your time.

Preparing a desk-top study: identifying and handling the data and acquiring the relevant skills[1]

Dr. Sarah Prosser and Dr. Elaine Baker

United Nations Environmental Programme(UNEP)/Global Resource Information Database(GRID)-Arendal

Please refer to the text on page 137, Section 4.

[1] This was presented in collaboration with Mr. Rao in Expert Meeting on Technical Matters regarding the Outer Continental Shelf on 8th March 2006.

Partnerships to address the establishment of Continental Shelf (eCS) issues[1]

Mr. Bhaskar Rao
Deputy Director, South Pacific Applied Geoscience Commission (SOPAC), Fiji

I thank the organizers for giving me an opportunity to show how we in the Pacific though daunted by scarce resources are attempting to address the issues of maritime boundary delimitation in the region. SOPAC - South Pacific Applied Geoscience Commission - is a Pacific-based regional inter-governmental organisation with a membership of 21 states formed in 1972 to address primarily the challenge of exploring our oceans for deep sea minerals and hydrocarbons. It now has a much broader mandate.

The Pacific can be thought of a liquid continent with a high sea to land ratio. The ocean is therefore of prime importance to the countries as a future resource. The prime driver for delimiting the maritime boundaries of the Pacific Island States was "Fish," in order to determine the sharing of wealth from the migratory species that abound in our EEZ, particularly Tuna.

Over the period since the 1980's there has been extensive marine scientific research in the region, some by academic institutes and others including a 20 yr Joint SOPAC-Japan Cooperative study to understand the distribution and quality of marine mineral deposits within member EEZ's. Marine minerals and hydrocarbons are now also drivers for determining better our maritime boundaries together with "Fish"

Pre 2002

A maritime Boundaries Project was based at the Forum Fisheries Agency (FFA) and funded by the European Union (EU) and Australia. The emphasis was on the determination of accurate baselines then followed by determination of the extent of the 200M EEZ. The earliest studies undertaken of eCS was a preliminary joint desktop study by FFA and SOPAC - Boyes & Larue (1996) that identified several states – Fiji, Tonga, Solomon Islands, Federated States of Micronesia and Papua New Guinea as having potential for an extended Continental Shelf.

[1] This was presented in collaboration with Ms. Sarah Prosser in Expert Meeting on Technical Matters regarding the Outer Continental Shelf on 8th March 2006.

Post 2002

Following discussions between SOPAC and FFA and the agreement of their respective governing bodies the project was transferred to SOPAC. Since then a new phase of the Maritime Boundaries has been based at SOPAC and has been assisted by Australia.

Activities to date have included:

Creation of a electronic database, termed PIRMBIS - the Pacific Island Regional Maritime Boundaries Information System modeled after the earlier Australian system AMBIS.

Development of a regional Maritime Scientific Research database.

Adaptation of maritime delimitation software (MarZone) to take into consideration archipelagic baselines and the training of individual Pacific Island nationals in its use.

Collaborative efforts to address eCS and related boundary issues with UNDOALOS, NOC (University of Southampton), UNP-GRID, Commonwealth Secretariat (UK) and Geoscience Australia.

2003-2004 Training of PIC nationals at the SOC in UK utilizing UN Trust Funds, February 2005 Training on DOALOS Technical manual, Negotiations Workshop in October 2005 in Apia Samoa are key examples of joint efforts.

UNEP-GRID Scanning Phase to validate the work of Boyes and Larue was undertaken in mid 2005.

Most recent has been the agreement to assist countries undertake desktop studies with funding of NOC.

Status of Desktop studies

Country	Status	Comment
Fiji	In Progress, ComSec	Boyes & Larue
FSM	2006, SOPAC	Boyes & Larue
Kiribati	2006, SOPAC	UNEP Scan Phase
Palau	UNEP-GRID	UNEP Scan Phase
Papua New Guinea Solomon Islands	In progress, ComSec Joint SOPAC/ComSec?	Boyes & Larue
Tuvalu	2006, SOPAC	UNEP SP
Tonga Vanuatu	Completed desktop independently 2006, SOPAC	Boyes & Larue

SOPAC provides a regional way of undertaking work supporting skills development of state national wherever possible. Geoscience Australia has provided valuable validation support.

Issues

Mobilizing interest in eCS and conveying the urgency to state government at the highest level. Approaching deadline of 2009.

Lack of resources particularly for additional data capture and analysis. I notice in early talks someone talked about a minimum group of experts - some countries don't even know what geophysics is, let alone have other geological or technical expertise.

Access to data is a major issue. 95% of scientific research data for the region resides outside the region and getting access to it is difficult, here the UNEP-GRID one-stop shop concept will assist.

Geological Issues - the region is arc-terrain and complex. And therefore difficult to understand.

A plea

We have noted with interest the resources put in by Japan, NZ and Australia in eCS work. The region with scarce resources will never approach this level of investment. A plea therefore particularly to NZ and Japan who share similar arc-geology to join us in assisting the region.

Chapter 2

Preparation for Submissions

Section 3

National Effort for Submission to CLCS

Australia's continental shelf submission-approaches and implications[1]

Mr. Mark Alcock

Project Leader, Law of the Sea project, Petroleum and Marine Division,
Geoscience Australia, Australia

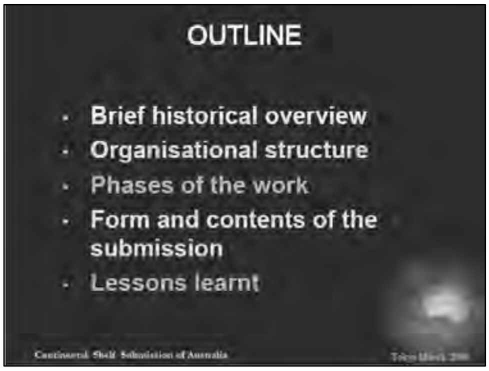
Slide 1

In starting, may I first thank the organisers for the opportunity to present Australia's approach for preparing its submission to the Commission on the Limits of the Continental Shelf.

Slide 2 (Outline)

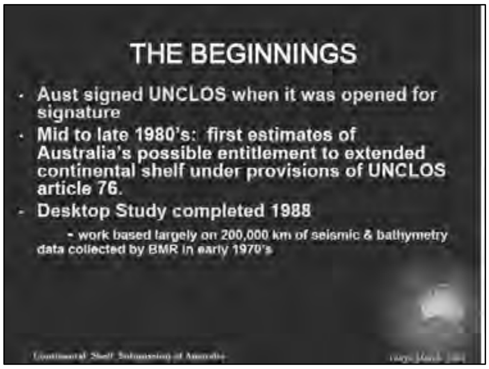
In a project that has been underway for more than 10 years, there are many aspects that may be of interest, and it is often the detail that is just as important as well as the facts. Unfortunately, time permits only the highest level elements to be presented. Today I will briefly discuss: the history of our Law of the Sea project - the name we give to our extended continental shelf project; the organisational structures put in place to manage this project as a cross-agency project; the phases of the work undertaken by the project to prepare for the submission; the form and content of Australia's submission; and lastly, some lessons that we have learnt along the way that may be of value to other States that are either considering making a submission or are approaching their submission date.

[1] This is combined text of the two presentation carried out in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March, and Expert Meeting on Technical Matters regarding the Outer Continental Shelf on 8th March 2006.



Slide 3 (The beginnings)

As a country with a large maritime jurisdiction, it is not surprising that Australia has shown an active interest in the development of the Law of the Sea. This interest is reflected by Australia's accession to the earlier Geneva Convention under which Australia's first Continental Shelf declaration was made and Australia's active participation in the negotiation of UNCLOS. On the completion of negotiations Australia signed UNCLOS when it opened for signature.



Slide 4 (Desktop Study)

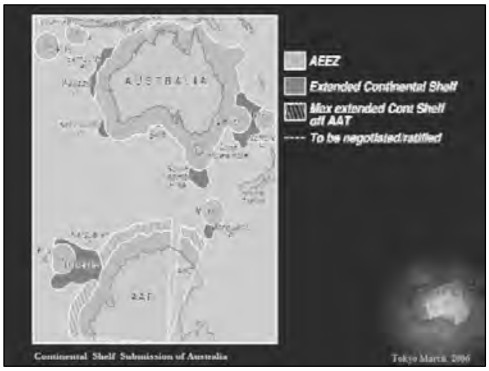
The first work to determine the extent of Australia's continental shelf jurisdiction was undertaken in the mid to late 1980s with the result of Australia's first desktop study being published by Phil Symonds and Barry Willcox of the Bureau of Mineral Resources - now Geoscience Australia - in 1988. This desktop study, produced only 6 years after the treaty opened for signature and before it came into force, was not only an attempt to identify and quantify the extent of Australia's continental shelf rights, but also tried to capture the knowledge gained by the authors who had acted as advisors to the Australian delegation during the negotiation of the Convention.

>bring in map of survey coverage

The tentative outer limit resulting from this study was based upon 200,000 line km bathymetry and sparker seismic data collected across the continental margins of the Australian mainland. For the remote areas of Australia's jurisdiction, data was used from sources such as the GEBCO fairsheets and from institutions such as Scripps and Lamont-Doherty.

Slide 5 (Map of Regions)

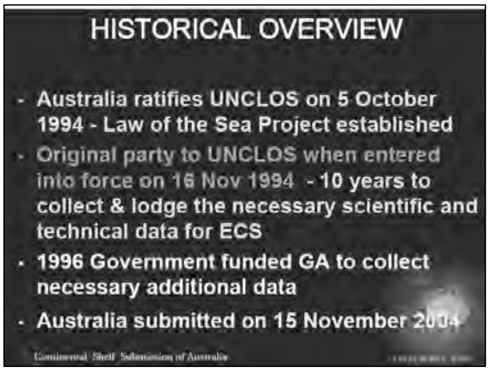
Given the paucity of available data and the fact that in many areas the data did not extend to the limits of the legal continental shelf, we were pleased and surprised with how well this original desktop study matched the final outer limit submitted.



Slide 6 (Historical Overview)

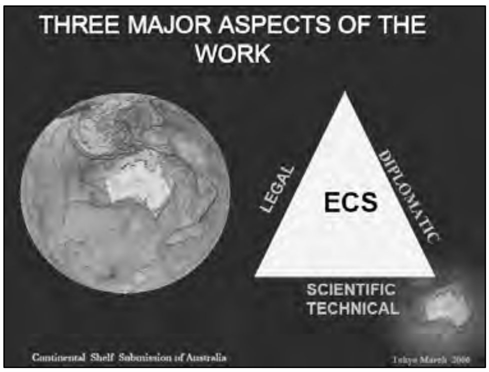
In the period immediately after that initial desktop study there was little activity with regard to defining Australia's continental shelf limits. In 1994, as the number of parties to the Convention approached that required for it to come into force, Australia again turned its attention to the issues of the continental shelf. After ratifying the Convention on October 5, Australia became an original party to the Convention when it entered into force on November 16, 1994. Earlier in that year, the first survey designed specifically for defining Australia's legal continental shelf was undertaken on the outer Exmouth and Wallaby Plateaus. The planning and operation of this survey marked the start of

Australia's Law of the Sea program - and incidentally my first exposure to Law of the Sea - although it would not be until 1996 that dedicated funds would be allocated to Geoscience Australia for the essential further surveys to be undertaken. From the inception of the project in 1994, the project had 10 years to prepare Australia's submission.



Slide 7 (triangle)

Having dealt with the start of Australia's efforts, we can now turn to the way Australia approached the submission. Central to understanding Australia's approach is this figure. It is Australia's view that the successful definition and of a State's continental shelf and its acceptance by the UN Commission on the Limits of the Continental Shelf can best be achieved by the close co-operation and integration of legal, diplomatic and scientific/technical expertise. The definition of the continental shelf cannot be achieved through technical expertise alone. Why is this? First and foremost, the submission is primarily addressing a legal matter - by using scientific approaches and tools that arise from article 76. It is our view that a State that does not take due regard of this matter may compromise its ability to obtain the full extent of the continental shelf that it may be entitled to.



Slide 8 (Who is involved in Australia)

The production of Australia's submission was a co-operative project, between a number of agencies in Government. Dealing with the legal and diplomatic issues are the Department of Foreign Affairs and Trade (DFAT) and the Attorney General's Department. In Australia's case, DFAT took the lead responsibility for making the submission. Working closely with DFAT and Attorney General's are the technical agencies, primarily Geoscience Australia which was responsible for planning and undertaking the surveys, collating and analysing the data required to define the continental shelf and preparing the submission materials. In addition to Geoscience Australia, two other agencies were involved in preparing Australia's submission: the Australian Hydrographic Service, part of the Royal Australian Navy, provided charting advice and access to hydrographic data; and the Department of Environment and Heritage, who were involved in the development of environmental planning and permitting issues related to the marine surveys and support in defining some parts of Australia's territorial baselines.

Slide 9 (organisational structure)

Because the preparation and support of Australia's submission required the collaboration of a number of Government agencies, and ultimately executive Government support, the reporting and administrative arrangements for the project are quite complex. Starting at the bottom, the main forum for decision making with regard to the submission is the Submission Working Group. The Submission Working Group is chaired by the Department of Foreign Affairs and Trade and includes members from DFAT, AG's and Geoscience Australia. Meetings of the Submission Working Group are informal, and are called on an as-needs basis and designed to address the detail of the submission. During the preparation of the submission the business of the Submission Working Group was very much focused on the details and strategy of the submission materials. As the date of the submission approached, the Submission Working Group would usually meet once a week. Now that the submission has been lodged and is progressing through the Commission, the meetings are less frequent, perhaps every six weeks, and membership of the group is essentially limited to Australia’s delegation supporting the submission.

Meeting less frequently, perhaps every 3 or 4 months, is the Technical sub-committee for the Law of the Interdepartmental committee or TSC. The TSC is chaired by the project leader of the Maritime Boundaries Project in Geoscience Australia. It is tasked with dealing with all technical issues related to the Law of the Sea and therefore has a wider membership than the Submission Working Group (SWG), although most members of the working group are also members of the TSC.

The highest level co-ordinating committee for Law of the Sea issues is the Interdepartmental Committee on the Law of the Sea, or LOSIDC. The LOSIDC meets infrequently, perhaps once or twice a year in normal circumstances and has senior representation from all government departments with an interest in Law of the Sea. Both the SWG and the TSC report to this Committee.

Lastly, the most significant decisions with regard to Australia’s Law of the Sea issues and the submission itself are made by the relevant Ministers, and in the most important cases by the Prime Minister and Cabinet. Examples of issues that were decided at the Cabinet level were the decisions to fund the survey program for the Law of the Sea project and the final decision to submit Australia’s submission to the CLCS and the areas that would be submitted.

Slide 10 (6 major Phases of the Work)

We can identify six major phases of the work program.

The first phase of our program was the preparation of desktop studies. In our situation, in addition to the overarching study completed in 1988, a more detailed desktop study was undertaken for each area before any further data acquisition was undertaken.

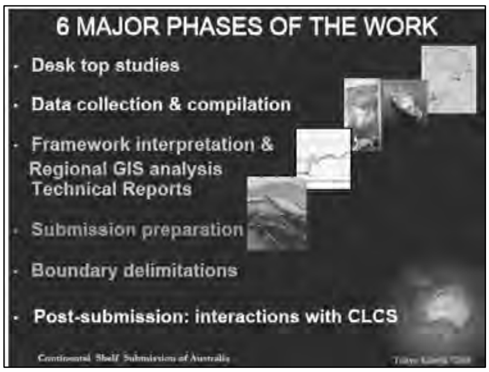
The second phase, and one of the most complex stages for Australia, was the data collection and compilation phase. This stage included survey planning, survey operations, data processing and data management.
The third stage, which ran partly concurrently with the collection of data, was the reduction of data in preparation for the final preparation of the submission. The four most important aspects of this were:

- preparation of regional geological framework reports for each area;
- compilation of regional GIS projects, including all shiptrack bathymetry available in each study area;
- data analysis within the GIS; and
- the preparation of technical reports which fulfilled the role of a final desktop study for each region before the preparation of its relevant part of the submission.

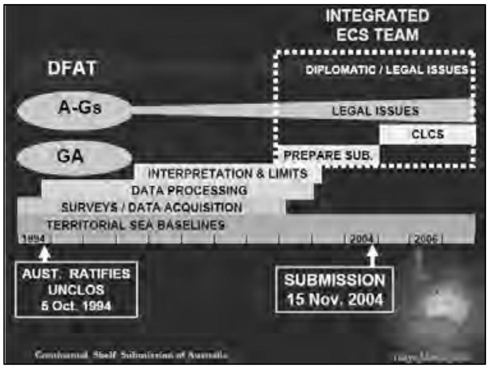
Preparation of the submission materials themselves was the fourth phase, that for Australia took three years from the time of the first pilot submission until the lodgement of the completed submission in 2004. As an aside, I would like to point out each the submission for each area was produced in 6 months, which meant that at any time we were working on several areas concurrently.

Many countries with a continental shelf entitlement will also have delimitation issues with neighbouring States. This was Australia's experience. These delimitation negotiations are a significant overhead for the submission team, and they should therefore be considered as a phase of the submission preparation that needs to be incorporated in the submission planning. This was Australia's fifth phase.

The last phase, the phase, which Australia is presently undertaking, is the post-submission interactions with the CLCS. I will refer to some of the issues associated with this phase later in the talk.

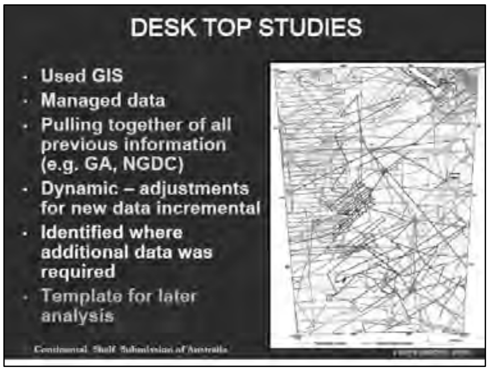


Slide 11 (major phases of the work - timelines)
This slide illustrates how aspects of these activities were scheduled and which agencies took responsibility for them during the development of the submission. As the major part of the work undertaken is in fact geotechnical, much of the work fell to Geoscience Australia (GA).
>Bring in DFAT and AG's
Of course while the geotechnical activities were being undertaken, GA was receiving advice and guidance from the department of Foreign Affairs and Trade and Attorney General's Department.
>Bring in Box
In the final stages of the process, the involvement of DFAT and AG's increased significantly, to the point that for the last year of the submission preparation DFAT and AG's staff were physically relocated to the Geoscience Australia building where they could work closely with their scientific colleagues.



Slide 12 (desktop studies)
As I mentioned earlier, the first comprehensive desktop study was completed in 1988. This study was limited by the sparse data coverage in many of the deep and remote areas, a situation that could not be quickly or easily addressed. As time progressed, more data became available, but often not in a systematic manner. Australia therefore chose to take a flexible approach to managing the planning issues covered in a static desktop study and decided that the best way to manage these issues was by using a geographic information system, or GIS. These were detailed desktop studies were performed in the ArcView GIS environment and became the template for the later area-specific GIS projects that are used to define Australia's continental shelf. The aim of these desktop studies was to compile all the available data into the GIS project, identify prospective foot of slope (or FOS) locations and also to identify those areas where the sediment thickness formula might be relevant. With the data compiled in this way, it was then possible to use the information to

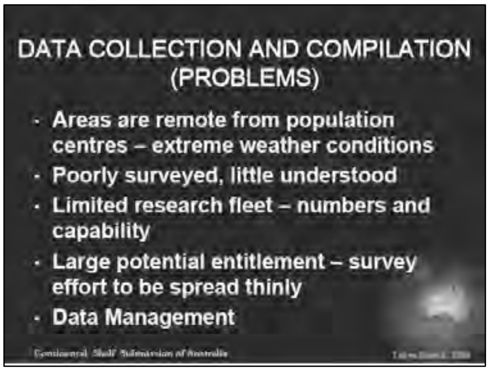
identify areas of data deficiency and then to develop survey plans to address those deficiencies.



Slide13 (Data collection and compilation – the problem)

For any State considering making a submission to the CLCS, the data collection and compilation phase will be one of the most daunting -particularly the survey component. For Australia, many of the areas of extended continental shelf are extremely remote, poorly surveyed and little understood. This makes survey planning complex and the undertaking of the surveys costly. In addition, Australia had only a limited blue water marine research capacity consisting of one vessel operated by Geoscience Australia (GA).

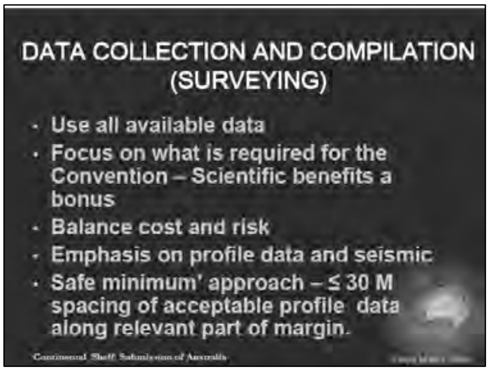
Once all this data were collected, data management presented its own problems. The Law of the Sea project needed to compile data from many diverse sources, often in a variety of formats and of varying quality.



Slide 14 (Data collection and compilation – survey planning)

To deal with these issues, Australia developed a strategy to get the maximum return from our survey effort with the resources available. One of the first decisions made was to include third-party data in Australia’s submission and to focus any new data collection on what was required to satisfy the Convention, with any broader scientific or resource goals being of secondary importance. With regard to the parameters to be surveyed, it was assessed that the best return would be achieved by acquiring deep-seismic data, with bathymetry, gravity, magnetic and limited refraction sonobuoy data collected concurrently. This gave Australia the option of using geological data to support, or even determine, the location of the foot of slope, as well as sediment thickness where this was relevant.

To determine the minimum data coverage that would be required, we looked to the provisions of article 76 to ensure that Australia would be able to construct a valid outer limit line in all areas, while accepting that some small areas of the continental shelf could be lost because of low data density and because of non-optimum line location. It was decided that an average line separation of about 30 nautical miles (M) would be an acceptable balance of cost and data density, and we refer to this as the 'minimum safe coverage'.



Slide 15

As an aside, here are a couple of pictures showing conditions experienced during our survey program: the mountainous seas near Heard Island, or the freezing seas of the deep south.

Slide 16

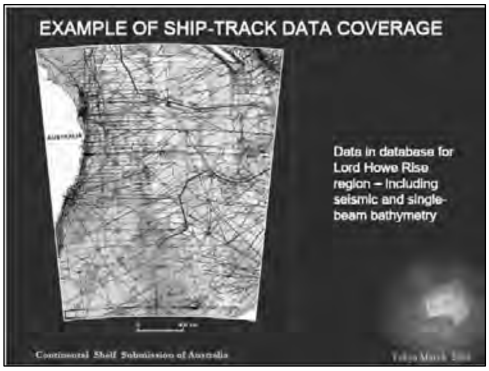
These are the vessels that performed most of our survey work. In the upper right is the Rig Seismic, for 14 years the workhorse of Geoscience Australia's marine survey program. In the top left, the GeoArctic, operated by Fugro Geoteam and AMIGE; bottom left is the L'Atalante, operated by the French Government agency IFREMER, which collected all of the multibeam bathymetry that was used in defining Australia's outer limit; and lastly the Polar Duke, again operated by Fugro Geoteam and Polar Ships.

Slide 17

This map shows a trackmap of the surveys undertaken by Australia to support its submission. The black lines indicating surveys on which seismic data was collected, while the bright red lines show the surveys on which multibeam bathymetry was the primary data type collected.

Slide 18

As an example of the line density that we had available when preparing the submission, this map shows the final data coverage for the Lord Howe Rise region. Lord Howe Rise is about 2500 km in length and approximately 600 km in breadth.



Slide 19

In summary, Australia collected over 30 000 km of deep seismic reflection data collected over six of the seven areas that required new data. Some of these data were acquired in cooperation with New Zealand and France. In addition, more than 20 000 km of swath mapping was acquired in some areas, partly in cooperation with France.

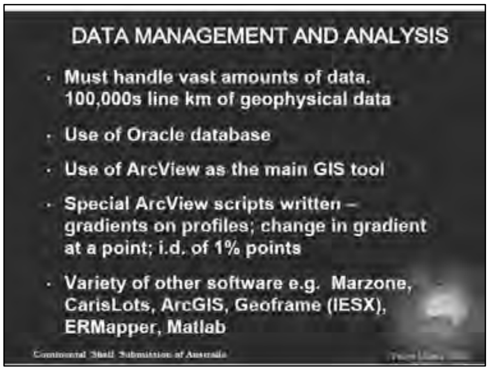
An additional 20 000 km of seismic data acquired off the Australian Antarctic Territory over two seasons in 2001-2002. In total, more than
70 000 km of seismic and other geophysical data were acquired by Geoscience Australia for Law of the Sea purposes on 15 surveys over the outer part of Australia's continental margins. These data represent a major contribution to the understanding of the formation of Australia's continental margins and their resource potential, and a major resource for regional marine planning.

Slide 20

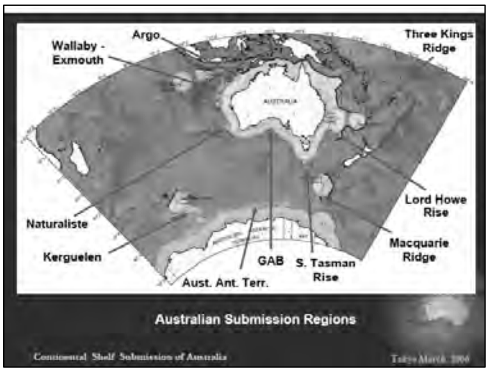
Even before the survey program had been completed, we had to develop techniques for managing the hundreds of thousands of line km geophysical data that would be used in Australia's submission. There were no specialist article 76 applications available when we first commenced our work. Early work, during the survey planning phase had shown that

GIS technology was particularly suited to the task. At the same time, Geoscience Australia was starting to use Oracle databases to manage some of our datasets and it was clear that this was a technology that would be well-suited to GA's wider corporate needs. Therefore it was decided to concurrently develop Oracle databases as the primary repository for shiptrack geophysical measurements and to use ArcView with some software extensions as the means of managing and analysing these data specifically for the submission.

In addition to these core tools a number of other software packages were used for specialised tasks: in particular, Geoframe, Marzone, Caris LOTS, ArcGIS, ERmapper and Matlab.



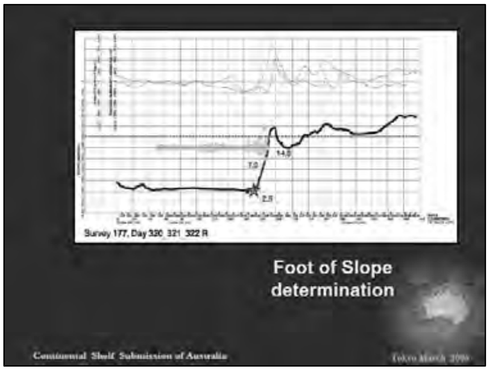
Slide 21 (Map of project Areas)
To assist in management of these data, individual projects for each of the ten geographical areas to be submitted were developed as shown on this map.



Slide 22 (Foot of slope determination)
One of main tasks that was undertaken in the GIS package was Foot of Slope selection. This process was undertaken on profile data, with profiles being selected that crossed the base of slope zone.

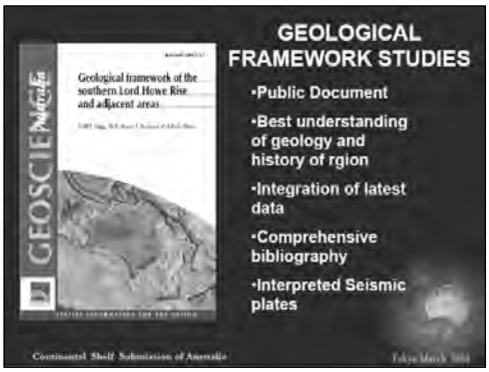
>bring in foot of slope analysis

The profiles selected were then assessed as shown in this view. The bathymetry profile is the heavy black line, while the red and blue profiles above are gravity and magnetics. The pale blue line on the bathymetry profile shows the change of slope from point to point, while the red star shows the location of the picked foot of slope. The ArcView software extensions also allowed for the determination of average gradient, on longer sections of the profile. The gradients determined in this way are shown in red. 1% sediment thickness determination was also conducted in the GIS environment using specially prepared scripts.



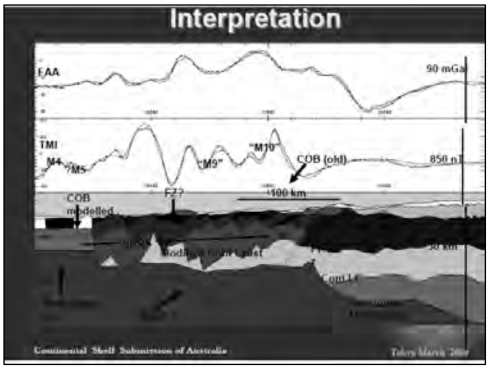
Slide 23 (Geological Framework Studies)

Whilst this article 76 analysis was being undertaken, studies were also undertaken that integrated the scientific results of the Law of the Sea surveys with previous studies. These substantial geological framework reports, which are available publicly, represent Geoscience Australia's best understanding of the geology and history of each region and also form part of the supporting data of the submission itself. They are a useful spin off for resource companies, environmental managers and academics.



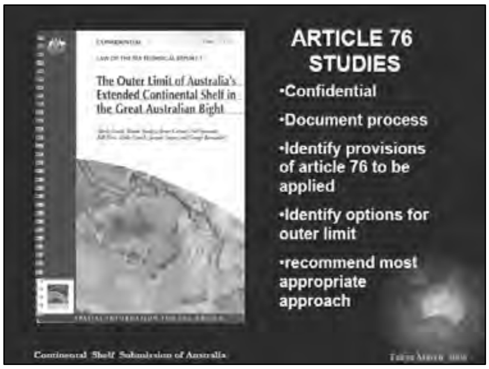
Slide 24 (Interpretation)

This slide shows a potential field model, one of the supporting geoscientific studies undertaken for the Law of the Sea project by scientists in the academic community who were able to benefit from access to new datasets in frontier areas. I would like to point out here that all of the datasets collected by Geoscience Australia (GA) he Law of the Sea project were treated in the same way as any other dataset collected by GA, and are therefore open file and publicly available for the cost of data transfer.



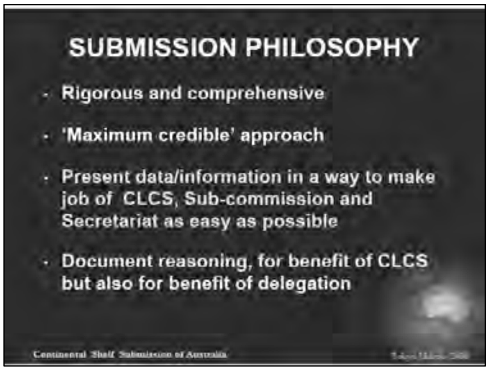
Slide 25

As well as the geological framework study, the other major document produced for each area prior to the submission phase was the Law of the Sea Technical Report. These reports, often of a similar size to the framework report, deal specifically with the Article 76 issues that are pertinent to each submission area. Production of these reports helped us to focus on the development of the final submission strategy Australia was to use in each area. These documents were all produced prior to the preparation of the final submission. They are not included in the submission and are confidential.



Slide 26 (Submission Philosophy)

Now at last we arrive at the submission itself, and it is probably best to start with the philosophy we applied when developing our strategy. Firstly, in our view the submission must be both rigorous and comprehensive. For us, this meant that everything that we felt that the CLCS was likely to need for it to analyse the submission would be contained within its materials. Also, where we define an article 76 fixed point or come to a legal conclusion we explicitly state our reasoning for selecting the point or coming to that legal view. Secondly, Australia has submitted what it views as the maximum credible outer limit. Thirdly, the data should be presented in a manner that makes the task of the Commission and Secretariat as straightforward as possible. Fourthly, recognising that the Commission's examination process may take some time, we have attempted to capture the reasoning that was used to underpin decisions and arguments contained within the submission.



Slide 27 (Form and Content of the submission)

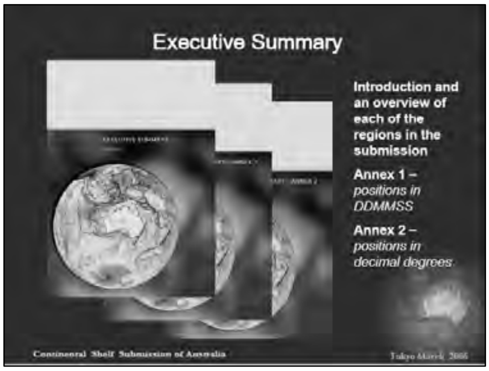
As far as possible, we have followed the requests made by the Commission in its Rules of Procedure and Scientific and Technical Guidelines. The submission is structured in three parts: an Executive Summary; the Main Body, which addresses the substance of article 76 directly; and Supporting Data, which consist of Maps, Charts, Seismic Sections and Documents. For each of these parts, we have supplied the relevant number of copies - 22 for the executive summary, eight for the main body and two for the supporting data. Importantly, we have supplied most material in both hardcopy and as digital files. The digital data are accessed through the GIS, with separate GISs being provided for each of the ten submission areas. The GISs are used to relate the data spatially in accordance with the provisions of Article 76 and they also contain the digital data on which the submission is based.

> bring up list of contents

To give an idea of the number of materials supplied for a single submission area, this is the list of materials supplied for the Lord Howe Rise Region. While this is onscreen, I would also like to point out that every item in the submission has its own unique identifier. We found this feature invaluable for the management of the preparation of the submission materials and also for subsequent communications with the Sub-commission.

Slide 28 (Executive summary documents)

Shown here are the three documents that constitute Australia's Executive Summary. This was accompanied by another 21 maps. These are the only submission documents that are publicly available, through the Commission's web site.



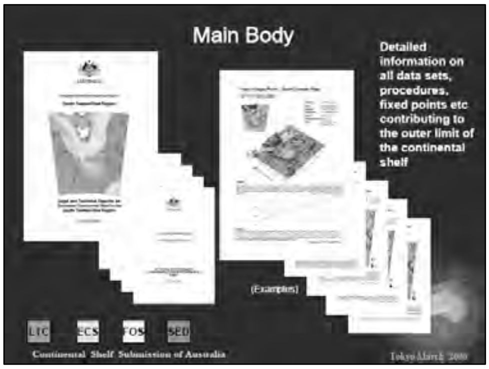
Slide 29 (main Body)

The main body is the largest part of the submission and addresses article 76 directly. Consistent with Australia's submission philosophy, a very structured approach has been taken for presenting the main body for each of the submission areas. The documents supplied in this section can be divided into two types. The first type includes general background documents that are relevant to the submission area. There are five of these general documents for each submission region.

> open LTC

The most important of these, as it sets out the basis of Australia's entitlement in each area, is the "Legal and Technical Case". This document brings the legal and the scientific/technical aspects of the submission together in a single document. Special care

was taken when this document was compiled to ensure its consistency with the Convention, and that it addressed the issues raised by the CLCS in its Scientific and Technical Guidelines.
>Close LTC
The second category of documents includes all the point description documents. These documents describe the location and source of all the points that were used to create the outer limit line as well as the outer limit line points themselves.
> open FOS point
For each foot of slope and sediment thickness point contributing to the formula line, and each 2500m isobath point contributing to the outer limit, there is a separate document supporting the determination of that point. The document shown here supports the location of a foot of slope point on the South Tasman Rise, a large submerged prolongation of the landmass of southeast Australia.
>Close FOS



Slide 30 (Supporting Data)
Australia has supplied extensive supporting data in its submission. The majority of this information is relevant to each specific submission area and includes items such as survey metadata, lists of surveys used, and velocity information where the sediment thickness formula has been applied. Some items are widely applicable to the Australian submission and have been categorised separately.
>bring in interpretive issues document
The most important of these latter supporting documents is the ‘Legal and Interpretive issues” document. This document sets out Australia’s views with regard to the legal interpretation of the Convention. We believe that this document is one of the most important single documents in our submission.
Also in this category of general supporting documentation is a document describing the technical methods used by Australia to manipulate the data. This document is called the

"Methods and approaches used to define the outer limit of Australia's Extended Continental Shelf" and runs to 146 pages.

Slide 31 (Seismic Data)

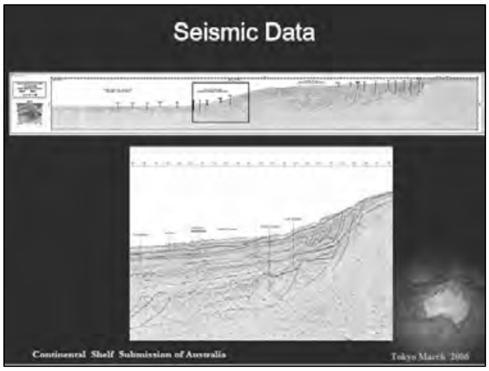
In addition to the documents supplied to the Commission as supporting data, Australia has also supplied a large amount of seismic data. These data have been supplied as paper copy and as PDF files. In general the sections are displayed at 1:200 000 scale and 3cm per second of two-way time.

This is one of the interpreted regional transect lines that we have supplied to give the Commission an understanding of the characteristics of the continental margin in the area.

> box

> detail

And a detail of the quality of seismic supplied.

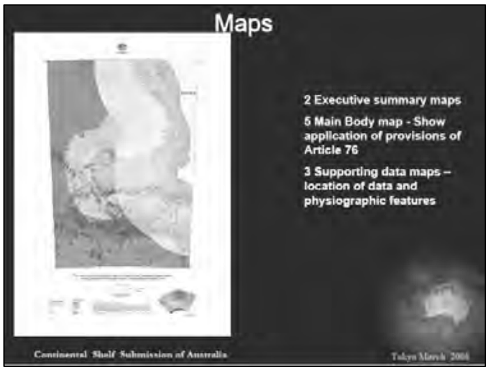


Slide 32 (Maps)

Australia also produced a series of Maps as part of the submission. For each area, two Executive Summary maps were produced;

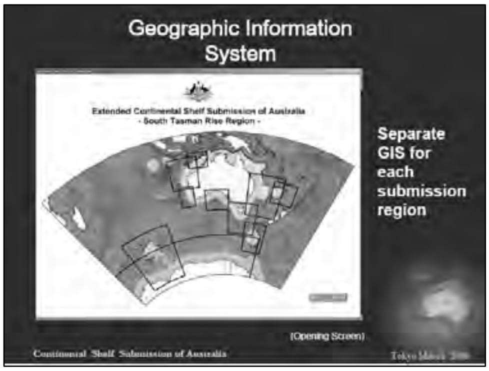
five Main Body maps, which illustrate the process of applying the provisions of article 76;

and finally three supporting data maps which primarily indicate the location of bathymetric and seismic data and the profiles used to define the outer limit.



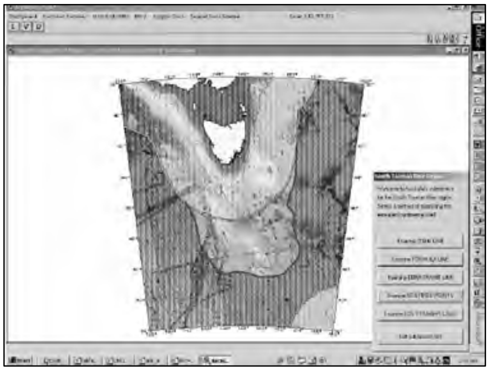
Slide 33 (Geographic Information System)

Although all of these elements standalone, Australia decided to tie them together with the use of the GIS tool. This not only allows all of these documents to be linked logically and spatially, but it also gives the Sub-commission the capacity to apply the same evaluation tools to the data that we used in the development of the submission. Each submission region is presented in its own customised GIS project.



Slide 34 (first active screen)

On entering the submission tool, a Commissioner can assess the points on the 200 M line that contribute to the outer limit, the construction of the formula line, the constraint line or the outer limit. Alternatively, a Commissioner may go directly to any document relevant to the submission area being assessed via the top menu.

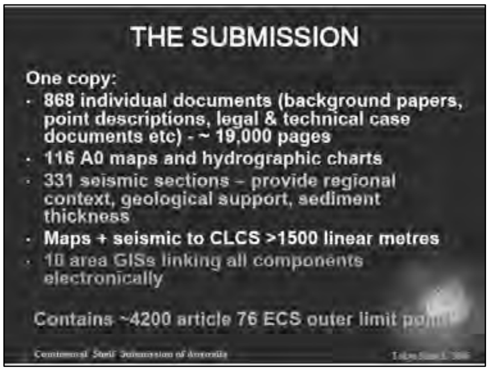


Slide 35 (The submission)

To give some idea of the final scale of effort involved to produce the submission materials, listed here are some statistics relating to the submission that was deposited with the Commission.

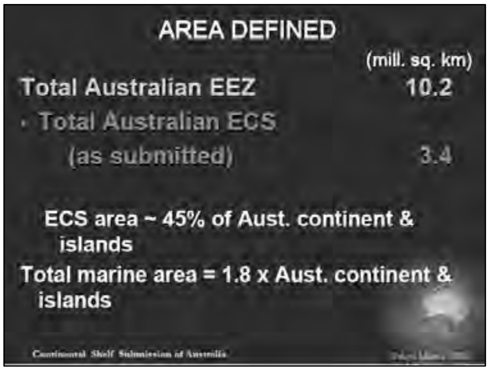
One copy of the submission contains:

868 documents, 116 Maps at A0, 331 seismic sections and 10 integrated regional GIS projects. These documents, maps, sections and GIS define the approximate 4200 outer limit points that make up the outer limit line. The number of Geoscience Australia scientists and technicians involved in the work varied from a maximum of about 20 during the article 76 GIS analysis and geological framework phases to about 12 during the preparation of the submission materials.



Slide 36 (Area defined)

The total area defined by these outer limit points is 3.4 million square km. This area is equivalent to 45% of the area of Australia’s continental landmass and islands, or just over one-third of Australia’s EEZ jurisdiction.



Slide 37 (Submission Photos)

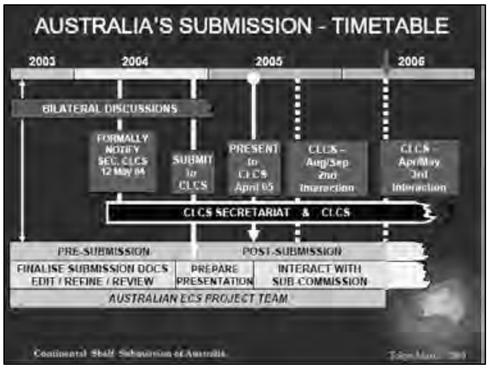
Here are some photos taken when the submission was completed and ready to be sent on its way to New York. In the top left is a picture of one set of the written materials; in the top right is Geoscience Australia handing over the submission to the Department of Foreign Affairs and Trade. The lower left is the submission loaded on the three palettes it took to deliver to New York; and the last photo is of the submission being handed over by one of Australia's diplomatic representatives in New York to the UN Division for Ocean Affairs and the Law of the Sea on 15 November 2004, one day before the original deadline for Australia.

Slide 38 (Submission Presentation)

Of course, sending the submission to New York did not represent the end of the process and we now have moved into the stage where the Commission is considering Australia's submission. Australia presented its submission to the plenary session of the CLCS on the 5th March 2005. The Australian delegation was led by Chris Moraitis, Senior Legal Adviser for the department of Foreign Affairs and Trade, and Bill Campbell QC, General Council for International Law and Head of the Office of International Law at the Attorney General's Department. The delegation included three members from DFAT, two from the Attorney General's Department and five from Geoscience Australia.

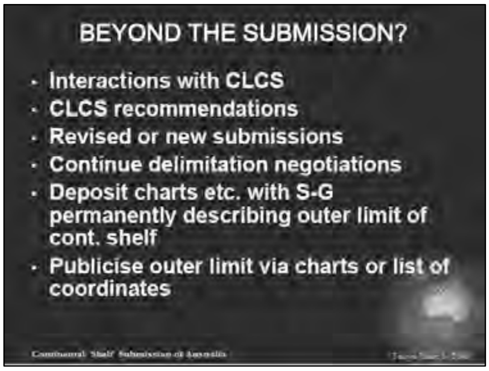
Slide 39 (Submission Timeline)

Here is shown the timeline for the submission process, although we are now significantly down this path. The Commission elected a Sub-commission to deal with Australia's submission in detail after Australia presented at the plenary session of the Commissions 15th session. Australia interacted intensively with the Sub-commission at its April and September sessions in 2005, as well as inter-sessionally, and in a few weeks we will again head to New York for our third set of interactions. At this stage, beyond expecting to meet with the Sub-commission later this year, it is difficult to determine how long the process will continue.



Slide 40 (Beyond the Submission)

What lies beyond? Well we still have plenty of activities to keep us busy. For the foreseeable future we will be meeting with the Sub-commission in New York until it is in a position to make recommendations. Depending on the nature of these recommendations, Australia may have to make a new or revised submission, although obviously we hope that this will not be the case, and Australia will be in a position to define an outer limit on the basis of the Commissions recommendations. This being the case then Australia will have to lodge the points defining this outer limit with the Secretary General and publicise its outer limit via charts etc.



Slide 41 (Lessons learned)

And lastly, what lessons have we learnt doing all of this work.

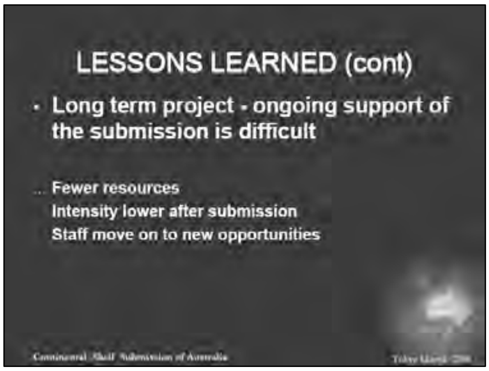
The first and most important is that integration between the legal, diplomatic and scientific agencies is critical at all stages of the process. This cannot be overstated.

The second is the importance of data management, both in terms of storing and cataloguing, but also to have the right tools to analyse and visualise the data.

Thirdly, the quality of documentation, the structure that these documents are arranged in, and the means to track these documents will make an enormous difference to the ability of the delegation to respond to the Commission now and into the future.

Slide 42 (Lessons learned [cont])

Finally, even for a country with a small submission, this is a long term activity. Staff will come and go, and maintaining expertise in the project is something that has to be planned for, particularly once the submission has been made. In Australia's case, during the preparation of the submission, the project had up to 20 staff working on it, with 14 of these working on the submission full-time. Once the submission has been made, the number of involved staff reduced considerably. The interactions with the Sub-commission are focussed on the periods when the Commission sits in April and September. In between there is often little activity. Agencies will have difficulty justifying having staff dedicated solely to the project during this phase that could take several years, so staff will be moved to other priorities. Beyond staffing, software is itself an issue. Australia used ArcView to present its submission, and ArcGIS to prepare most of its maps. ArcView, however, is an application that is no longer being developed and fully supported by the vendor.



I hope this presentation has given you some insights into the content of Australia’s submission, the philosophy behind it and the work involved in preparing it.
- Thank you

An Academic Desktop Study in Support of a Potential U.S. Submission under UNCLOS Article 76[1]

Prof. Larry Mayer
Dr. Martin Jakobsson
Capt. Andrew Armstrong
Center for Coastal and Ocean Mapping, NOAA/UNH Joint Hydrographic Center,
University of New Hampshire, United States of America

Let me join Lindsay and Sarah in thanking our hosts for putting on this extraordinary series of meetings. Given all the ambiguities associated with Article 76, it's really important that we have chances like this to interact and share ideas. The more of this we can do, the better job we will all do with our respective submissions. So once again, we appreciate very much your hospitality, and your initiative in hosting this meeting.

What I'd like to do is start by looking at the title of my presentation because there are a couple of important things about it that I want to point out. The first is the word "academic" because I have to say right up in front that we are academics and thus do not represent the US government. I need to make it clear that I'm not speaking for the US government in any way, shape or form. The other word I want to point out is "desktop". What I will be describing is a desktop study evaluating U.S. data holdings. It fits very well with the outlines that both Lindsay and Sarah presented for desktop studies but it's not a complete desktop study. It does not do the final analysis of the existing data in terms of a potential submission but rather it focuses on the evaluation of existing data holdings in order to see where new data, if any, may need to be collected. This is, in essence, the starting point of many desktop studies.

Despite the fact that the US hasn't acceded to the treaty, there are still some people in the government who have paid attention to UNCLOS and who have had the foresight to see to it that some preparatory work be done. And so, in about 2001, the Center for Coastal and Ocean Mapping at the University of New Hampshire was asked to undertake a desktop study and look at the state of existing data holdings relevant to a potential U.S. submission under UNCLOS Article 76. Our tasks were, quite specific. The first was to identify all the available bathymetric and seismic data relevant to a potential US submission under UNCLOS, Article 76. We were not just to look at the presence or absence of data but also to evaluate the quality

[1] This was presented in Expert Meeting on Technical Matters regarding the Outer Continental Shelf on 8th March 2006.

of the data and to identify those areas were more data would be needed. And here's where they were very explicit. We were instructed to determine what data were needed to make the 'best possible' submission. Words like "irrefutable" were used. Once we had identified the data gaps, we were to estimate the level of effort necessary to fill these gaps. You see, this is very similar to the approach that Lindsay and Sarah both mentioned. We were to prioritize the work needed and submit a report in six months.

I wondered why we had to do this in less than six months when the U.S. hadn't even acceded to the treaty yet. It turned out that this had to do with internal government budget cycles. There were people in the government who were willing to start funding new surveys if they were necessary, but in order to do this they had to get a request into the next budget cycle. So we basically had to do the desktop study within six months and thus we felt the same pressure that I think many of you are feeling right now.

Let me tell you a little bit about who we are. As I said, we are an academic unit at the University of New Hampshire called the Center for Coastal and Ocean Mapping. We are a national center of excellence in ocean mapping. Our focus is on developing techniques and approaches to ocean mapping, and that includes both the seafloor and water column with a particular emphasis on multibeam sonar bathymetry and backscatter - the imagery that comes from multibeam sonars. We have a training program, offering a Master's and PhD in ocean mapping studies. And we're very proud to be the host of the GEBCO-Nippon Foundation Certificate Program in ocean bathymetry. This is a program funded by the Nippon Foundation and run through GEBCO that is designed to do capacity building for students from around the world in the art of the collection of deep-sea bathymetry.

One of our main focuses is on the development of software tools to help in processing the tremendous amount of data that are acquired from multibeam sonars. We've developed an approach we call CUBE, Combined Uncertainty and Bathymetric Estimator, which is a statistically robust method for automatically processing multibeam sonar data that has resulted in time savings of about 30 to 70 times over the techniques that are currently being used. One of the most important things about CUBE is that at the end of the processing scheme, it attributes all the data that's been processed with an uncertainty value which allows the hydrographer - the person processing the data - to focus their attention on those few places where they need to intercede manually and subjectively look at the data.

Our lab also looks into issues of seafloor characterization and fisheries habitat mapping. This is to show an example of a technique we have developed called the Local Fourier Histogram which determines the roughness of the seafloor and attempts to associate that roughness with different habitats. Another techniques that has been developed to analyze multibeam sonar backscatter data is what we call AVO - Amplitude Versus Offset Analysis. This approach looks at the angular dependence of the backscatter data, and using a constrained inversion of a physics-based model for the interaction of sound with the seafloor, comes up with a guess at what the seafloor material is. So these are the kind of things we focus on from the data analysis point of view. Our lab also develops tools for visualizing these complex data sets - you're seeing a number of examples of these tools. Let me show a little bit of a new tool we are developing, called GeoZUI 4D, a four - dimensional visualization package that allows us to explore time-varying 3-dimensional processes. In this example, we visualize the submerged behavior of humpback whales. Tags are placed on the whales. The tag, which is attached by suction cups, has a motion sensor, a depth recorder, and a hydrophone on it. Eventually, the tag falls off - the longest record is about 28 hours - and the tag with the recorded data is then recovered. We take the data that comes back - here you can see the sea surface and the seafloor - and can display the true 3-dimensional submerged behavior of the whale. If I turn the sound on, you'll also hear the whale vocalizing. You can see the whale diving, swimming along the bottom, as well as it's feeding behavior near the bottom. The unique aspect of this approach to visualization is the ability to move and zoom through both space and time simultaneously. I can speed up or slow down as I zoom through time. What is coming into view here is a vessel, a little zodiac, up on the surface. One of the goals of this experiment was to look at the response of these particular whales, to the vessels. Do they avoid the vessel? Are they scared by it? These are important concerns with respect to marine mammals.

Another application of this four-dimensional visualization is what we call the "Chart of the Future", an interactive, three-dimensional electronic chart which shows the vessel moving along with complete 360-degree video panoramas of the harbor. The charts are actually tide aware, you can see the seafloor change as the tide changes. And again, we can zoom through time and space at the same time. And finally, for local interest, a visualization we recently did of the December 26th tsunami. This was actually done with Fledermaus not GeoZui. You can see the bathymetry under the sea-surface and the effect of this bathymetry in building up the tsunami, especially in northern Sumatra near the epicenter. The modeling was done at sea by a team led by Stephan Grilli from the University of Rhode Island. We put in the best bathymetry we had as bathymetry is extremely important for understanding and predicting the run-up. In this case the model was calibrated by using actual run-up measurements collected from all along the coast of Thailand and Indonesia.

So that's the kind of stuff we do in the lab. That's who we are but its even more important to tell you who we're not. We're not experts in maritime law. For those of you who heard Dr. Golitsyn's comment yesterday, when he corrected me about using the word "claim," you know that this is true. We're just plain old marine geologists and geophysicists. And most importantly, again, I remind you that we don't represent the US government. OK, enough of the fun stuff. Let's get back to what we're supposed to be doing now.

Let's start by taking a look at a flow chart of how we approached the desktop study. I think you'll see it is very, very similar to what you've seen from Lindsay and Sarah. Our first task was to find all the major data compilations. These are the kinds of data sets you've been hearing about: ETOPO 2, ETOPO 5, etc. I'll talk a little bit more about these in a few minutes. We also entered all the existing trackline data, individual point sounding data, and polygons in those areas where multibeam sonar data was collected.

As we brought the trackline data into our database, we made sure that it was attributed with what's called "metadata,"- data about the data - that is as full a description of the data as possible so that we would later be able to extract information about the data through the interactive interrogation of a point or line. The metadata contains a number of descriptors including when the data was collected, how it was collected, and what sonar system was collected with. This allows us to evaluate the quality of the data brought into a database.

As a general outline of what we did, once we put together our database we asked the question "where is it possible that the U.S. might have grounds for a submission for an extended continental shelf?" We then focused on those areas and produced a more detailed set of map products that looked at the various components of a potential submission. We looked at the quality of the existing data and anywhere we had high-quality data we marked as an area not in need of further survey work. Those areas that had low-quality data would justify further survey. We estimated the effort needed to acquire new high-quality data, and then estimated the costs.

So let's start by looking at the data compilations that served as our fundamental guides. You've seen bits and pieces of these throughout the last few days. The first two, the bathymetric compilations, ETOPO 5 and ETOPO 2 are the best data sets we have representing global bathymetry in a gridded form. Let me talk about the differences and then show you an example of each. ETOPO 5 is a gridded product that's based strictly on sounding data - mostly single-beam sounding data and I'll bet you there's even some lead-line data in it. But mostly it's single-beam echo-sounder data. It's gridded at five-minute intervals, so approximately one point every five miles. ETOPO 2 is the next generation of global gridded data which has also incorportated land based topographic heights. It also uses single-beam echo-sounding records but ETOPO 2 has also included bathymetry that is based on satellite altimetry. Using the satellite altimetry-derived bathymetry has allowed a product that is gridded at two-minutes or a about two-mile spacing. I suspect you've all seen these wonderful maps that show global compilations of bathymetry. They are basically using changes in the elevation of the sea surface, which reflect changes in the typography on the seafloor, combined that with existing sparse soundings, to predict the bathymetry. The predicted bathymetry is only used between 64 North and 72 South. Below 72 South, a US Navy database called DBDB-V, the V for variable, meaning a variable scale grid was used, and above 64 North a product called the IBCAO - International Bathymetric Chart of the Arctic Ocean - which is gridded at two and a half kilometers, but sub-sampled here to 2 minutes, was used.

Just to give you an idea of the differences, here is an example of the ETOPO-5 data set. Somebody send me to a place that interests you. Where should we go? OK. So, here's the depiction in ETOPO 5, the five-mile spacing data. Let's now take a look at what the approximately two-mile spacing data, ETOPO 2 looks like. You can see the much greater resolution. You also see this interesting texture, which is not necessarily real. There's a lot of debate about what this represents, but it's probably an artifact of the processing, but even ignoring this texture, there's certainly a lot more detail in the ETOPO-2 data. Now it's important to know that the Commission - please feel free to correct me here - the Commission has said explicitly that they will not accept satellite-derived bathymetry in a submission. Even so, it's still an extremely useful product for doing a desktop study, and certainly where everybody should start. But remember you won't be able to use ETOPO 2 data in the actual submission because it has satellite-derived bathymetry. OK, so you see the difference between ETOPO 5 and ETOPO 2. I'll give the website where you can download each of these from the National Geophysical Data Center (NGDC).

In the States we have the potential for a very large extended continental shelf in the Arctic and thus Arctic bathymetry is very important to us. Yesterday I spoke about the difficulty we face in collecting bathymetry through the ice. For now the best compilation of Arctic bathymetry is the IBCAO chart - International Bathymetric Chart of the Arctic Ocean, which is gridded at 2.5 kilometers. Again you can download that from NGDC.

Specific to a submission around the U.S. there is a data set called the Coastal Relief Model. This is a gridded bathymetric data set with a resolution of three - arc seconds, or about 90 m.

Again, there is a lot of interpolation in this data set because there isn't really the data needed to generate 90 m grids in most places. For most of the shallow shelf area around the contiguous U.S., we can draw upon this Coastal Relief Model, but unfortunately products like this don't exist for many other places.

Another important source of bathymetric data, is the GEBCO Digital Atlas. When we did our survey in 2001-2002, the GEBCO Digital Atlas was a digital version of their contours - they hadn't yet produced a gridded bathymetric product. So we used the GEBCO contour data in our desktop study. Since then, GEBCO has produced gridded bathymetry from their contour data. Now, I personally think it is strange to create a gridded product from contours. I'd much rather seem them go back to the source data and generate a gridded product from that, but this is not the path they have chosen. What is important is that this is another source of publicly available data that does not have any satellite bathymetry in it, so should be acceptable for inclusion in a submission. And here's the website - again, go to NGDC and from there you can get connected to GEBCO.

Understanding the general nature of sediment thickness is another key component of a desk-top study and a very coarse global compilation of sediment thickness data can also be down-loaded from NGDC. You have to keep in mind that it's very, very coarse as it's based on very sparse data. It's gridded at five minutes, or again, about five mile spacing. Despite this, it's still a very helpful starting point for trying to understand general trends in sediment thickness and where there might be the possibility of a Gardiner Line-based submission. Let's take a quick look at what looks like. As we can see, in most of the Pacific, and particularly the Western Pacific, there is not a terribly thick accumulation of sediment, in many areas less than a kilometer thick. But if we look at say, the Bay of Bengal, we see a phenomenal 16-kilometer-thick section of sediment. So, again, the sediment thickness compilation gives us a very quick idea of the general distribution of sediment and where there may be grounds for a sediment-thickness based submission.

For Arctic sediment thickness, the Canadians have put together a compilation of very sparse data which implies a very thick accumulation of sediment in this region. Again, the compilation gives you a rough idea of where you may or may not expect a thick accumulation of sediment that may trigger a Gardiner Line-based submission.

For shoreline information, the U.S. National Geospatial Intelligence Agency (NGA) - which is the former Defense Mapping Agency, has the World Vector Shoreline. Sarah, mentioned this source too. We used the 1:250,000 coastline data that is currently available on their website. NGA is now upgrading the World Vector Shoreline and working on a 1:50,000 coastline. I'm not sure if that's public yet, but I know they're working on it. For territorial baselines, we again went to NGA's Digital Chart of the World and the U.N.'s World Databank. And finally, let me say that I'm very excited to hear about the new UNEP Shelf Program effort. We didn't have this opportunity and thus had to search out each data set individually. The idea of an integrated, one-stop-shopping place for data relevant to Law of the Sea is a wonderful one and will hopefully make your lives a little easier than ours in putting the necessary data sets all together.

Thus there is a wide variety of data sets that are freely available and provide a very good starting point for any kind of desktop study. There are also tools available for the kind of interactive visualization that I've just shown you. I can leave you a data set and a little tool that allows you to interactively fly through the data so you can all at least show your folks back home what your area looks like.

I've summarized our work with the compiled data sets. Our next step was to collect individual data sets - bathymetric, seismic, and other geophysical data sources from each region for which we believed the United States had the potential for an extended continental shelf. The first stop for this was again, NGDC, which is charged with collecting every bit of data collected by public funds in the U.S. Not everybody submits their data to NGDC but they are supposed to. We also went to NOAA's National Ocean Service (NOS) and searched their archives to see if there was hydrographic data that might not have been in the NGDC archive. NOS and NGDC are part of the same organization, they're both part of NOAA - the National Oceanic and Atmospheric Administration - but as in many large organizations, there are sometimes lapses in communication. We also went to the NGA - the National Geospatial Intelligence Agency - which has for years been accumulating bathymetric data from vessels-of-opportunity. We also searched the holdings of the academic institutions, some of them through their websites which are getting more and more sophisticated, but others by just visiting them and roaming around boxes and old pieces of dusty paper to try to get ideas of ship tracks and that might not have been reported to NGDC. In the end we found about 50% more data than was originally in the NGDC database, these additional data were also sent on to NGDC. Here is what the result of this effort looked like in terms of ship-track information for bathymetric data. I'll give you the numbers in a few minutes.

The seismic data is a bit more difficult. NGDC also has some responsibility for the archiving of academic (and some government) seismic data, but the industry data is much more protected. We worked with the US Geologic Survey (USGS), who dealt with an organization called the MMS - Minerals Management Service - which does have access to all industry data. The goal here was to at least understand the location of where industry data had been collected. In many cases, the industry is very, very hesitant to give people access to their data, and sometimes they are not even comfortable letting us know where it was collected. But, if we knew that there was a critical line that was still proprietary, we could then start negotiations, or the government could start negotiations with that company to see if they could get access to it. As with the bathymetric data we also searched the individual academic institution databases. You can see that the seismic data trackline database is much more sparse than the bathymetric database. We must keep this in mind when we discuss the global sediment thickness database as the sediment thickness database was created from this sparse seismic database.

To review what we have done so far - we collected a number of compiled data sets: bathymetry, shorelines, sediment thickness, and searched NGDC, academic institutions and other databases for as much individual trackline data as we could find. Once we located the individual trackline data we wanted to attribute each line with “metadata” or data about the data as well as some measure of data quality. We wanted to know who did the survey, when was it done, what ship was used and what sonar and navigation system they used. We gave each line a unique ID number. The data that came from the NGDC - the National Geophysical Data Center - comes with its own identification number. Of the information we collected, the positioning system used when the data was collected represented the most critical piece of information with respect to judging the quality of the data. The data we are interested in is, for the most part, from relatively deep water (more than say 2000m). Most echo-sounders can measure depth with a vertical accuracy of much less than 0.5 percent of the water depth, however, given that most of the data in the database was collected in pre-GPS days, the horizontal accuracy of the positioning system is the single most important feature in determining the overall quality of the bathymetric measurement. In an area of relatively steep slope, the inaccuracy of the positioning system can result in depths that are incorrect by hundreds (if not thousands) of meters.

And so we attributed the data with an accuracy value based on the type of positioning system used during data acquisition. Was it positioned using celestial navigation or by a radio system like Omega, or Loran? Or was it positioned using satellites and if so was it intermittent transit satellites or GPS or differential GPS, or P-code GPS. Depending on how it was navigated, we assigned an uncertainty value to it. If we didn’t know what system was used we gave it the maximum level of uncertainty which was 10 kilometers. We used 10 kilometers for celestial navigation down to 20-meter accuracy for P-code GPS. This is really what controls the accuracy of a single-beam sonar survey. If you're on a very flat seafloor it doesn't matter where you're at within 10 kilometers because the depth will all be the same. But if you're on any kind of steep slope, and you don't know where by several kilometers, you're going to have radically different depths.

We thus attributed every trackline with a data quality assessment based on the positioning system. Speaking about the database, we generated two different databases. First we brought all of the data into a very sophisticated and very expensive database, called ORACLE. Fortunately at the University we benefit from a University site license which makes it affordable for us. We also brought it into a much more accessible and available database called Access, which is a Microsoft product.

This comes back to the question we had earlier today for Lindsay. At the time we did our study the GEOCAP software was not available. We thus had to create our own approach to doing the geodetic calculations. For this we used a sophisticated GIS package called GeoMedia; I would not recommend this to inexperienced folks as it has a steep learning curve. When you do something on your own, you're a little nervous, so we checked our results against results obtained with CARIS LOTS and several other approaches just to ensure that we had not done something silly. It appears that GEOCAP may provide a single tool-kit to allow much of this to be done with the exception of the database. My suspicion is that, in most of your cases, the database issue will not be very large, though, because there's just not that much data around. And so you don't have the concern we had for a very efficient, fast and sophisticated database.

If we now look at the database we can pull up the same trackline data we saw earlier but now as attributed data, with the color representing the accuracy of the data. If we only want to use the most accurate data, we just look at the purple lines. If you want to dismiss things that are plus-minus 10 kilometers, get rid of the yellow and gray lines, and so on. In this manner we can get a quick overview of the accuracy of the data.

At the end of our effort we had about 40,000 individual single-beam sonar tracklines and 6,037 polygons surveys - that is multibeam surveys, in our database. And, although we originally didn't intend on bringing the soundings in, the bottom line is that even with 40,000 tracklines of single-beam soundings, there's not that much data. All of these tracklines represented just several million individual soundings so we brought those in too. The entire NGDC world-wide database of single-beam sonar soundings, is only about 60 million points. Contrast that with a multibeam sonar survey where we can collect 60 million soundings in just a minute in shallow water. So, multibeam sonars have brought us into a very different world.

So we now have all of the attributed trackline data and several million individual soundings and multibeam sonar polygons in the database. With the GIS system we can look at the distribution of the tracklines in the context of all sorts of other information like the global compilations, but we can also pull out a line and interrogate it and get all the information about it.

Once the database is established and the data available in a GIS, we can then start the general analysis. This general analysis is not entirely dependent on the actual data. We can use just the compiled data for the general analysis if that is all we have. And this is really, in a sense, a general perusal of the data to see if we think we have the potential for an extended continental shelf. Basically, we are exploring where we believe we have natural prolongations that could justify a submission. In our case we took the most inclusive approach we could. Keep in mind we were not going through the exercise of preparing a submission, rather we where exploring where we might need to collect more data. So we wanted to be careful not rule out anything that might have the slightest chance of proving the case for an extended continental shelf. And so we looked at any place where we thought there might be a chance and then we examined the data in that region in more detail. The result of this process was the identification of eight regions where we thought there was some potential for an extended continental shelf: the East Coast of the US, the Gulf of Mexico, the Arctic, the Bering Sea, the Gulf of Alaska, the Marianas and the Kingman and Palmyra area. I'll come back to these at the end of my talk because I suspect that these last two are of the most interest to you. I should also point out, as Lindsay brought up yesterday, that we suffered at this point from not having legal experts on our team to help us with the interpretive aspects of the treaty. This was one of the down sides of this exercise being carried out as an academic exercise instead of a well-coordinated government project.

Once we had identified these eight regions, we started a more detailed analysis of the data in the areas identified. I'll use the east coast of the U.S. as an example and outline the steps we took in generating a series of more detailed map products for each region. Our first step was to extract the ETOPO-2 data for the region which provides an excellent starting place. The commission won't accept satellite-derived bathymetry, but from the perspective of an early desktop study, the ETOPO-2 data certainly give us a reasonable idea of what is generally happening with the bathymetry in an area, and for better or worse, it represents the most detailed gridded global bathymetry that is publicly available.

The first question we asked when we looked at each region was: “If we were to make a submission, what would it be based on?” Would it be based on the Hedberg Line or would it be based on the sediment thickness formula? Where will the cut off lines be? We started by plotting the 200 NM EEZ which, in our case, we got from NOAA. We then plotted the limit lines. The first limit line, the 2,500 m isobath plus 100 nautical mile line was plotted by extracting the 2,500 m contour from the ETOPO-2 data, and then constructing a geodetic projection 100 nautical miles seaward. We then plotted the 350-nautical mile limit line, projected from the coastal baselines. In the case of the East coast of the U.S., the 2500 m isobath plus 100-nautical miles line is always well landward of the 350-nautical mile line. This says that in terms of future planning that we really don’t have to be concerned with where the 2,500 m contour line is because, if we have to use the cutoff lines, the 350-nautical mile cutoff line will always be most advantageous to us. So right away we can eliminate the need for a detailed survey of the 2500 m contour in this region.

We then look at the formula lines: the foot of the slope plus 60 nautical miles and the Gardiner or sediment thickness line. At this point we are faced with the difficult question of finding the foot of the slope. As we have seen many times, if we look at 2-D cross-sections across the slope, in many real situations, there is not a clear-cut foot of the slope. I think this is going to be one of the great challenges facing us all. I’ll come back to the idea of bringing in higher-resolution data and exploring these data in 3-D as an approach to determining the foot of the slope. I’m not sure if this will totally resolve the ambiguity, but at least with high-resolution data viewed in 3-D we get a much better idea of what is really there.

If we look at the New Jersey margin as an example, we see that even with high-resolution multibeam sonar data it is still not perfectly obvious where the foot of the slope is. The full-coverage multibeam sonar data does, however let us explore a number of algorithms that may allow us to quantitatively determine the location of the foot of the slope. We can also take advantage of some visualization tricks and do things like increasing the vertical exaggeration which can help us find the foot of the slope from a morphological point of view. Or we can look at the rate of change of the seafloor and generate a slope map that allows us to instantly see where the steepest slopes are. Often, however, the steepest slopes are associated with canyons and so again, I think there’s going to be a lot of work necessary to come up with the proper approach to determine the foot of the slope. Now this is all in the absence of the other geologic information - this is where evidence to the contrary can play an important role.

But remember we are just doing a preliminary desktop study - we don’t have to have our final answer at this point and so we're basically just going to make our best guess of where we think the foot of the slope is and what we think is most justifiable. So for our example on the east coast we select a number of points using 2-D cross sections and 3-D visualization tools. We then project a line 60 NM from the foot of the slope and we see that in this area we do have the potential for extension of the shelf beyond the 200 NM EEZ based on the foot of the slope plus 60 NM formula line.

To explore the viability of an extension based on the second formula line - the Gardiner Line, we turn to the sediment thickness compilation we discussed earlier. Again, this isn't intended to generate a final submission but rather to get a rough idea of what the best approach might be for an extended shelf submission in this region. We calculate the position of the Gardiner Line based on the sediment thickness compilation and our estimate of the position of the foot of the slope. Based on the plotted position of the Gardiner Line we see that there are areas where the Gardiner Line extends seaward beyond the 200 NM EEZ, so again we have the potential for an extended continental shelf using the Gardiner Line. Thus we have the potential in this region to make a submission and both formulae lines will come into play while the cutoff line will be the 350-nautical mile limit line. The foot of the slope is going to be critical for the determination of both formula lines.

And so we are brought back to the issue of where the foot of the slope is. Remember, our purpose was not to define the foot of the slope. Our purpose was to evaluate the data we had and see whether new data needed to be collected. What we did was use ETOPO-2, the highest resolution global gridded bathymetry publicly available to get an overview of the morphology of the margin. We generated slope maps and from the slope maps we defined a zone in which the foot of the slope will most likely be found. We defined what we called "a corridor of uncertainty." We know that the foot of the slope is going to be somewhere between say between the 2,000-meter contour, and the area where the seafloor flattens out into the abyssal plain. This zone of uncertainty is the area where we would want to collect new high-resolution survey data.

Once we defined the zone that we would want to survey, we then looked at what existing data we had in the area. We turn to the attributed database and see where we have high-resolution, high-quality data. We remove these areas from our zone of uncertainty as we can't justify re-surveying an area that we've already surveyed with a high-quality, high-resolution system. In the best of worlds, for me as a geologist and geophysicist, not strictly from a Law of the Sea perspective, I would go out and resurvey everywhere but within the context of Law of the Sea., it is only in these areas that we can justify new surveys. For the example of the east coast of the U.S. this means about 220,000 square kilometers of new survey. We estimate an average swathwidth for the multibeam sonar of about three times the water depth and then determine the line-kilometers needed and average vessel speeds. And that's how we start estimating the level of effort that we need.

We did a similar exercise for the seismic data. We imported the seismic trackline database in order to get a quick feel for where more seismic data might be needed. We put a 30-nautical mile buffer around each line, using the logic of the Nyquist sampling frequency for 60-nautical mile straight-line segments. We looked to see if there were gaps in the seismic coverage but at this point we didn't know anything about the quality of the data particularly whether or not it showed basement, or had any sort of velocity control. Determining the quality and usefulness of the seismic data is a much more difficult task then for bathymetric data - a task that we directed to the US Geological Survey because they're the ones with the expertise needed to examine the seismic data on a line-by-line basis. This aspect represents the next phase of the desktop study - looking at the data line-by-line and seeing what the quality of the data is and whether it will serve the purposes we need for Law of the Sea.

What we concluded, based on our study - and this, I think, is a very, very important point for the folks here - is that for the most part, the bathymetric data sets that we have, with the exception of the Arctic (where there is very, very sparse data) were probably sufficient for a submission. There is nothing in the commission guidelines that says you have to have multibeam sonar data. We had a lot of discussion about this yesterday. Multibeam sonars were not commonly used when the UNCLOS process started. But, given the fact that there was a willingness on the part of the government of the United States, to collect more and better survey data, we argued that complete coverage, high- resolution multibeam sonar data should be collected in those regions where there was potential for an extended continental shelf, as defined in Article 76.

We presented several arguments for the collection of new high-resolution, full-coverage multibeam sonar data. Our first argument was that full - coverage high-resolution multibeam data is invaluable for resource studies, for fisheries habitat studies, and for offshore engineering and environmental studies - all the kinds of things we saw yesterday in terms of geologic studies. We also argued that with high-resolution multibeam sonar data we could make a more precise, less ambiguous, definition of the critical bathymetric features needed for a submission. The result would be a more defensible submission. Finally, we argued, and I alluded to this yesterday, that by collecting full coverage, high-resolution multibeam sonar data, we may be able to optimize the area of the extended shelf. To demonstrate this we used the New Jersey margin to show the difference in the location of key morphologic features as defined by single beam sonar data versus multibeam sonar data. If we look at say the 2,500-meter contour, we find that it is quite smooth in the single-beam sonar data as compared to the multibeam sonar data. In the multibeam sonar data we see many seaward extending promontories and landward indentations. The detail of the multibeam sonar data allows us to connect the promontories which inevitably result in a greatly extended shelf area relative to the area defined by the single-beam sonar data.

This is what the eight areas look like with the corridors that we recommended for new surveying. A large area has been defined on the east coast of the U.S. and small areas in the Gulf of Mexico - little doughnut holes. The same thing in the Bering Sea with a couple of doughnut holes there and a large area in the Gulf of Alaska. The Arctic north of Alaska has tremendous potential with areas defined for surveying off the North Slope and on the Chukchi Cap. In this region an extended margin submission would be based on the very thick accumulation of sediment in the area. The Gardiner Line would extend many hundreds of kilometers beyond the 200 NM EEZ and would be limited by the 350 nm cutoff line off the coast of Alaska but by the 2500 m isobath plus 100 nm cutoff line off the Chukchi Cap. So in the area off the Chukchi Cap we need to focus our effort on mapping the 2500 m isobath.

I promised I'd present some numbers. To give you an idea in terms of the estimated survey needs, I present both estimated tracklines and the estimated costs. Most importantly I want you to notice the large discrepancies in these estimates. If we look at the Gulf of Mexico with 2,845 track kilometers needed, the estimated cost is $700,000 and yet the Aleutians, with much less needed surveying has an estimated cost of $1.1 million. The reason for this goes back to what Lindsay and Sara talked about. There's a huge expense involved in mobilization and demobilization of survey vessels -- often as much as $1,000,000 depending on where the vessel must be brought from. For our estimates, we had to pick some starting spot, and we chose the Gulf of Mexico, figuring that over 10 years it would average out. So to get a vessel from the Gulf of Mexico to the Bering Sea cost $500,000 before we'd even started surveying. The message here is that if you can find vessels of opportunity that are operating in your areas, you'll save a tremendous amount of money. The same thing is true with our estimate for the Mariana Islands. There is a very large mobilization/demobilization cost because we used a transit from the Gulf of Mexico.

To estimate ship costs we polled the major survey companies, and asked the costs for ships equipped with the multibeam sonar equipment that we thought would be necessary for the work. We received a large range of quotes and took the highest and multiplied that by 1.5

because we knew that the work would not be done for several years. You can read all the details of this in our study which is published on our website.

The arguments we made in support of new surveying were accepted and we have been funded to collect bathymetric data in the regions we outlined. In 2003, we started in the Arctic and the Bering Sea. In 2004, we returned to the Arctic and we will continue to work in the Arctic for many years to come as the areas we have to map are ice-covered and mapping is a very slow process in ice-covered regions. In 2004 we started on the northeastern part of the Atlantic margin and the last year we did the southwestern part of the Atlantic margin as well as the Gulf of Alaska. Next year we hope to map a small area in the Gulf of Mexico and then head to the western Pacific. We'll be happy to let you know where we will be working in case there is an opportunity to piggy-back on our effort to get one of your areas mapped. And, to again emphasize the value of the multibeam sonar data let me show you a comparison of single-beam sonar data versus multibeam sonar data from the Bering Sea. If we look at it a little more closely, again, you see what I've been saying about being able to connect promontory to promontory. In each of the data sets we collected, whether we look at the foot of the slope or the 2,500-meter contour, we found a tremendous extension in the multibeam sonar data that we just didn't see with the single-beam data set.

Just to end with something I suspect a little more relevant to you let me show what we are proposing for the Marianas Islands. Here again, we start by looking at the ETOPO- 2 data to get a rough ideal of the topography in the area. We have not yet considered , the geology and geophysics of this area - the kind of knowledge that the Japanese scientists are bringing to the table. As we talked about yesterday, I see very little separation between the kind of work we do in support of Law of the Sea and the data we need in support of first rate science. The science that the Japanese are doing will be tremendously helpful in that they are broadening our understanding of these kinds of geological settings. Looking just at the rough morphology, we envision the potential here for the use of a foot-of-the-slope based argument for an extended continental shelf. If this argument is accepted this would indeed extend the shelf beyond the 200 NM EEZ. So our goal is to define the nature of this feature in much more detail.

This is my last slide and it's to remind you again that the details of what I have been talking about can be found in our report which is available on our website along with all the data that we have collected so far. If you go to the website and click on the map, you can download any and all of this data.

Let me end here, thank you for your attention and call for questions.

Reference
Jackson, H. R. and Oakey, G. N. (1988) *'Sedimentary thickness map of the Arctic ocean'*, The Geology of North America, Vol. L, The Arctic ocean region, Geological Society America, Plate 5

General Bathymetric Chart of the Oceans (GEBCO)
http://www.ngdc.noaa.gov/mgg/gebco/gebco.html

National Geophysical Date Center
http://www.ngdc.noaa.gov/mgg
http://www.ngdc.noaa.gov/mgg/bathymetry/arctic/arctic.html
http://www.ngdc.noaa.gov/mgg/coastal/coastal.html
http://www.ngdc.noaa.gov/mgg/sedthick/sedthick.html

National Geospatial Intelligence Agency
http://www.csc.noaa.gov/shoreline/nga_wvsplus.html

Chapter 2

Preparation for Submissions

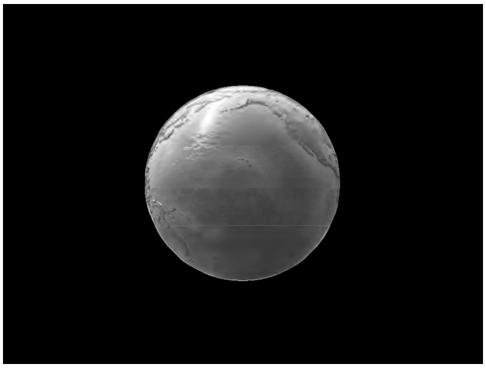
Section 4

Support by international organisations

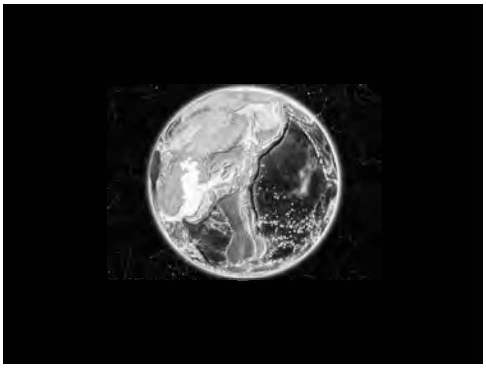
Contribution of ABLOS[1]

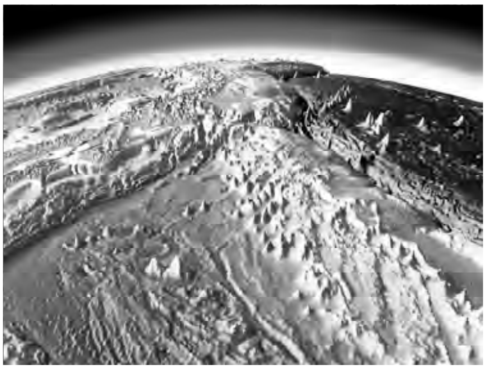
Mr. Shin Tani
Chairman, Advisory Board on Hydrographic, Geodetic and Marine Geo-Scientific Aspects of the Law of the Sea (ABLOS)

Thank you Mr. Chairman.



This is the globe. I took this photo from the outer space. Remember this.

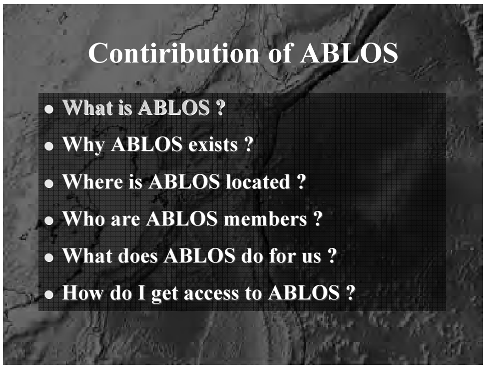




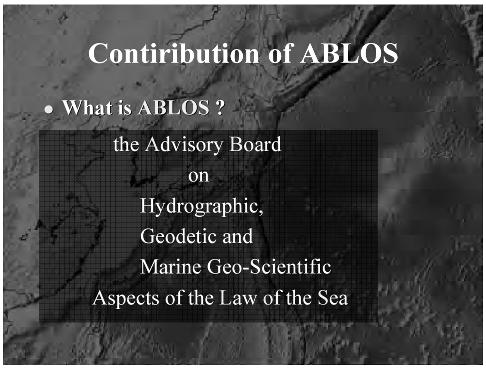
This is the bathymetry.

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

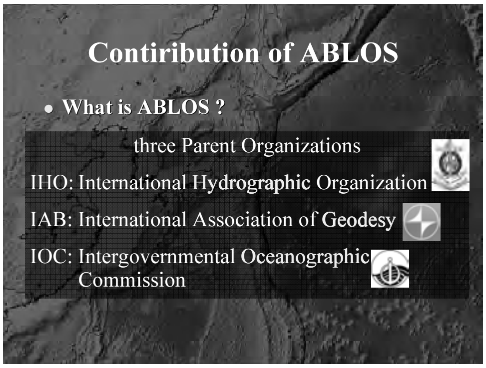
I'll talk about the contribution of ABLOS. Do you know ABLOS? Maybe not. People always think that when they look at me, ABLOS stands for Alcohol Booze Liquor Oriented Society, but it's not.



I'll talk about "What is ABLOS?" , "Why does ABLOS exist?", "Where is ABLOS located?", "Who are ABLOS members?", "What ABLOS does for us?", us, I mean not me, but you, the audiences, and "How do I get access, I mean, not me but you, how do you get access to ABLOS?".

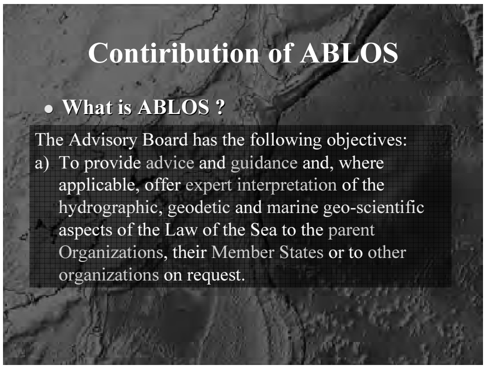


First, I'll tell you about what ABLOS is. It is not at all alcoholic, but the "Advisory Board on Hydrographic, Geodetic and Marine Geo-Scientific Aspects of the Law of the Sea". So, it is relevant to this Symposium.



ABLOS has three parent organizations, which are IHO, the International Hydrographic Organization; IAB, the International Association on Geodesy; and IOC, the Intergovernmental Oceanographic Commission of UNESCO. Now, you may wonder why hydrography, why geodesy, and why marine geoscience are related to the Law of the Sea.

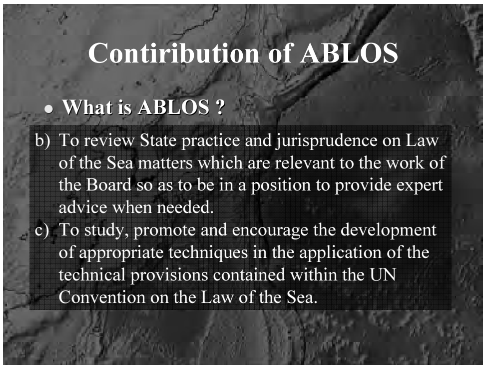
The hydrography is because the Law of the Sea uses a lot of technical terms like low-water line, or 2,500 meter isobath, or something like that. Geodesy is used in the Convention like a median line between two countries for delineating the boundary between two nations. And of course, we can not forget about the marine geoscience, which IOC handles. Those three parent organizations established ABLOS, actually established by IHO and IAB, and IOC joined later.



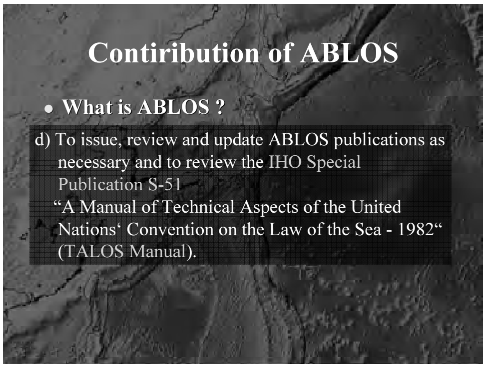
The TOR says that the ABLOS provides advice and guidance and, where applicable, offer expert interpretation of the hydrographic, geodetic and marine geo-scientific aspects of the

Law of the Sea to the parent Organizations, their Member States or to other organizations on request.

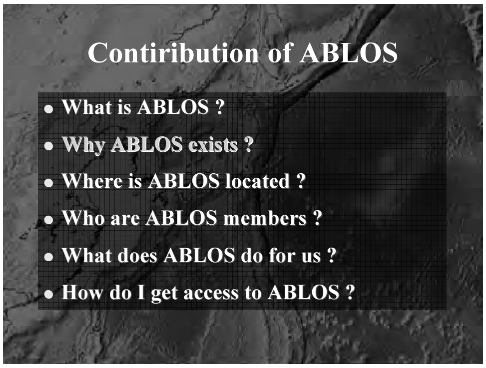
I hope that most of the participants here belong to some of these, like parent organization, or member states, or like other organizations. Even the CLCS may be included in "the other organization".



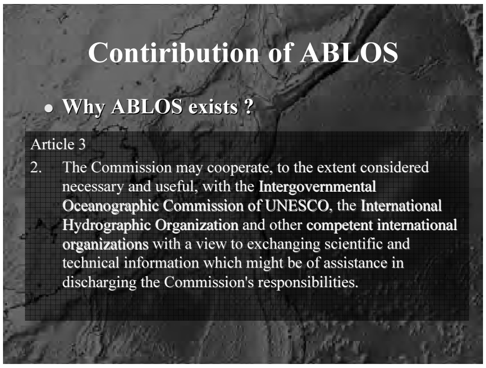
And there are other terms. Among them I have to read the last one, because it is relevant to the audiences.



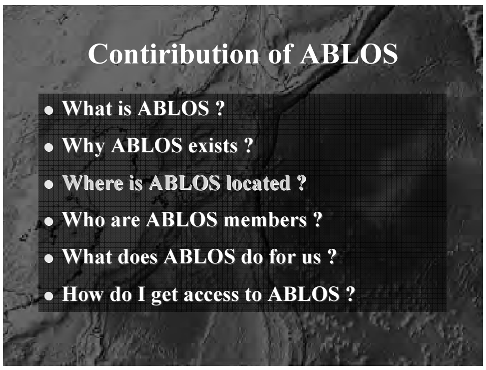
"To issue, review and update ABLOS publications as necessary and to review the IHO Special Publication S-51 "A Manual of Technical Aspects of the United Nations' Convention on the Law of the Sea - 1982". This is called TALOS Manual. TALOS stands for Technical Aspect of the Law Of the Sea. It was first published as early as in 1984.



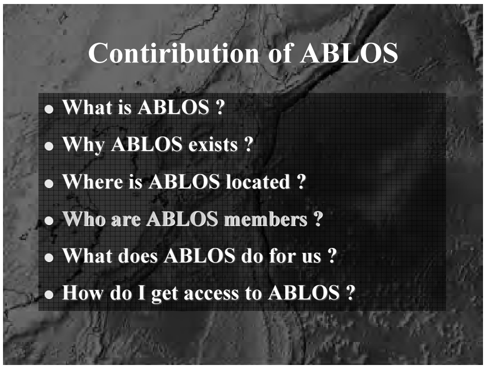
Why does ABLOS exists? I mentioned, the UNCLOS, United Nations Convention on the Law of the Sea includes lots of technical terms and phrases which are really difficult to understand, and ABLOS is here to help support people.



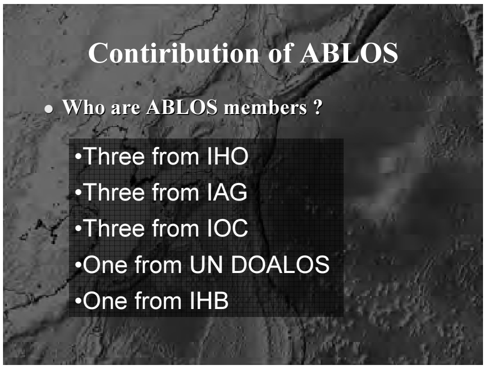
But also the annex II to the convention at Article 3, it says that the commission, the CLCS, may cooperate, to the extent considered necessary and useful, with the IOC of UNESCO, the IHO and other competent international organizations with a view to exchanging scientific and technical information which might be of assistance in discharging the Commission's responsibilities. And from the view point of IHO, ABLOS is exactly the body which is designed and established to discharge IHO's responsibility of working for this article.



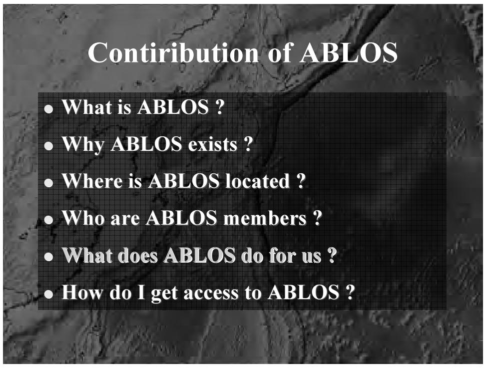
Where is ABLOS located? You know where it is? It is in Monaco. And this is where the IHB, the Bureau of the IHO, its headquarters, is located. ABLOS is not a standing board. However the permanent secretary serves here at IHB, and we have our meetings and conferences here at IHB. Monaco is a nice and fancy place to visit.



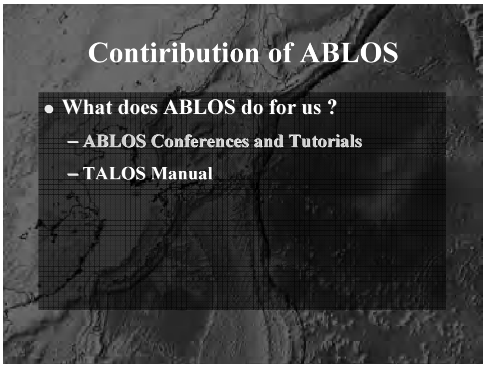
Who are ABLOS members?



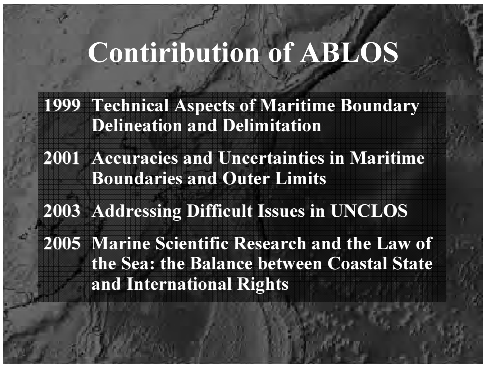
We have eleven members; namely three from IHO, three from IAG; three from IOC, and one from UN/DOALOS. This is an ex-officio member. And one from IHB who is also an ex-officio member and also serves as the permanent secretary. I am a member of ABLOS from IHO.



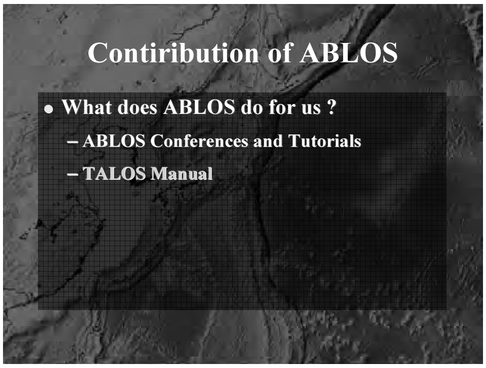
Now what does ABLOS do for us?



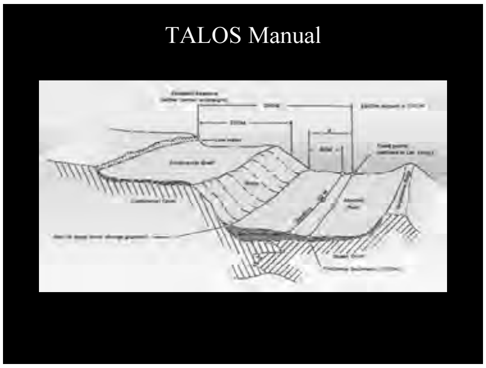
There are two things. The first thing is ABLOS Conferences and Tutorials.

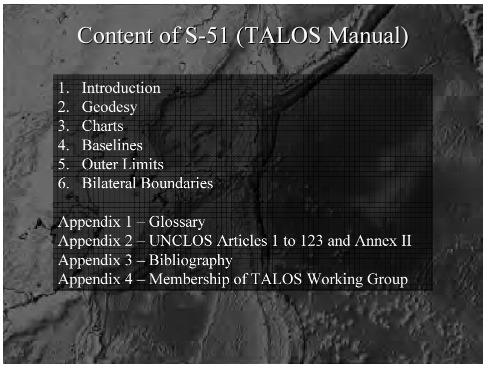


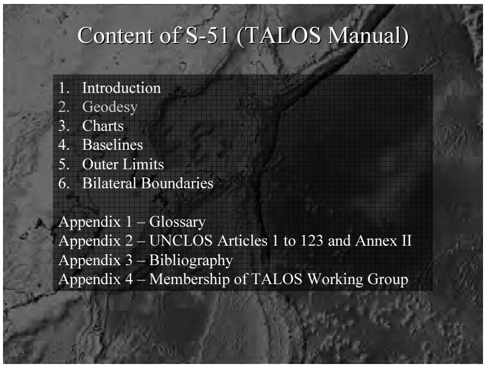
Here are the titles of the past conferences. The first one was in 1999. It was titled "Technical Aspects of Maritime Boundary Delineation and Delimitation". All the conferences are held in Monaco, which will give you a great business excuse to visit Monaco, and spend or earn money. The conference is held biennially. The second one was held in 2001, and the title was "Accuracies and Uncertainties in Maritime Boundaries and Outer Limits." The third one in 2003 was titled, "Addressing difficult issues in UNCLOS", which sounds really interesting and difficult. The last one was held last year, "Marine Scientific Research and the Law of the Sea, the Balance between the Coastal States and International Rights". If you remember the UNCLOS, it has the articles on Marine Scientific Research, MSR. It sounds like legal in nature, but once you go into that, you may want to know what the scientific research is, and what kind of researches there are. These matters were discussed here. ABLOS is working, not only on the article 76, the continental shelf, but also on every aspect of the technical issues in UNCLOS.

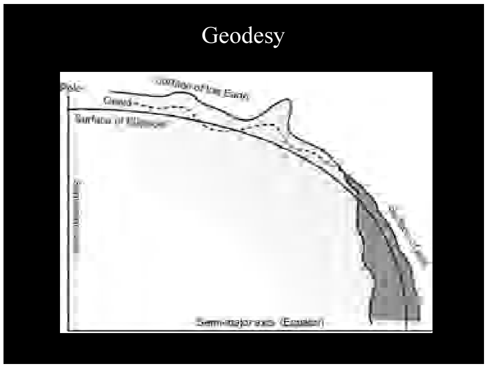


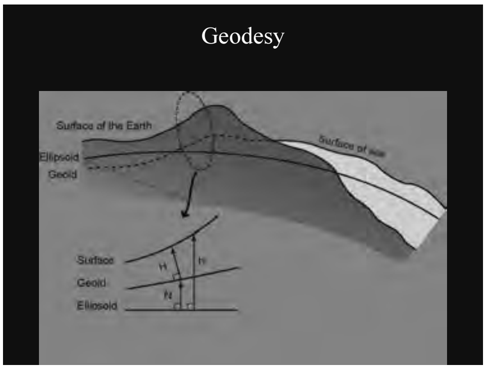
The other activity is the TALOS Manual.

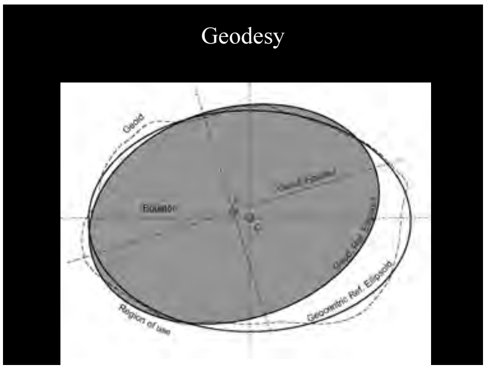


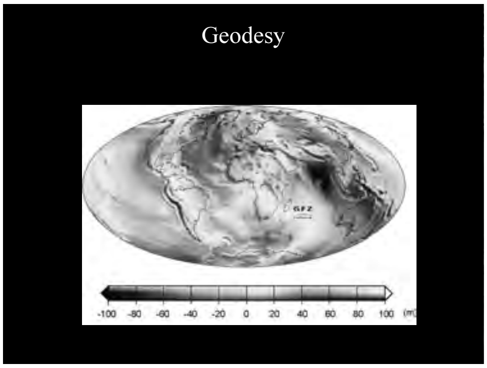


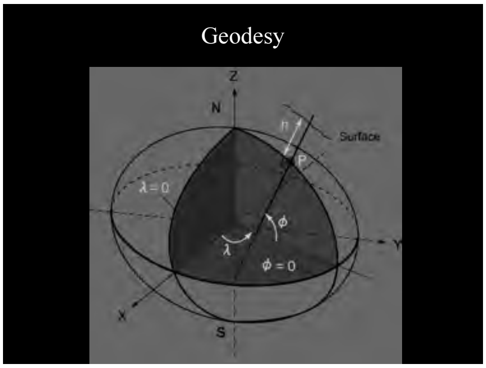


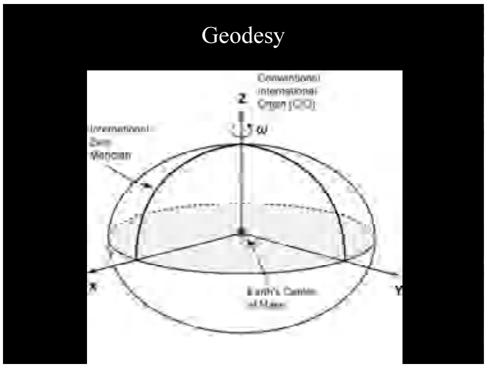


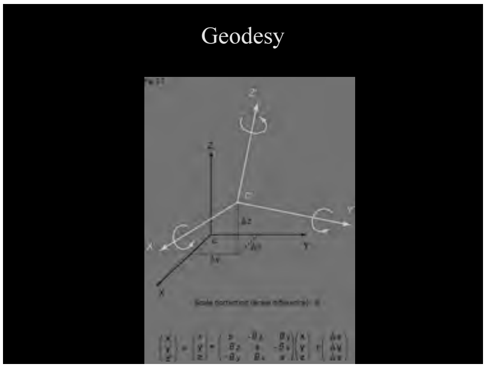




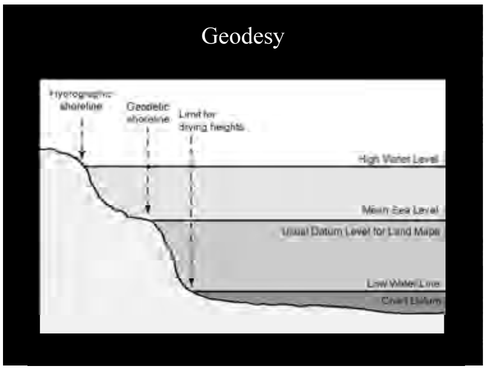




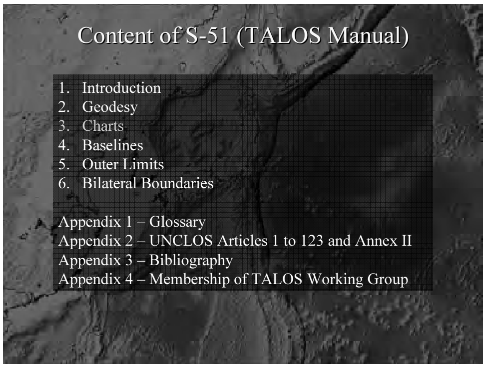




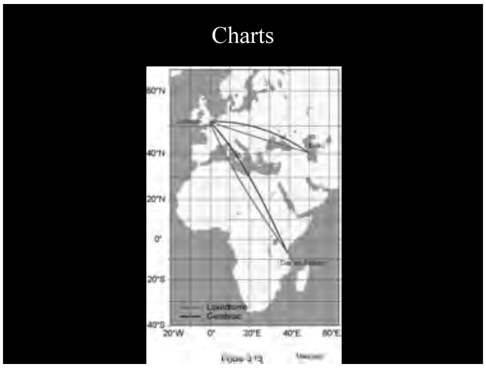
This is the cover page of the TALOS manual, "Technical Aspect of the Law of the Sea", and it covers almost all the issues of the article 76. But other than this, it contains other areas of the convention, such as the outer limit or boundaries of territorial seas, for example, from the view point of geodesy, which handles the shape of the globe, to precisely measure the distance on the ellipsoidal globe. This is important, because, many speakers today mentioned WGS84. This is how to define where you are on the globe. And this is one of the geodetic systems. You have to know about this; otherwise, you may lose your territorial area by not knowing where exactly you are located.

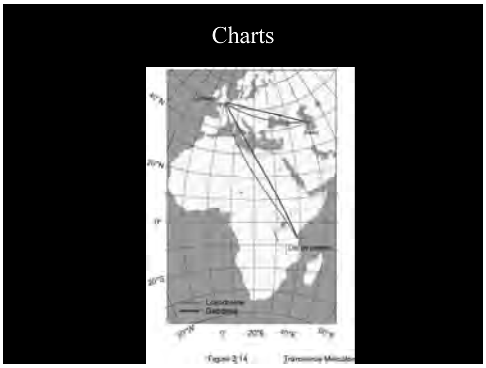


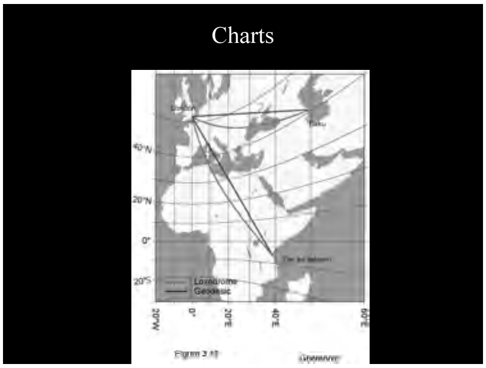
And also, a low waterline is the baseline, normal baseline for a country, which is described in the convention, and this is the low waterline. This is the limit for drying height and also the normal baseline.

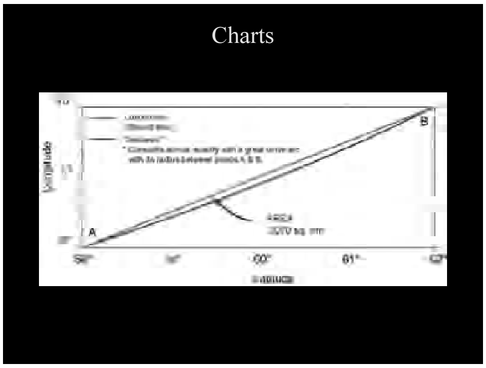


Charts.

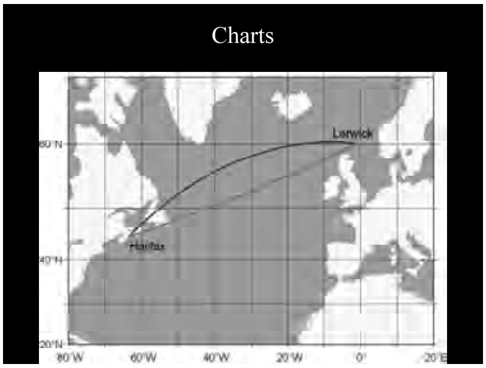




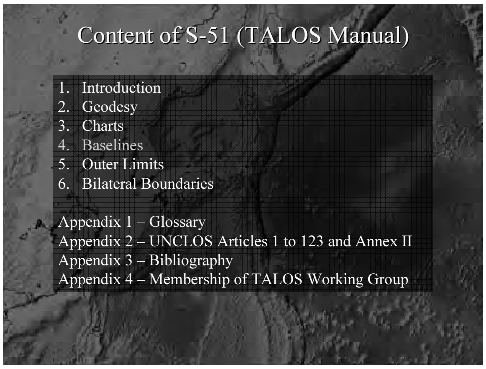




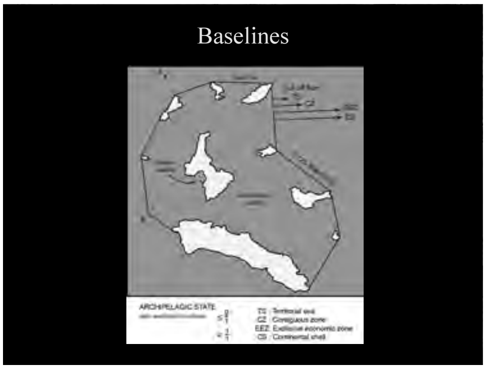
Here is a line. How do you draw a line? When you draw a line on a Mercator map, the shortest line does not appear to be the shortest line.



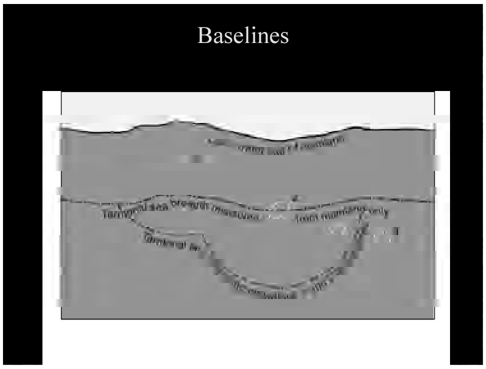
Actually, it looks longer on the Mercator map, but the real shortest line is this one, the red one.



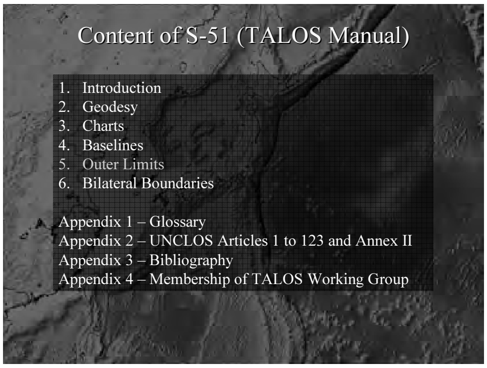
Baseline.

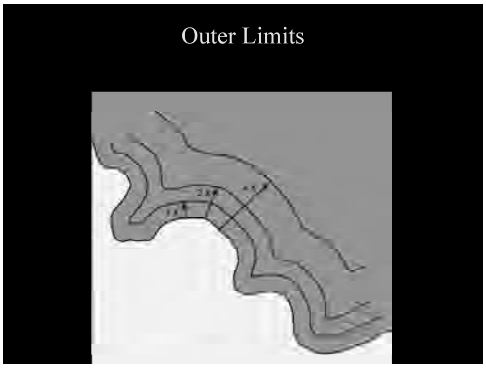


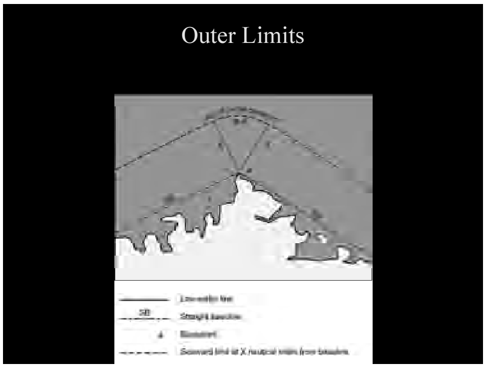
Our colleague from Philippines mentioned the archipelagic country. The TALOS Manual describes about the baseline,

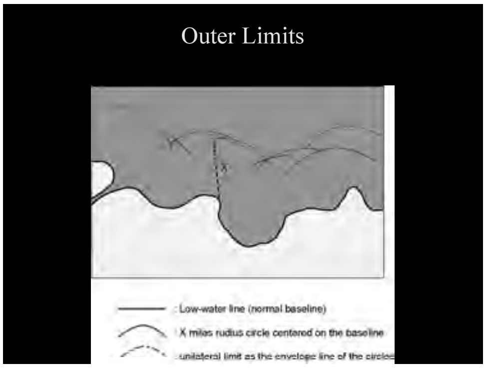


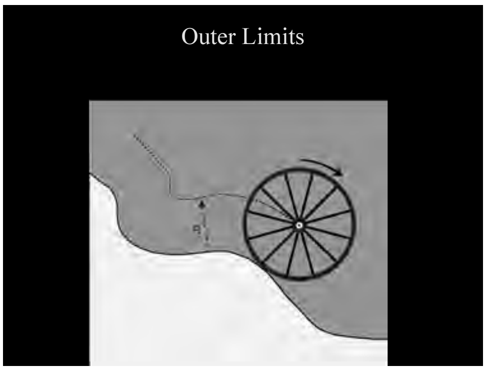
and outer limits,

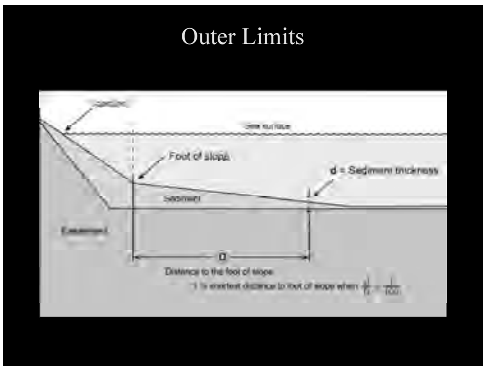


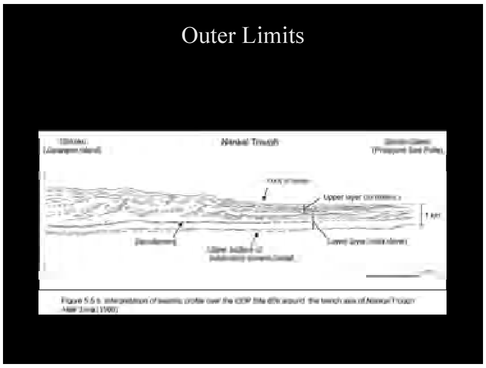




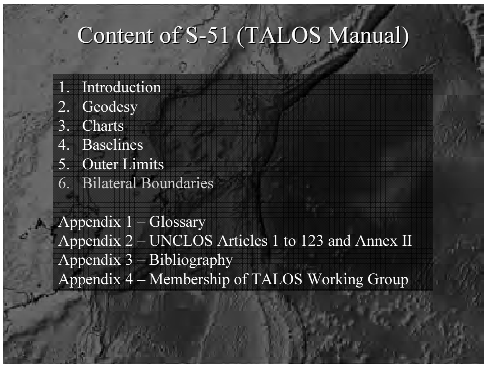


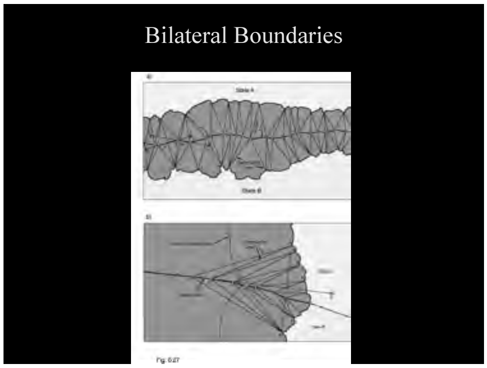


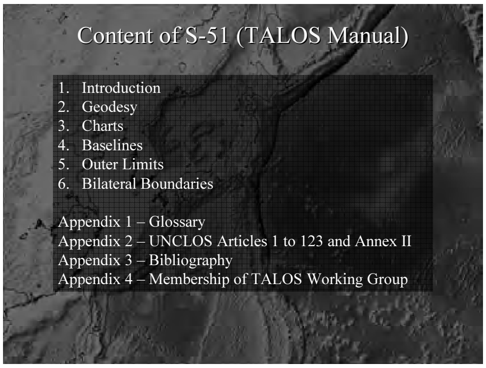




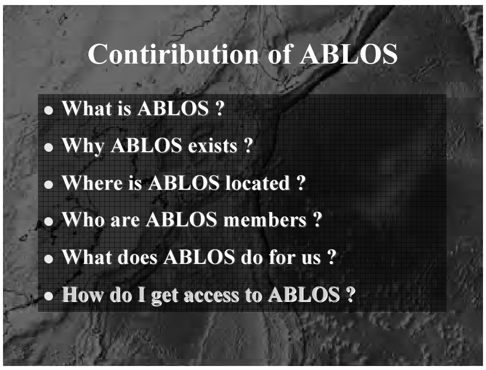
and bilateral boundaries. How to draw these?



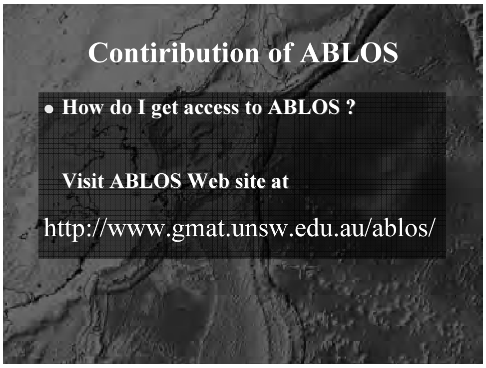




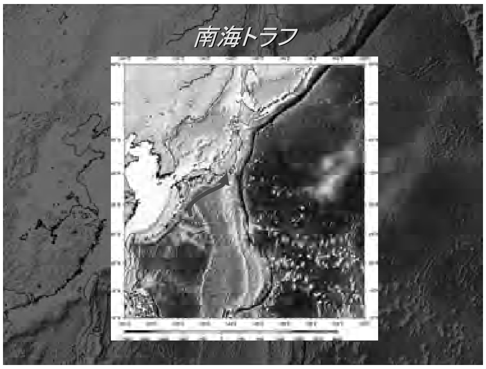
The Manual comes with the glossary, the UNCLOS text, and the bibliography, and names of the member of the TALOS working group of ABLOS.



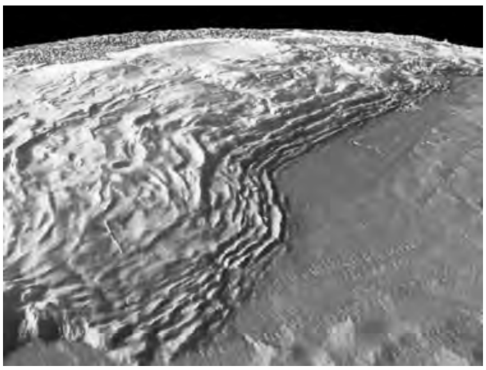
Now how do I get access to ABLOS.

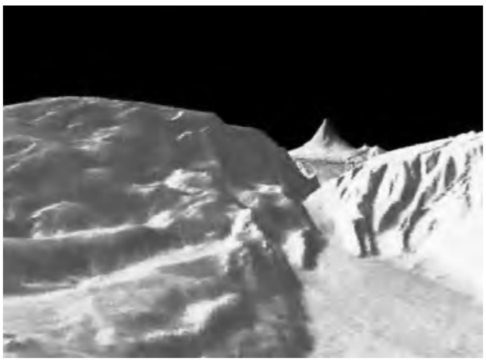


There is the ABLOS web site located at the University of New South Wales in Australia. Here is an ABLOS web page. You don't need to remember this web address. Of course, it's in the abstract, but you just need to type "ABLOS" for Google-search, and the first line of the search result will be the ABLOS home page. I ask you to use ABLOS for your sake.

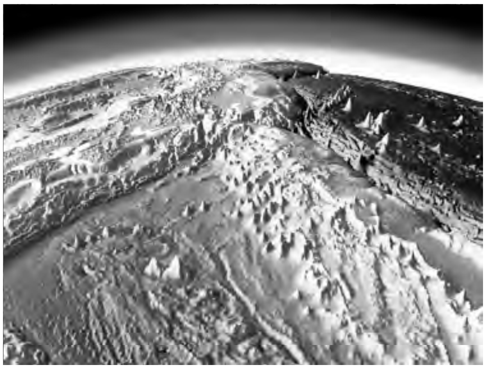


Now I give you the answer where I took my photo of the globe from the outer space. This starts from here. This is the Philippine Sea plate, and we're here in Tokyo. This is Japan, and this is Pacific Ocean. And the plate is moving in this direction to have huge earthquakes.





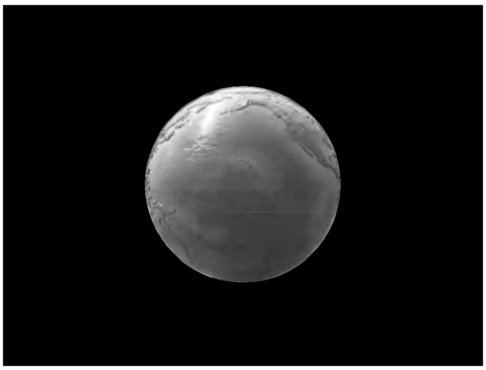
When you have very nice bathymetric data, you can enjoy very precise sea-bottom features like this. Even you can see a river on the ocean floor, where the sediments are carried from the upstream mountain, which is this one. This is actually a plate boundary and this is Mount Fuji.

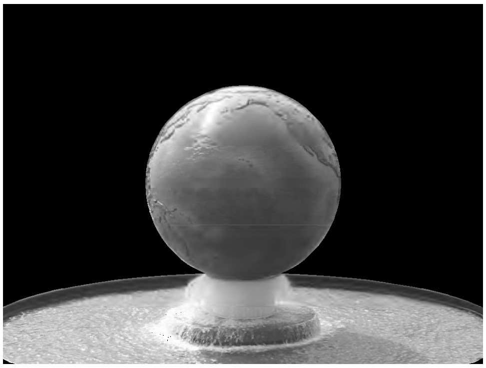


Do you remember this one? I showed you. This is Mount Fuji. Tokyo is here.

This is plate boundary, and I showed this one before and Tokyo is here again.

Now you remember this one.





The globe is supported by the fountain.

You can find this place not too far from here. It is about 30 minutes subway and train ride to Tokyo Disney Sea. Good news is you don't need to pay money to see this one. You have to pay money to go beyond this place, but before this, it's for free.

Thank you very much.

Reference

IHO, IAG, IOC Advisory Board on Law of the Sea (ABLOS) (2006) ‘*A MANUAL ON TECHNICAL ASPECTS OF THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA – 1982*’（4th Edition) http://www.gmat.unsw.edu.au/ablos/TALOS_ed4.pdf

UNEP Shelf Programme[1]

Dr. Sarah Prosser and Dr. Elaine Baker
United Nations Environmental Programme(UNEP)/Global Resource Information Database(GRID)-Arendal

The UNEP Shelf Program was established as the result of a mandate that the UN General Assembly passed in 2002. This mandate defines our strategy and highlights the main areas of our work:
called upon the United Nations Environmental Program (UNEP), working within the global resource information database, GRID system, for data and information management to expand on voluntary basis the capacity of existing GRID centers to store and handle research data from the outer continental margin on a basis to be mutually agreed with the coastal state and complementary to existing regional datacenters, giving due regard to confidentiality needs and in accordance with part 13 of the convention, making use of existing data management mechanisms under the Intergovernmental Oceanic Commission and the International Hydrographic Organization with a view to serving the needs of coastal states and in particular developing countries and small island developing states in their compliance with article 76 of the convention.

The resolution was passed in 2002 and subsequent to that DEWA (the Division of Early Warning Assessment in UNEP, which is responsible for the GRID centers) called on GRID-Arendal to coordinate the work.

The first two years of operation were spent communicating with relevant developing countries, and raising financial support. The UNEP Shelf Program was finally established in December of 2004 with the majority of funding coming from the Norwegian Government.

The initial discussions with the developing states concluded that the most effective way to make use of UNEP's GRID system was to establish a center for the management of marine geophysical, bathymetric, and geological research data that will be hosted in one of its centers. The need for a 'One Stop Data Shop' was also identified (see below for details) and subsequently this became one of the main objectives of the UNEP Shelf Programme..
The UNEP Shelf Programme has two main goals:

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[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

1. To help developing countries and small island developing states in the identification and access of data. To do so through the One Stop Data Shop.
2. To work with local staff in the relevant aspects of long-term capacity building.

In addition The UNEP Shelf Programme aims to help with other aspects of complying with the convention as appropriate, either directly or through a network of relevant institutions.

The One Stop Data Shop came up as an important facility needed by client states because data coverage in a particular area can be quite comprehensive but can be located in all sorts of different organizations from universities, to research institutions, to the publicly available and geophysical and geological databases (such as GEODAS) to geological surveys in the oil industry. For a developing state with little internal capacity to go around these different websites and institutions and be able to acquire data in all different formats it could be a major hurdle to get over to just start the whole process of continental shelf delineation.

The initial phases of development of the One Stop Data Shop has involved the development of lots of technical filters that help bring in different data types and convert it into one data format and locate it in a single database. The major data holders have been contacted, including the National Geophysical Data Center (NGDC) in America, BGR in Germany, IFREMER in France, Southampton National Oceanographic Centre have provided us with their SeaDOG metadata and the ODP and DSDP drilling programmes.

The first product of data collection and assimilation has been the creation of a user interface available on the internet through the UNEP Shelf Programme website. It is possible to zoom in on an area of interest and view what data coverage exists, as well as the information about this data. It is not possible to download data from this site, though if requested the UNEP Shelf Programme team would aim to get hold of it for the state by contacting the data holders as required. A project could then be compiled and sent out in the right format for whatever software was used by the client state.

The UNEP Shelf Programme uses Geocap Software internally. This is a user friendly package with powerful graphic capabilities. It has a UNCLOS plug-in developed to enable interpretations according to the official requirements in the UNCLOS scientific and technical guidelines. But the one-stop data shop does however export data into any of the other kind of formats that a developing state might be using.

The future use of the One Stop Data Shop is demand driven. If a state requests help to find all the data that is relevant to their claim, then it would be the aim of the UNEP Shelf

Programme team to try to do so and to do so for free (up to a certain level). The costs involved are evaluated on a case-by-case basis: if the data is inaccessible, or is very difficult formats, or involves high levels of travel, then there are major costs involved and full funding of providing the service will be impossible to achieve; the starting phases are however free of charge.

The capability of the One Stop Data Shop includes all phases of the submission. It can be used for early phases of identifying data coverage and interpretation as described above; it can also be a place where newly acquired could be loaded in to supplement the original database. A full interpretation and submission can also be based on this foundation.

Who can use the one-stop data shop? The UN Resolution of 2002 by which the UNEP Shelf Porgramme defines its mandate, dictates that 'the needs of coastal states and in particular developing countries and small island developing states' are met. The services of the One Stop Data Shop are therefore available for all such states, or all parties that the state has formally requested be assisted on their behalf. That means that if a state employs an external consultant and if the state asks for the UNEP Shelf Programme team to directly to work with that external consultant then it will be done.

The UNEP Shelf Programme is (in addition to the One Stop Data Shop) also committed to capacity-building services. It organises activities in those developing countries that ask for this type of support. This reactive response to the request from a state currently manifests itself as a capacity building event that is a hands-on workshop, following up on the initial phase of DOALOS training courses that have been held in each relevant region of the world.

An example of such a workshop organized by the UNEP Shelf Programme is an event that will take place in Nairobi in March 2006 for East African countries. Participants will come from Kenya, Mozambique, and Tanzania. The content of the workshop will start with two days general training for the whole committee in Kenya and representation from the committees in Mozambique and Tanzania. Following this the technical people (geoscientists) will stay on for eight full days of hands-on data interpretation using data offshore their region. This will enable them to start interpreting real data and designing the desktop study phases. Project planning for the whole submission process will also be part of the workshop content, to give momentum to the participants once they leave the workshop.

In conclusion: the aim of the UNEP Shelf Programme is to work with others for the mutual benefit of the developing states. It is our hope that all relevant institutions and experts pull together to maximize the chance of these states preparing their submissions in a manner that gives long term benefit for each and every country.

Support for Developing States[1]

Dr. Vladimir Golitsyn
Director, Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs,
United Nations Secretariat

Introduction

Coastal States intending to establish the outer limits of their continental shelf beyond 200 nautical miles from the baselines from which the breadth of their territorial sea is measured are required by article 76 of the Convention to submit the relevant data and information to the Commission on the Limits of the Continental Shelf ("the Commission"). In accordance with article 4 of Annex II to the Convention, the particulars of such limits should be submitted to the Commission within 10 years of the entry into force of the Convention for that State, the earliest deadline for submission for States is 13 May 2009.

The delineation of the continental shelf of a coastal State in accordance with article 76 and Annex II to the Convention and Annex II to the Final Act of the Third United Nations Conference on the Law of the Sea requires hydrographic and geoscientific surveying and mapping of the continental margin and evaluation and processing of the data. The complexity and scale of such survey and collection of data vary greatly from State to State according to the different geographical and geophysical circumstances. Data acquisition requires the contracting of high-level scientific/technical expertise and use of modern technology. Developing States, in particular the least developed countries and small island developing States, may face difficulties in acquiring necessary expertise and complying with the time limit for submissions to the Commission.

Assessment of the needs of developing countries

The following most pressing needs of developing countries have been identified:

- Training of technical and administrative staff;
- Assistance with regard to a desktop study or other means to make an initial assessment of the nature of the continental shelf and its limits;
- Assistance in working out of plans for the acquisition of necessary additional data and mapping projects;

[1] This was presented as the second presentation in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 6th March 2006.

- Assistance in the preparation of final submission documents; and
- Advisory/consultancy assistance related to the above points.

Among other needs common to all developing States are:

- Availability of free data for the completion of desktop studies;
- Need for specific technical expertise and scientific and technical advice;
- Need for additional surveys and collection of data;
- Assistance with tenders and application for assistance from trust funds.

Relevant resolutions of the General Assembly and DOALOS mandate

The General Assembly resolutions establish a general mandate of the Secretary-General with regard to the ocean affairs and the law of the sea programme. Resolution 49/28 of 6 December 1994 requested the Secretary-General to ensure "that the institutional capacity of the Organization can respond to requests of States, in particular developing States, and competent international organizations for advice and assistance and identify additional sources of support for national, subregional and regional efforts to implement the Convention, taking into account the special needs of developing countries". Resolution 52/26 of 26 November 1997 further requested the Secretary-General to ensure "appropriate responses to requests of States, in particular developing States, for advice and assistance in implementing the provisions of the Convention and the Agreement"; and to strengthen "training activities in ocean and coastal area management and development".

Regarding training specific to the outer limits of the continental shelf, General Assembly resolution 59/24 of 17 November 2004 requested "the Secretary-General, in cooperation with States and relevant international organizations and institutions, to consider developing and making available training courses, based on the outline for a five-day training course prepared by the Commission in order to facilitate the preparation of submissions in accordance with its Scientific and Technical Guidelines, and welcome[d] the progress made by the Division for Ocean Affairs and the Law of the Sea in preparing a training manual to assist States in preparation of submissions to the Commission". Resolution 60/30 of 29 November 2005 commended the Division upon the completion of the training manual and the successful conduct of regional training on the preparation of the submissions and requested "the Secretary-General, in cooperation with States and relevant international organizations and institutions, to continue making such training courses available at the regional and also the subregional and national levels, as appropriate".

Sources of expertise

General Assembly resolution 57/141 of 12 December 2002 encouraged States parties to the United Nations Convention on the Law of the Sea of 10 December 1982 that are in a position to do so to make every effort to make submissions to the Commission on the limits of the Continental Shelf regarding the establishment of the outer limits of the continental shelf beyond 200 nautical miles within the time period established by the Convention, taking into account the decision of the eleventh Meeting of States Parties to the Convention (SPLOS/72).

In the Capacity-building section of resolution 57/141, paragraph 40, the Assembly "request[ed] the Secretary-General to compile in a uniform format a directory of sources of training, advice and expertise and technological services, including relevant institutions and other sources of technical information and practice, which may contribute to the preparation of such submissions, to be available to Member States and to be posted on the web site of the Division for Ocean Affairs and the Law of the Sea …, bearing in mind that an entry in the directory would not imply official endorsement by the Secretariat of the United Nations of any such sources". The full texts of all resolutions can be found on the web site of the Division at www.un.org/Depts/los.

In February 2003, the Division requested Governments to provide, as soon as possible, a list of such sources of training, advice and expertise and technological services, including relevant institutions and other sources of technical information and practice, which may contribute to the preparation of submissions to the Commission by developing States, including the assessment of the nature of the continental shelf of a coastal State made in the form of a desktop study, and the mapping of the outer limits of its continental shelf.

To facilitate the compilation of a directory of sources, the Governments were invited to communicate the information to the Division in electronic format. By December 2003, ten countries had responded to that request. The Division circulated copies of relevant information that had been provided and requested again all States that had not responded to the previous request of 18 February 2003 to identify sources of training, advice and expertise and technological services as soon as possible. The information collected is available on DOALOS web site.

Regional training courses on the preparation of submissions to the Commission on the Limits of the Continental Shelf on the outer limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured

Training Manual

The training manual for delineation of the outer limits of the continental shelf beyond 200 nautical miles and for preparation of submissions to the Commission on the Limits of the Continental Shelf was developed by DOALOS in collaboration with Mr. Harald Brekke and Mr. Galo Carrera, two members of the Commission, who have acted as coordinators developing some its modules as well as inviting, on a widely representative basis, a number of qualified experts from both within and outside the Commission to participate in its preparation. The manual is based on the "Outline for a five-day training course for delineation for the outer limits of the continental shelf beyond 200 nautical miles and for preparation of a submission of a coastal State to the Commission on the Limits of the Continental Shelf. (CLCS/24 and Corr.1 prepared by the Commission in 2000.)

The preparation and use of the training manual was directly connected to the mandate of the Secretary-General to develop training courses to facilitate the preparation of submissions in accordance with the Scientific and Technical Guidelines of the Commission, as contained in General Assembly resolution 59/24 of 17 November 2004. As originally envisaged, the manual was completed in time for the first training course organized by the Division.

The preparation of the manual was finalized following its validation during the training courses, even though, at the last stage, certain developments in the practice of the Commission (amendments to annex III of the Rules) necessitated adjustments in the manual. Since the copies circulated during the training courses so far have been provisional, all participants in the past training courses would receive the final version of the manual, which has been translated into French and has also been translated into Spanish.

DOALOS partnerships

In organizing its capacity-building activities regarding the outer limits of the continental shelf, the Division has drawn on the expertise of the members of the Commission. While recognizing that training is not one of its functions, the Commission, in order to facilitate the preparation of submissions prepared the "outline for five-day training course" and its members lent their expertise for both the preparation of the training manual and the delivery of the training courses as will be mentioned later. In organizing training courses, the Division, which has limited budgetary resources, benefits from the cooperation with States, both developing and developed, as well as relevant international organizations and institutions, such as the Commonwealth, South Pacific Applied Geoscience Commission (SOPAC), the African Union, and the Economic Community of West African States (ECOWAS).

Training course in Pacific Harbor, Fiji

The Division conducted this training course in collaboration with SOPAC, the Commonwealth Secretariat and the Government of Fiji, and with the sponsorship of Australia and Norway, in Pacific Harbor, Fiji, from 28 February to 4 March 2005. The instructors for the training course were Karl Hinz and Iain Lamont, both former members of the Commission, and two DOALOS experts. They delivered training modules on technical, scientific and organizational aspects of the implementation of article 76 of the Convention. Galo Carrera and Phil Symonds, who are current members of the Commission, were also present throughout the training course as experts to answer questions in order to complement the delivery of the material and to oversee the lab exercises.

More than 30 technical and administrative staff from six South Pacific developing States, members of SOPAC, namely Fiji, Micronesia (Federated States of), Papua New Guinea, Solomon Islands, Tonga and Vanuatu, as well as from four other developing States of the neighbouring South-East Asia subregion, namely Indonesia, Malaysia, the Philippines and Viet Nam, participated in the training course. The participation of eight trainees from developing countries was financed by the Trust Fund for the purpose of facilitating the preparation of submissions to the Commission on the Limits of the Continental Shelf for developing States, in particular the least developed countries and small island developing States, and compliance with article 76 of the United Nations Convention on the Law of the Sea, established pursuant to General Assembly resolution 55/7 (“Article 76 Trust Fund”). Representatives from SOPAC and the Commonwealth Secretariat attended the training course as well. Overall, the feedback from the participants indicated that the training course was successful and was found useful. At its end, the participants demonstrated a general understanding of the process and procedures involved in the delineation of the outer limits of the continental shelf.

Training course in Colombo, Sri Lanka

The second training course was organized in collaboration with the Government of Sri Lanka and the Commonwealth Secretariat, in Colombo, from 16 to 20 May 2005.

The training course was attended by 40 technical and administrative staff of 12 developing States from the Indian Ocean Region: Bangladesh, India, Kenya, Madagascar, Mauritius, Mozambique, Myanmar, Pakistan, Seychelles, South Africa, Sri Lanka and United Republic of Tanzania. The various components of the course had been delivered by Karl Hinz and Iain Lamont (former members of the Commission), Harald Brekke, Galo Carrera and Yong-Ahn Park (current members of the Commission), as well as experts from the Division.

The feedback received from the participants in the training course had shown that the course had been received positively and perceived as extremely useful. Again, at the end of the course, the participants demonstrated a general understanding of the process and procedures involved in the delineation of the outer limits of the continental shelf beyond 200 nautical miles.

The support of the Government of Sri Lanka was particularly significant in view of the difficulties faced by Sri Lanka after the tsunami and the fact that the Government was hosting a major donor conference for the tsunami-relief efforts in Kandi and that the training course had taken place just before a major national holiday.

Training course in Accra, Ghana

The third training course was organized by the Division in collaboration with the Government of Ghana, the Commonwealth Secretariat, and with the support of the African Union and the Economic Community of West African States (ECOWAS). The training course was conducted in Accra, Ghana, from 5 to 9 December 2005.

Fifty-four technical and administrative staff from 16 developing States of the African region bordering the Eastern Atlantic, assessed by various studies to have potential for extended continental shelf beyond 200 nautical miles, participated in the training course. Representatives from the Commonwealth Secretariat, African Union and GRID-Arendal attended the training course as well.

The training course started with a high level segment, at which the Minister for Foreign Affairs of Ghana made a statement. This opening received an extensive TV and press coverage. There were six instructors and experts delivering the substantive part of the training course, among them, Mr. Peter Croker, Chairman of the Commission on the Limits of the Continental Shelf, Mr. Larry Awosika and Mr. Galo Carrera, members of the Commission. Two experts were from DOALOS/OLA.

It has been noted that the training course in Ghana was the first one, during which the trainees received and used the training manual prepared by DOALOS in French language. Even though all presentations were made in English, French interpretation was available, provided by a group of interpreters financed by the African Union and ECOWAS.

Once again, the training course was received positively and perceived as extremely useful. At its end, the participants had a better understanding of the process and procedures involved in the delineation of the outer limits of the continental shelf beyond 200 nautical miles. The manual itself was marked as complete and very useful.

Training course in Buenos Aires, Argentina

The fourth regional training course was organized by DOALOS in collaboration with the Government of Argentina and with the support of international organizations, including the Commonwealth Secretariat, from 8 to 12 May 2006. The training course followed a similar programme as the previous ones, and was delivered in English and in Spanish. A Spanish translation of the training manual was available as well. Close to 50 participants attended the training.

Regarding all training courses, it is to be noted that participation of the members of the Commission as experts and instructors is with full knowledge and support of the Commission. Consistent with the conclusions of the Commission, such participation is in their personal capacity, with due regard to ethical considerations consistent with internal code of conduct endorsed by the Commission. The views expressed by them are not binding on the Commission or its subcommissions and their participation in training should not amount to providing scientific and technical advice to a particular State.

Other relevant activities of DOALOS and other planned training (subregional and national symposia)

In conformity with the General Assembly mandate, the Division intends to continue with the delivery of the training courses, adapted to the desktop study phase, at the subregional and national levels.

Also and mandated by the General Assembly, the Division continues, in cooperation with the Member States, supporting workshops or symposia on legal, scientific and technical aspects of the establishment of the outer limits of the continental shelf beyond 200 nautical miles, taking into account the deadline for submission.

For example, a DOALOS staff member attended the national Workshop on the Law of the Sea, Jakarta, Indonesia, 13-16 December 2004, in order to deliver presentations on the implementation of UNCLOS and the issues relating to the outer limits of the continental shelf beyond 200 nautical miles.

Another staff member attended the Tokyo Training Course/Seminar on the UNCLOS Continental Shelf Survey (15-18 March 2005) organized by Japan Coast Guard and delivered two presentations – one on an overview of UNCLOS article 76, and the second on the examination of a submission by the CLCS.

Trust Fund for the purpose of facilitating the preparation of submissions to the Commission on the Limits of the Continental Shelf for developing States, in particular the least developed countries and small island developing States, and compliance with article 76 of the United Nations Convention on the Law of the Sea. Assistance from this Trust Fund

Purposes

The tenth Meeting of States Parties to the Convention (May 2000) recommended to the General Assembly to consider at its fifty-fifth session, the establishment of a voluntary fund or funds, for purposes of (a) providing assistance to States Parties to meet their obligations under article 76 of the Convention, and (b) providing training to countries, in particular the least developed among them and small island developing States, for preparing submissions to the Commission with respect to the outer limits of the continental shelf beyond 200 nautical miles, as appropriate (SPLOS 59).

In its resolution 55/7, the General Assembly decided to establish a trust fund "to provide training for technical and administrative staff, and technical and scientific advice, as well as personnel, to assist developing States, in particular the least developed countries and small island developing States, for the purpose of desktop studies and project planning, and preparing and submitting information under article 76 and annex II to the Convention in accordance with the procedures of the Scientific and Technical Guidelines of the Commission on the limits of the Continental Shelf" and approved the terms of reference of this trust fund, which are contained in annex II to resolution 55/7.

Activities

Financial assistance may be sought for the following purposes:

(a) Training of technical and administrative staff, in order to enable them to perform initial desktop studies and project planning, or at least to take full part in these activities;
(b) Desktop study or other means to make an initial assessment of the nature of the continental shelf and its limits;
(c) Working out of plans for the acquisition of necessary additional data and mapping projects;

(d) Preparation of final submission documents (the preparation of the final submission documents will have to meet the requirements of article 76 and Annex II to the Convention (and for some States, Annex II to the Final Act) and the Scientific and Technical Guidelines of the Commission). The preparation of the submission may induce costs that may be met by funds from the Fund (e.g. software and hardware equipment, technical assistance, etc.).

(e) Advisory/consultancy assistance related to the above points.

In all cases the application shall be accompanied by an undertaking that the requesting State shall supply a final statement of account providing details of the expenditures made from the approved amounts, to be certified by an auditor acceptable to the United Nations.

Each request for financial assistance is considered by the Division, which acts as the secretariat of the Commission. The Division has engaged an independent panel of experts of the highest moral standing to assist in the examination of applications and to recommend the amount of financial assistance to be given. In considering the application, the Division is guided solely by the financial needs of the requesting developing State and availability of funds, with priority given to least developed countries and small island developing States, taking into account the imminence of pending deadlines.

As stated, the Financial Regulations and Rules of the United Nations apply to the administration of the Fund. The Fund is subject to the auditing procedures contained in these Regulations and Rules. Information on the activities of the Fund, including details of the contributions to and disbursements from the Fund, is contained in the annual report to the General Assembly.

Since 2002, almost 140 participants in various training courses from 38 countries have been assisted by this Trust Fund. Fourteen of them attended training workshops in Southampton in 2002 and 2004. Others attended the DOALOS-organized training courses in Fiji, Sri Lanka and Ghana in 2005 and in Argentina in 2006.

Other support

Thus, through its capacity-building activities, the Division has greatly contributed to a better understanding of the provisions of the continental shelf provisions of UNCLOS and provided substantial assistance to developing States in the form of training of their technical staff who will be directly involved in the preparation of their respective submissions.

Conclusion

In concluding, it may be useful to note that the Division also contributes widely to the understanding of issues relating to the implementation of article 76 of the Convention by providing general advice and assistance to States Parties, inter alia, through dissemination of information, which is posted on its web site, and through its library facilities available at the United Nations Headquarters.

Chapter 3

Updated Scientific Investigations relevant to
the Continental Shelf

Section 1

Updated Scientific Investigations relevant to Active Margins

Active Margins[1]

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Thank you very much for your very kind words and thank you for convincing me that I should come here. I did learn quite a lot already, and I think it is a very useful and interesting conference we have here.

Before I start, I will tell you about the advice that I was given one day by an editor of Scientific American. I was asking how they were preparing their articles. And he told me that the basic principle is that the article should start with very simple concepts that any reader can understand. Then progressively, one increases the level of complexity until by the end of the article only a specialist can understand. In this way, readers can leave at any time the article without feeling they have lost their time. This is what I will try to do today, starting with the simplest ideas, and progressively increasing the complexity, because we are dealing with structures that are extremely complex.

Active margins are completely different from passive ones. First, **the formation of passive margin is additive.** During their creation new material is added to the continental crust but none is lost. In principle one should be able to reconstruct the continent as it was before the rifting started. This is obviously important when one wants to find the limit between continental and oceanic crusts. Second, in a first approximation, **the formation of passive margins is a symmetrical process** in the sense that both margins are more or less constructed in the same way although there are significant exceptions that I ignore here. Passive margins are created by a symmetrical process of insertion of new oceanic crust and lithosphere within thinned and ruptured continental lithosphere. Consequently, in theory, one can reconstruct the complete evolution from the unrifted continent to the new oceanic crust and the margins that it separates.

On the other hand, **the formation of active margins is subtractive**. A large amount of oceanic lithosphere has disappeared within them and the remaining material is highly altered and deformed. It is thus actually impossible to reconstruct in detail the evolution that led to

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the present structure of the margin. In addition, **subduction is asymmetric**. It does not have symmetry. Instead, there is a systematic polarity in the processes that shape the margin.

The cartoon by Serge Lallemand (1999) illustrates the problems I just discussed. A thick (typically 100km) oceanic lithosphere is disappearing within the mantle and the contact with the overriding plate occurs along a frictional interface about 100 km long. Although this friction induces large earthquakes at the source of significant deformation, at the scale of the whole subduction process the margin itself is a relatively modest structure that is built up above this material discontinuity.

There is total discontinuity in material from the margin to the ocean crust. Where then is the continuity? **The continuity is in the processes that continuously shape the margin**. This is why they are called active margins. **Thus the processes at work rather than the structures of the rocks should be used to characterize the extent of the active margin.** This is very important, because it means that a purely structural approach to the understanding of active margins is bound to fail. The structural approach should be combined with studies of the active processes that shape the margins. It is actually essential to understand how these processes progressively modify and build the margin.

Unfortunately, as we shall see throughout this lecture, these processes are highly variable, and they are active over a width that is significantly larger than the margin itself. The giant December 26th 2004 Sumatra earthquake had the whole Earth vibrating during several months! The problem then is to determine the level of significance of these processes on the structuration of the margin. Fortunately research in this domain is in very rapid progress, thanks in particular to events such as the Sumatra earthquake.

The following scheme from Shemenda (1994) demonstrates how different active margins can be! There are contractional margins in which the system of forces is acting to push the oceanic lithosphere against the margin, deforming it in contraction and compression. But there are also extensional margins in which the oceanic lithosphere is moving seaward! These two completely different sets of active margins are both subduction margins!

The trench is the location of discontinuity in material from oceanic crust to marginal material, but it is not the limit of the action of the processes that shape the margins as they act significantly seaward of the trench. So the subduction processes act from quite far seaward of the trench to inland. The topography of the Chile trench illustrates this point. There is indeed a discontinuity at the contact of the trench with the margin. But this discontinuity is very limited and has little significance in the whole subduction process. This fact was the source of very important problems in the beginnings of plate tectonics. Nobody understood how subduction could produce so small an effect at the surface of the sea floor. Another important difficulty in the study of subduction is illustrated in the following map of the distribution of subduction zones. It is their enormous length, 35,000 km, and their extraordinary variety.

I obviously cannot talk about all these 35,000 km of margins, and I will focus on those on which I spent a considerable amount of my research time: the western Pacific ones, intensively studied especially from Japan to Taiwan, and the Indonesian ones, because they were just affected by the giant Sumatra-Andaman earthquake of December 26th, 2004. The figure of Hsu and Sibuet (2005) compares these two systems of trenches. To facilitate the comparison they rotated 180° the Japan-Taiwan system. Both systems have about the same extent, 3,000 km. The Sumatra earthquake alone ruptured about 2,000 km of margin!

By the way, let me mention that our research group just produced an electronic atlas of the whole Southeast Asia, including bathymetry, gravimetry, tectonics and structural evolution published by Société Géologique de France and The American Association of Petroleum Geologists. This atlas follows an earlier one on the Mediterranean. These are our most recent contributions to the study of subduction zones.

I will now look at the main culprit, the slab, the piece of oceanic lithosphere that goes down in the mantle. The two following figures of Gumundsson and Sambridge (1998) show the example of the Sumatra slab, which is representative of most slabs. It consists of two parts: a flat, upper seismogenic portion (the portion that fabricates the earthquakes) and a steep deeper portion that extends to 600 km depth. The seismogenic upper part is where there is mechanical interaction between the two systems, the oceanic lithosphere and the margin and this interaction is at the origin of most of the processes that shape the margin.

But the interaction between the deep portion and the surrounding mantle may also determine the nature of these processes. This is illustrated in the figure of Schnurle (1994), where the dips of the slabs are correlated with the tectonic style of the margin from erosion for very steep ones (the margin is actually losing material) to accretion for relatively shallow ones (the margin is progressively building up with new sediment). Thus the shape of the deep slab itself controls the balance of forces that act between the slab and the margin and affects the tectonic style of the margin.

The figure of Von Huene and Scholl (1991) shows the distribution of accretional and erosional margins. Accretion is probably the simplest structural process acting within an active margin. It transfers material from the oceanic plate to the active margin. There is a very simple but excellent mechanical model of accretion that was produced by the group of Princeton as shown on the figure of Davis (1983). Many models are purely kinematic. Kinematics describe the phenomenon but do not explain what are its causes. But this model is dynamic. It can be compared to the formation of a sand wedge by a bulldozer. There is a level of decollement (the plane of friction between the two plates) at the base and the dynamics impose a certain relation between the topographic slope created and the slope of the decollement. A seismic reflection profile from Lewis and Pettinga(1993) shows that the deformation is not as continuous as in the model and actually occurs through thrusting of successive slices of trench infill.

Another example from the Sumatra trench opposite the Sunda Strait is after Kopp and Kukowski (2003). Notice the very important landward limit of the accretionary wedge, which is marked by a fault called an out-of-sequence or splay fault. Beyond this fault exists an older wedge that acts as the backstop, the equivalent of the blade of the bulldozer.

This process of accretion may be greatly affected by the subduction of topographic objects such as volcanoes or ridges. An analog laboratory model using sand discussed by Serge Lallemand (1999) shows the deformation induced. Because many seamounts and ridges cover the oceanic lithosphere, their subduction plays a significant role in the evolution of the margin.

The next point I would like to make is that the formation of active margins is a dynamic process that occurs generally through successive catastrophic events, the subduction earthquakes. The difficulty there is to understand how the succession of catastrophes leads to the progressive building of the margin. This difficulty is illustrated in the simple cartoon, which explains the cause of the Sumatra earthquake. As the Indian plate subducts below the overriding Burma plate, the decollement is locked by the resisting force due to the friction. As a result, the margin moves with the plunging oceanic lithosphere and is bent downward through elastic deformation. Finally when the downward motion overcomes the frictional resistance, the margin jumps back to its undeformed state producing the earthquake. This system being elastic is theoretically entirely reversible. The coseismic motion undoes the deformation accumulated during the interseismic one and the net structural effect should be null. And yet, the margin is progressively structured through the successive earthquakes! Resolving this apparent contradiction is an important domain of research.

The figure by Meltzner et al. (2006), which concerns the Sumatra earthquake shows that the coseismic motion of the margin is vertical as well as horizontal. Note that the large coseismic uplift that produces the tsunami does not coincide exactly with the previously locked zone. We will come back to this point later on.

The part of the decollement that is locked during the interseismic phase is related to its temperature as shown on the illustration of Hyndman and Wang (1993). Why is that? Below approximately 100°C, the type of clays present along the decollement enables to creep. And beyond 350°C the material forming the decollement becomes able to creep. Thus it is only between 150 and 350°C that the decollement is locked. As a consequence, the temperature structure of the slab and the thickness of sediments in the trench determine the length and depth of the locked zone which are major components defining the characteristics of the subduction earthquakes. This is demonstrated by the two figures of Oleskevich et al. (1999) in which the position of the locked decollement of different subduction zones is determined on the basis of the temperature along it. If there is little sediment in the trench and if the heat flow is low, the temperature on the decollement at the edge of the trench is well below 100°C and the part of the decollement that is locked may be situated quite far inland as in the Chile or Alaska trenches. The earthquake rupture will not extend to the trench. If there is a lot of sediment in the trench and if the heat flow is high, as is the case for the Nankai trough or for the Cascadian margin of Canada, then at the edge of the accretionary wedge, the temperature at the decollement is already close to 100°. The whole decollement starting from the trench is locked and able to produce the earthquake.

Now, let us go a little bit more into the complexity and try to ask how the margin is progressively built through this repeated dynamic rupture process. I will take the example of the Nankai margin using work that our French group did some time ago. The figure from Pierre Henry (2004) shows the part of the decollement that is locked where the slab is mechanically coupled with the margin. The figure, which is based on GPS observations shows that the continent over a width of 150 km is shortened because of the coupling with the slab. This shortening may reach several meters. And then during great earthquakes like the Nankaido earthquake in 1946, the Tonankai earthquake in 1944, and the expected Tokai earthquake in the east, this shortening is suddenly released.

The two following figures from Nakanishi et al. (2002) show a section across the Nankai margin. The locked zone is situated below a basin that is called the forearc basin. What is the origin of this basin, which is a major structural feature present within many margins? Is it related to the mechanical coupling with the slab along the locked zone?

A simplified mechanical model by Fuller (2006) explains the relationship between the inner limit of the coupling zone and the formation of the forearc basin and of the adjacent outer ridge. In the model, the slab goes down at a continuous velocity and the deformation of the crust above it is modeled. The results are shown in a series of sections, which picture the intensity of deformation of the margin as the motion of the slab proceeds. In this model a forearc basin is the result of the change in mechanical coupling between the descending slab and the crust. A second set of experiments shows that when the basin is filled up with sediments the distribution of deformation changes drastically because of the change in the temperature distribution.

I next come back to the effect of the subduction of topographic features on the structuration of the margin. Kodaira et al. (2000) made this very interesting section along the Nankai margin where they showed that the subduction of a seamount produces not only deformation on the margin, that was already known, but probably also produces splay faults or faults out of sequence that cut from the decollement to the seafloor. These faults appear to be very active.

Park et al. (2002) have explored further the role of these splay faults on the same margin. They propose that part of the motion of the subduction earthquakes may be taken along these splay faults. Because these faults are much steeper than the decollement, they may produce significant vertical motion of the seafloor and thus contribute in a major way to the production of tsunamis. This may have been what happened during the great Sumatra earthquake. I will come back to that.

A section due to Siegfried Lallemant (1999) and his colleagues on the same margin but in the Tokai region, shows that there are at least two active splay faults there, the Tokai and Kodaiba faults which may play a major role during the expected Tokai earthquake.

So let us now consider the giant Sumatra earthquake. There were only four earthquakes of magnitude larger than nine in the last 50 years but this is the first one that has been properly recorded and the new results obtained have already significantly changed our understanding of earthquakes in subduction zones.

The next figures are special geographic projections (oblique Mercator) that better image the whole Sumatra trench system and the two great earthquakes that affected it on December 26 2004 and March 28 2005. The aftershocks that followed are also shown. The length of the rupture is 1,600 km for the December 26 earthquake and 500km for the March 28 2005 earthquake. So it is a total rupture of 2,100 km. Notice the importance of the topography of the sea floor that is being subducted. Notice also the large 90° East Ridge, which is progressively buried in sediment and extends north all the way to the Bengal basin and becomes more or less parallel with the margin. This ridge may become economically important because it is covered by reefs that were buried below sediments to the north, thus becoming a possible trap for oil. The tectonic problem concerns the interaction of this ridge with the margin, which is likely to be strong. What is this interaction and what does it imply?

The following figure from Ammon et al.(2005) shows the horizontal rupture distribution during the two earthquakes based on seismological data. The motion was more than 20 meters opposite the extremity of Sumatra and decreased to a few meters near the Andaman Islands. It was about 5 to 8 meters during the March earthquake.

But of course there was not only horizontal motion but also vertical motion, which was responsible for the generation of the huge tsunami. The motion predicted by Ammon et al. (2005) is a maximum of about 12 meters uplift with subsidence landward. For example, in Banda Aceh, in northern Sumatra, the flooding was not only due to the tsunami, but also to a permanent instantaneous subsidence. Note that after the earthquake, the uplift will progressively start again to begin a new seismic cycle.

The following figure shows the solution for the rupture using GPS and uplift results recently published by Banerjee et al. (2006), compared to the data of uplift and subsidence of Meltzner et al. (2006). The rectangles are the different planes of rupture obtained by Banerjee et al. (2006) and the arrows give the motion on each rectangle. The maximum motion exceeds 20 meters. The dotted black line gives the limit between uplift (red points) and subsidence (blue points) after Metzner et al. (2006). This limit indicates that the rupture extended all the way north to Myanmar.

The next figure is a very interesting section based on a micro-seismicity survey that was made by Araki et al.(2006) between February 20 and March 1 2005. The blue dots are the aftershocks recorded by Araki et al. (2006) The red dots are the relocated earthquakes. The fault plane solutions are in black before the earthquake and in red after it after http://www.globalcmt.org/CMTsearch.html. The black line is the plane of rupture after Banerjee et al. (2006) The decollement is well defined by the blue dots until they join the deeper seismicity of the dipping slab down to 250 km. These new data show that the deeper part of the decollement adopted by Banerjee et al. (2006) is not correct. What is very interesting is that Araki et al. (2006) found out that the aftershocks in the lower part of the decollement are compressive whereas those in the upper part are extensional. Thus in the upper part, the motion has changed from compressional during the earthquake to extensional after. The upper part appears to have moved too much! On the other hand, in the lower part, there was afterslip, a prolongation of the slip of the earthquake at a deeper level. This phenomenon was quite unexpected.

I now want to briefly look into the role of the morphology of the subducted seafloor in the structuring of the margin in the Sumatra area. I will in particular consider the interaction of oceanic features such as the 90° East Ridge with this active margin.

The next figure shows to the left the pseudo-topography as obtained from satellite altimetry. To the right, I have identified on the topography the main structures. A thick red line with dents outlines the trench. Thin red lines outline the active faults. Fracture zones on the sea floor appear as yellow. The westernmost fracture zone follows the eastern boundary of the 90° East Ridge. Note that the northern extension of this fracture zone passes below the Andaman Islands. In this northern part, the 90° East Ridge and the fracture zones to the east of it form the main framework on which the margin is built. Note also that the direction of subduction in this area is about 15°N, quite close to the direction of the fracture zones. The subduction is thus oblique to the trench to the south, but nearly parallel to it at the level of the Andaman Islands. As I mentioned before, the 90° East Ridge continues north of the Andaman Islands in the Bay of Bengal, but it is now buried, probably covered with reefs and buried below turbidites which makes it a possible target for oil exploration.

The situation I describe is already quite complex, but in addition, because the trench becomes parallel to the motion, there is an additional process called partitioning in which part of the motion is taken along the trench in frontal subduction and part of the motion is taken in pure lateral slip (called dextral strike slip here) along an inner fault system called the Sumatra fault system, at a distance of about 230 km from the trench. This system is transformed to the north into the extension of the rift of Andaman. Thus the process of subduction there is affected by the presence of sea floor fractures and by the obliquity of the subduction. It is probable that the obliquity itself is imposed by the presence of the 90° East Ridge which cannot be easily subducted.

Deplus et al. (1998) have surveyed part of these fracture zones and have demonstrated that they are active and absorb part of the motion between the Indian and Australian plates. The fractures actually cut though the whole lithosphere so that the slab that has entered the trench is already precut and can easily be separated in distinct entities. The study of earthquakes within the slab has actually demonstrated that this tearing apart continues while the plate is subducted.

I wish now to briefly discuss a recent bathymetric survey by Sibuet et al. (2005) just over the part of the wedge under which the rupture was maximum, about 20 meters. We first see the upper wedge with well-developed splay faults. Then we see on the lower wedge the presence of N/S faults that reflect the influence of the underlying fracture zones of the subducted sea floor. Finally we see a rather surprising frontal wedge, just next to the trench with very little deformation, except some slumping.

I now enter into the last complexity that I will only allude to: the transition from oceanic subduction to continental subduction. Actually there is not that much difference between continental subduction and oceanic subduction. But because of the importance of the continental crust, a much larger crustal wedge may form that will become the mountain belt.

My first example of collision concerns the subduction of the Izu-Ogasawara ridge below Japan, which produces the Izu peninsula. One of the results of the Franco-Japanese program KAIKO has been the identification of a Zenisu platelet, due to shortening by thrusting within the subducting oceanic crust to the east of the ridge. Mazzotti et al.(1999) have worked out the kinematics of this Zenisu platelet. It seems to me very interesting that on September 5 2004, there were fairly large earthquakes, immediately to the southeast of the system of Zenisu, that could be interpreted as the propagation of this Zenisu oceanic fracture to the south, as proposed in the figure of Pierre Henry (2004). If this is correct, these 2004 earthquakes would not be related directly to the subduction but probably indicate the possibility of large intra-oceanic earthquakes there.

Finally, I just want to use the example of Taiwan to show that when you have sufficient scientific information on the structure of the wedge, you find even more extreme complexity than what we can already see when we look underwater with sophisticated means. I compare the Park et al. (2002) model for role of the splay faults in the underwater Nankai subduction with the Loevenbruck(2003) model of the above water Taiwan collision-subduction responsible for the recent Chi-Chi earthquake. There is an overall similarity. The difference is that we have much more details on the Taiwan wedge.

I will next show some of these details based on the remarkable work of the group of John Suppe. The first figure by Carena et al. (2002) of the relocated micro-seismicity shows that the decollement can be followed through most of Taiwan and that it fits very well the bulldozer model that I mentioned earlier.

But an important point is that when you look at the history of building of the wedge, several major splay faults are active, and the locus of main activity changes through time. When there is an earthquake, the rupture starts from the decollement and branches upward through one of the splay faults.

The last figure by Yue et al. (2005) shows that the complexity of the system is even increased by the presence of sub-aerial erosion. The wedge is actually a continuously evolving dynamic system. The subduction motion that is being taken along the decollement is distributed in a very complex way within the wedge and this distribution is in great part responsible for the structure of the wedge in particular through the pattern of splay faults.

I hope that by now I have not lost all of you. I tried to start from the simplest and to show you progressively the increasing complexity and the interaction between the short-term study of active processes and the long-term evolution of the margin. There is an extreme variety of processes acting to structure the active margins and no two active margins are identical. It is through the understanding of the active processes shaping an active margin that we can understand its identity. Although we are making great progress, we are still in the learning phase. The Sumatra earthquake was completely unexpected. The structure it revealed in Sumatra was essentially unknown and the consequences for the understanding of the margin even for economic consequences will be very large. An important lesson for us scientists is humility leading to cautiousness. Let us not consider that we have already sufficiently understood the processes that shape the structures to decide in a definitive way. Science makes dramatic progress and changes the perspective even for economic aspects. For example, where is the limit of the so-called shelf in places where the 90° East Ridge interacts with the active margin along Indonesia, India and Myanmar? I do not think it is clear at the present time. What belongs to what? Is the 90° East Ridge building the margin? Or is the margin affecting the Ridge, or are both structures interacting in a complex way?

Thus my final advice is: “ Be cautious, look at the new results of research and try to act in an interdisciplinary way. You need a combination of geomorphologists, structuralists, sedimentologists, paleontologists, seismologists, geodesists etc.. to understand this very complex evolution”.
Thank you.

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New Views of the Gulf of Alaska:
Mapping a Transitional Margin[1]

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I would like to start by thanking the Ministry of Foreign Affairs and the United Nations University for hosting this excellent meeting, and for their wonderful hospitality. It's truly been enjoyable. It is a humbling task to try to follow Professor Le Pichon in a discussion of active margins particularly because I am not at all a specialist in tectonics. I am just a simple mapper, but sometimes maps have much to tell us about how the earth works. If we can make better maps we can then provide better tools for specialists like Professor Le Pichon, and that will allow him to gain even more insight into how our earth works.

Three years ago, the University of New Hampshire began a program of multibeam sonar mapping of selected regions around the coasts of the U. S., including the Arctic, the Bering Sea, the Gulf of Alaska, the Atlantic margin, and the Gulf of Mexico (FIGURE 1). Many of these areas had been mapped with single beam sonar (FIGURE 2), but we argued that the tremendous advantage of multibeam sonar, in terms of complete coverage and high resolution, would provide tremendous new insights into the processes going on in these areas (FIGURE 3). This mapping also had a very pragmatic aspect in that it would greatly improve our knowledge of the morphology of the margins with respect to the information required to make a submission for an extended continental shelf under UNCLOS Article 76, but, most importantly, new mapping would provide an incredible new picture of the seafloor and seafloor processes.

To support our argument for the collection of new, modern, multibeam sonar data, we used as an example an area of the margin off New Jersey on the east coast of the U.S. We compared what the important UNCLOS-related morphological features (like the 2500 m contour) would look like as viewed from single beam sonar data as compared to what it would look like as viewed with multibeam sonar data (FIGURE 4 and 5). Even the bureaucrats in Washington were able to see the remarkable differences and thus provided the funding to allow us to

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.

remap these areas with multibeam sonar. And in each case, the differences have been significant. Let's quickly look at some of the areas we've mapped: in the Bering Sea; the Bowers Ridge; the single beam sonar dataset versus the multibeam sonar dataset (FIGURE 6 and 7); the Beringian margin; the northern part of the Bering Sea, again the single beam dataset versus the multi-beam dataset (FIGURE 8 and 9). You can see the remarkable detail that we can now see in nature of the margin. Even on the east coast of the U.S. where we thought we actually knew what was going on, the differences between the single beam sonar data set and the the multibeam sonar dataset are remarkable and revolutionizing our understanding of the formation of deep sea canyons (FIGURE 10 and 11).
Yesterday Peter Croker mentioned the work that we are doing in the Arctic. Our focus in the Arctic is on the Chukchi Cap, an area that's ice covered the year around (FIGURE 12). Here we have to go to extreme measures to map as we must use an icebreaker equipped with a multibeam sonar. There is a fundamental incompatibility in this combination (FIGURE 13) as icebreaking makes lots of noise and sonars don't like noise. But despite these challenges we have still been able to collect data and it has improved tremendously our understanding of what the morphology of the Arctic seafloor is really like. Peter showed a figure like this yesterday with a comparison of our pre-survey knowledge of the location of the 2,500 meter contour versus its actual position as measured by the GPS-navigated multibeam sonar (FIGURE 14). And so again, we see so much more when we map in detail, even to the point of discovering major features like the seamount which on the original IBCAO chart appeared as a single closed 2,700-meter contour but in reality is a feature that starts off at 4,000 meters depth and comes up shallower than 900 meters (FIGURE 15). I'm sure there are many, many more of these yet to be mapped.

Our most recent mapping effort was in the Gulf of Alaska (FIGURE 16), a survey we finished several months ago. For this survey we used the University of Hawaii's research vessel Kilo Moana with an EM120 (12 kilohertz) multibeam sonar (FIGURE 17). We spent 51 days mapping an area of about 162,000 square kilometers. In addition to the 51 mapping days there was about an eight and a half day steam from Hawaii to the Gulf of Alaska and eight and a half days back, but after 51 days in the Gulf of Alaska, a trip back to Hawaii was well appreciated by all.

The Gulf of Alaska is an intriguing place and with many of the characteristics of active margins. The eastern boundary of the Gulf of Alaska is defined by the Queen Charlotte Fault zone a strike-slip fault with about 6.5 cm per year of right-lateral motion (FIGURE 18). The western boundary is demarked by the Aleutian Trench with the Pacific plate converging beneath the North of American plate and many of the processes that Professor Le Pichon talked about going on there. What's most intriguing is the zone in between where somehow this strike-slip motion is transformed into convergence. It was in this area that our surveys were concentrated. We'll call this the "transition zone" for now (FIGURE 18). There has been lots of speculation about what's going on in this zone. Complicating it is the presence of an accreted terrain, called the Yakutat Terrain (FIGURE 19). Most of the information about this terrain comes from land exposures, but seismic evidence implies that it's most likely oceanic crust -- very, very thick, oceanic crust, probably about 22 kilometers thick. The most recent suggestion is that they Yakutat Terrain is probably an oceanic plateau that has been accreted onto the North American plate. Perhaps Mike Coffin will tell us something about that a little later.

There is lots of debate and lots of speculation about how motion is transferred from the strike-slip motion of the Queen Charlotte Fault zone to the subduction of the Aleutian Trench. One thing that is generally agreed upon is that the terrain probably started down by the Queen Charlotte Islands about 30 million years ago moved north-westward with the plate and sometime between 10 and 5 million years ago collided with the North American plate (FIGURES 20-24). GPS recorded motion shows a vector of motion in the transition zone that is somewhat different from that of the subduction and at rates that are also different. Convergence is at about 6.5 cm per year but in the transition zone we're seeing a more north westerly vector at about 4.5 cm per year (FIGURE 24).

What's happening in this transition zone is certainly subject to much speculation, and this was the area that was the focus of our survey. The convergence of the 22-kilometer thick piece of crust with the North American plate has led to the formation of a tremendous mountain range, the Chugach-St.Elias mountain belt which is the highest mountain belt in North America. There is tremendous relief in this region with mountains 5,000 to 6,000 meters high within 25 kilometers of the coastline. This relief is the result of having this thick piece of crust accreted into the trench. The accretion and the formation of a large mountain belt, in combination with glaciations and the harsh the climatic conditions in this region have resulted in a tremendous sediment supply. This sediment supply has, in turn, resulted in the formation of three deep-sea fans: the Zodiak Fan, which is now being subducted into the trench; and the Surveyor and Baranof Fans (FIGURE 25). These two fans are younger than the Zodiak Fan and are currently active. And so, a very thick sequence of sediment has come from this large mountain. More significantly, we have more than 6 kilometers of sediment on the seaward side of the Yakutat Terrain and about 6 kilometers of sediment along the Queen Charlotte Fault margin (FIGURE 26).

What I would like to do now is explore our new multibeam sonar data in a more interactive mode in order to better see what we can see in this remarkable new dataset. The first thing that becomes apparent is that the multibeam sonar record reveals what appears to be an active fault propagating from the southeast to northwest (FIGURES 27, 28, 29). This appears to be an incipient step-over of the Fairweather Fault slightly north of here. It goes from a single strand in the eastern end getting much, much, more complex as we approach the trench and finally into the trench where we see a very, very complicated structure.

And so, the speculation about transitional motion has been substantiated with the mapping of a transitional fault. At the same time, this tremendous amount of sediment, the high mountains, and the climatic conditions have created some remarkable sedimentary features, giving us some insight into the way the margin itself is being built up. We can clearly see a feature that looks like a cascade feature – like a series of waterfalls (FIGURE 30), but we are at 2,000 to 3,000 meters water depth. Even more remarkably, we have at the base of the slope, again at 3,000 meters depth, what appears to be a plunge pool, a 300 meter deep, one kilometer wide, hole with no sediment fill in it (FIGURE 31). Are these the result of catastrophic failure of ice damns or hyperpycnal flows?

As we move further eastward, beyond the Yakutat Terrain, where the margin is much thinner we have tremendous building of fans and channels. If we go back to the PowerPoint we can look at the build-up of the margin in terms of the sediment distribution of the fans on the eastern side. Lets start by looking at the pre-existing single beam sonar dataset and its representation of what's been named Mukluk Channel and the Horizon Channel (FIGURE 32). If we turn now to the multibeam sonar data, we see the spectacular depiction of these channels (FIGURE 33). This has been the representation of the channels from the bathymetry produced by the multibeam sonar. The multibeam sonar also collects what is called "backscatter" which is information about the amplitude of the return that gives us a hint about changes in sediment type. If we look at the backscatter data we see a clear demarcation between the fan sediments and the abyssal plain sediments (FIGURE 34). If we take a closer look at the bathymetry from Chatham Fan (FIGURE 35) and Horizon Channel (FIGURE 36), we can actually start seeing the distributory channels that are building up the fan and the headward erosion in the channel itself that's creating the meandering of the channel. Even more remarkable is a channel that wasn't at all depicted on the single beam sonar data. Located next to Horizon Channel is an absolutely spectacular, meandering channel (FIGURE 37); the hydrodynamicists are going to have a field day trying to figure out how this is all happening.

If we take a little closer look, we even see evidence of a channel break-through, a process called avulsion where the meander is broken; we see bedforms forming in the break-through area (FIGURES 38 and 39). We can also start putting these features into a context of the glacial history of the region (FIGURES 40 – 43). At the last glacial maximum, ice went just beyond the shelf break. Tills were built up at the shelf break but then with the retreat of the ice, the rise of sea level, and the reworking of the till, we build up the fans and channels, and redistribute the sediment.

As I said, really, we just collected this data a few months ago, and we obviously have a lot more to do in terms of understanding it. But we also believe that we alone could never extract all the wonderful information that is contained in the data. And so our approach has been to ensure that all of the data that we have collected in this survey and in every other survey that I described is made available on the web within about three weeks of returning from sea. Thus all the data that I've shown is available at our website -- http://www.ccom.unh.edu (FIGURE 44). In the world of Law of the Sea, the lawyers and the diplomats and even the geologists can argue about the meaning and the interpretation of words, but these arguments should really be based on a very best possible shared understanding of what the true morphology of the seafloor is. There really is only one true morphology of the seafloor, and it should be our obligation as scientists to try to define that.

In this sense, we can look at the morphologic data that we collect as another aspect of the common heritage of mankind. And it is in that sense that I would like urge each nation – as they go out and collect their data in support of Law of the Sea submissions – to also make their data freely available to the scientific community -- let the lawyers and diplomats argue all they want, but let us serve our common scientific heritage by pooling our collective resources to discover the one truth about the shape of our planet.

Thank you.

Continental Crust in Intra-Oceanic Arcs[1]

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Thanks Mike. I am very happy to be here for presenting our recent result of seismic study around Japan. So today, I am going to talk about continental crust in the intra-oceanic arc mainly about the south of Japan, Izu-Bonin Arc, on the basis of our seismic survey detail. Since I am -- as Mike introduced, since I am a structural seismologist, so my talk is mainly about structure studies of the crust and upper most mantle.

As Professor Le Pichon said I start with very simple things about the crustal structure. Yes, roughly speaking, as you know the structure of the crust is varied very much around the world from single crust to very thick crust. So roughly speaking, we can identify kind of two end members of the crustal structure; one is oceanic crust and the other one is continental crust. If you take a look at oceanic crust around the world, the structure is very uniform except for kind of late, I mean oceanic plateau like Mike's going to talk about. But thickness of oceanic crust is very uniform and very same. It's about 7 -- like a 7 kilometer thickness, and globally -- roughly speaking globally very uniform.

About the continental crust, the structure is varied place by place. And also the thickness is very, very thicker than the oceanic crust. The other thickness of the continental crust in the world is about 35 kilometers; but at the thickest part, it is say down to 50-70 kilometers around the continental collision zone like the Himalayas. And in terms of seismic velocity, seismic imaging study which I am going to talk about and also laboratory experiment of possible continental rock showed that the continental crust might consist of andesitic type of crust which shows seismic velocities about 6. About 6 means roughly between 6 and 7. So well, this is a result of laboratory experiment. They showed 6 kilometers per sec, at least upper half of the crustal section. And this is actually a structure from oceanic crust to continental crust. You can see the thickening of the layer having seismic velocity of 6. So what our geophysicist is looking for to identify the -- I mean structure type, continental or oceanic, we try to find out a layer showing seismic velocity of 6 kilometers per second.

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[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.

Okay since -- because geologists, they agreed or they proposed that new regeneration of our continental crust may take place in the active subduction zone. So since the last couple of years, our geophysicists tried to find out such kind of new regeneration of continental crust in the or around active -- I mean intra-oceanic arc. So, about 10 years ago, Suyehiro et al, a Japanese group, they found a kind of first seismological evidence of the continental crust in the intra-oceanic arc, south of Japan, which is located here where Tokyo is. Around here, we have Izu Peninsula. So this is so called Izu Island arc.

So a very important point from this structure is here. This is a layer seismically showing this velocity -- seismic velocity of about 6. So they agreed or they proposed this is andesitic crust existing in the middle of the intra-oceanic arc. This is the first seismological evidence of the continental crust created in the intra-oceanic arc. And another point -- important point of this structure, we can see a rather high velocity lower crust below the middle crust. I call it the middle crust. And this is actually too high to make the continental crust. So this failure may have to return to mantle by so called germination process.

Okay, so after getting this structure, it’s first evidence, Japanese seismic -- I mean geophysicist group as well as a US geophysicist group has been trying to find another or additional evidence of continental crust in the intra-oceanic arc. Recently we got this result crossing at middle part of Mariana and here. So today I will not explain the details of the tectonics of the Mariana, but you can see the two lines of the arcs. One is presently the active arc, and the other one is so called remnant arc. Actually this arc has been formed by the oceanic say lifting and spreading processes.

So anyway there are two rich island arc systems, arctic arc and remnant arc. The structures of these two arcs are very similar to the northern part of these arcs. Both sections show the 6 kilometer per sec layer in the middle level of the crust. And also recently, Japanese -- Japan coast guard, they got a crustal section up here on the Kyushu-Palau Ridge. This is actually a conjugate margin of Izu arc. This arc is formed by spreading and -- lifting and spreading of the Shikoku Basin. So although this is a very preliminary result that it looks similar to the structure of Izu arc.

So after looking at these structures, if you ask this question does the continental crust grow by itself in the intra-oceanic arc, from the result of this survey you think answer maybe looks yes. But if you go to another subduction system like Aleutian, the structure of the entire crustal structure is very much different from the Izu arc. I took this figure from Holbrook et al papers,

and this is Izu section. And this layer, dark grey layer is our key layer 6 kilometer per sec probably andesitic layer in the middle of the crust.
But if you take a look at Aleutian structure, there is no evidence of this layer in the middle part of the crust. This -- you cannot see that these are in any place in these section. So they conclude that there is no seismological evidence of andesitic crust and Aleutian arcs. So after looking at this structure, things are -- or is very complicated. So the new regeneration of continental crust in the intra-oceanic arc is still kind of sort of a depression.

So recently in order to examine that question or in order to examine if the continental crust is continuously created along the entire arc into an oceanic arc, or this structure we got just a coincidence, just local things. So in order to examine this question, a Japanese group actually JAMSTEC as well as Japan Coast Guard have studied active cell structure study around Philippine Sea Plate. So today I am going to show you the result of along the arc profile, along the volcanic arc profile from our Japanese island to Torishima, which has been acquired 2004. And actually we got additional data in 2005 down to further south just north of Mariana -- Mariana arc.

Okay, what are we doing or we have done for getting image of the crust is I think many of you are very familiar with this. But we normally use a seismic refrection technique to get shallow part of the crustal image and also we normally use the wide-angle refraction and reflection technique to get the deeper part of structure. So okay, the reason why we use kind of combined refraction and wide-angle refraction survey, it’s shown here. This is just an example we acquired along the Izu arc by the conventional MCS survey. So you can see the very clear image of the shallow part, several packages of segment and volcaniclastics. But if you go down to a much deeper part along this kind of volcanic arc, it’s very hard to see the inside of crust. So this means only using MCS data I cannot answer the existence of new regeneration of oceanic -- I mean continental crust along this kind of arc.

So that’s why we normally use the combined wide-angle and MCS survey. So this is what we are using for such a survey. Actually JAMSTEC has two vessels for seismic survey. One is called Kairei and the other one is called Kaiyo. And on both ships we have large airgun array, yes, total cubic inch -- total volume is about 200 litres. This is actually not tuned airgun array, but this airgun generates very kind of low frequency energy that helps very much to get the deeper image. And also Kairei has a 5000-meter long streamer cable for MCS survey.
And for the wide-angle seismic survey, we normally use the ocean-bottom seismo brands. And we use about 100 OBSs, actually four-component OBSs, which is deployed normally at 5 kilometer intervals along a 500-kilometer long profile, like I show on that map. Okay this is

our profile, and red indicate OBSs we deployed. And this is our seismic image we obtained from Japanese coastline to Torishima about 500 kilometers long. The top figure intra-seismic velocity structure and bottom one is seismic, reflective to image obtained by a wide-angle -- I mean obtained by the migration -- depth migration of wide-angle phase seismic data. I will explain the details of this structure later on, but a very important point is this band or layer of green region which indicates seismic velocity within 6 and 6.8. So you can see the continuation of this green layer, but it's fluctuated very much.

Okay so, before I am going to explain the details of the structure, first I show the resolution of the model. Our geophysicists normally use a so called Checkerboard test in order to show the resolution of the model. And I don't want to tell you the details of that, but the procedure is very simple. We gave the kind of high and low velocity perturbation on the model. And then we showed how that pattern can be recovered using the same data set. So this is kind of recovered Checkerboard pattern. Actually we gave different Checkerboard size, but you can there are rather clear recovery of blue and red pattern down to 30 kilometers. This means the -- our observed fluctuation of the structure is a very reliable structure.

And also in order to show the reliability of the model, I just calculate the travel time fitting and actually average mean travel time residual for every OBS. So please take a look at this one. The mean residual is almost zero, actually +/- 0.05. So this is comparable value of uncertainty of the observed phase. So from this figure, we emphasize that the reliability of our model is very, very high.

Okay, so this is the final interpretation of our structure from Japanese coastline to Torishima. Okay, the important point is as I said before, we can see the continuation this green layer which shows seismic velocity is about 6. So we are -- believe that the andesitic or continental type crust continued from Japanese island to Torishima. But our new finding by this experiment is this is not uniform -- uniformly continuation. We can see very much fluctuation, yes, like this along this layer with wavelengths about 100 kilometers.

And also another point is again that we can -- we obtained high velocity lower crust along the entire crust. This may have to be returned to mantle by germination process in order to make a typical continental crust. And another very important point is -- okay, take a look at this. This black means -- shows the very bright reflector in the mantle. We -- our data shows a clear reflector just beneath the place where we have thicker continental-type crust like here, and like here, and like here.

Okay, so my -- the couple of time -- couple of minutes, I will just interpret the -- our structure, upper structure perturbation. The important character of the volcanism along the Izu arc is so called bi-model volcanism. This paper Tamura & Tatsumi, they clearly show the two peaks of the volcanic rock corrected along this arc -- Izu arc. Of course predominant rock shows the basaltic type, but you can see another peak at rhyolite rock like this. Okay, so I just compiled his obtained chemical component of rocks along our profile at this figure on the top.

Okay, so vertical axis indicate the silica content of the volcanic rock sample. You can see the -- actually two members, one is around here and the other one is around here, roll a silica content and a high silica content. So this is a group showing in basaltic rock. And we have another group showing the rhyolite or basalt group up here. And this pattern, peak and the trough pattern shows very good correlation with our obtained structure. I just calculate the thickness of the continental-type crust along the profile from our result, but just keeping in mind see I took the vertical axis downwards. The red color indicates the thickness of the continental-type of crust. The peak and the trough show surprisingly very good correlation with the chemical component of this structure. I mean this graph. Okay so from these results, we are now thinking that basaltic volcano is located on the very well developed andesitic continental-type crust. That rhyolite volcano is located -- CNT continental-type crust -- on the CNT continental-type crust.

I think I'll just skip this one. So from this seismic result as well as geological result our interpretation is like this. Along the Izu arc there must be two magnetic processes going on; one is growing continental crust, which takes place beneath the basaltic volcano where we got thicker continental type of crust. And also another process is probably re-melting of pre-existing continental crust beneath a rhyolite volcano in between the thicker part of the crust by laterally like this, laterally into the basaltic magma.

Okay, but the one thing I want to point out again is predominant process is basaltic volcanism around the Izu arc. So this means the crustal growing process is kind of predominant process in the Izu arc, and we believe re-melting process may be locally superimposed in the crustal growing process along this arc. Okay, so I will stop very soon. The conclusion is the seismologically or pathologically continental crust is where you would have seismic velocities about 6 from the results of a seismic or laboratory experiment.

And the first seismological evidence of andesitic layer in the intra-oceanic arc has been found in the northern part of the Izu arc at the middle level of the crust by the Japanese group and that it has mystery is questionable if our -- an andesitic continental crust is universally observed all around the world in the intra-oceanic arc. So the conclusion too is kind of new insight from our recent result. The newly obtained seismic image along the entire Izu arc clearly show continuation of the 6 kilometer per sec andesitic or continental crust, that its thickness is significantly varied along the Izu arc. And the observation of the Bonin, of the andesitic middle crust may be related to kind of magnetic process in the Izu arc. So we propose two processes; one is growing process passive basaltic volcano and the other one is re-melting of pre-existing crust beneath the andesitic crust. I think I will stop here. Thank you very much.

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Prolongation in Convergent Margin Systems: Examples from New Zealand Over the Last 100Ma[1]

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Thank you Mr. Chairman; Before beginning I would like to convey my thanks to the Ministry of Foreign Affairs for the opportunity to present this talk, which I hope will be instructive, showing that there are similarities between New Zealand's tectonic setting and much of the Western Pacific and Japanese islands. What I want to do today is present examples of prolongation in a convergent margin system.

There is in the order of 23,000 linear kilometers of convergent margin that essentially extend from New Zealand all the way around the Western Pacific to Japan. From the discussions this morning, it can be appreciated that prolongation in these Western Pacific-style convergent margins can be exceedingly more complex than the passive Atlantic-style margins. I hope to demonstrate that a number of examples from New Zealand are instructive as cases for prolongation in a convergent margin setting.

The disclaimer: though possibly stating the obvious, this presentation is not the official view of New Zealand. The structure of my presentation is firstly, I will talk about the obvious differences – which Professor Le Pichon talked about this morning – between passive and Western Pacific convergent-style margins. Secondly I will talk about the New Zealand tectonic setting. Thirdly I will talk about volcanic arc migration, and show an example of a volcanic arc system that migrates from the early Miocene Three Kings Ridge system, to the middle Miocene Lau and Colville arc system, through to its present position since the late Miocene along the Tonga-Kermadec arc. Finally, I will discuss the subject of accreted terranes, and give an example of what I consider to be an accreted terrane - the Hikurangi Plateau.

Most margins are either passive Atlantic-style or West Pacific-style convergent margins, and I have shown an idealized convergent margin in this slide. Convergent margin systems are inherently more complex than passive Atlantic-style margins, but in reality are even more

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.

complex. The incoming plate can have a variety of terranes, including continental fragments, large igneous plateaus, and hot spot seamount chains. These terranes sitting atop the incoming plate, are in time conveyed to the subduction system. At the subduction system some of these terranes will be accreted, some will be sutured, and some will be potentially under-plated. Hence there is inherent complexity where these terranes are accreted or sutured to the convergent margin, and become natural prolongations of it.

New Zealand is a continental land mass, and by a virtue of fate, lies astride the Pacific-Australia plate boundary. To the north, Pacific Plate is being subducted beneath the Australian Plate. To the south, the subduction becomes more oblique, and we move to a transform margin boundary – the Alpine Fault. Further south, during Cenozoic subduction, the polarity of subduction has reversed, and the Australian Plate is being subducted beneath the Pacific Plate.

A first observation here is that active plate boundaries need not be the edges of continental margins. Here we obviously have continental rocks on either side of New Zealand plate boundary. The second point is by the virtue of being astride, or near a plate boundary for an extended period of time, New Zealand has sustained a prolonged history of terrane accretion. The last point is that there are a series of volcanic arc ridges to the north of New Zealand, which I will argue are prolongations of New Zealand. These arc ridges have migrated eastward since the Eocene, but the critical point is that they extend to, and are hinged in, the continental land mass. I will also talk about the Hikurangi Plateau, which is an elevated triangular plateau immediately north of the Chatham Rise. I will also talk about the migration of a volcanic arc from the Norfolk Ridge, to Three Kings Ridge through to the Colville-Lau ridge, and ultimately to its present location along the Tonga-Kermadec ridge.

New Zealand has had a very long history of being at the edge of a plate boundary and therefore has undergone a prolonged evolution of terrane accretion. A reconstruction for 100 million years ago shows the relative positions East Antarctica, Australia, Tasmania and also parts of the Campbell Plateau, the Lord Howe Rise, and the North and South islands. The point that I want to make here is that parts of New Zealand have been at the edge of this Gondwana margin, with the associated construction of volcanic arcs and fore-arc basins infilled with sediments since the mid-Paleozoic. Even prior to 100 million years, New Zealand was being built by terrane accretion.

Then at approximately 90 million years, the region sustained the first phases of continental rifting, and then ultimately, the New Zealand continental mass split from Australia and

Antarctica by seafloor spreading in the Tasman Ocean. The important point here is that the basement terranes of New Zealand reveal a number of different accretion phases. In western New Zealand, these basement terrane blocks (in orange) were accreted during the Paleozoic. In western and central South Island there lie a series of plutonic rocks and batholiths (in red). In eastern New Zealand rocks (in yellow) were accreted to New Zealand during the Mesozoic. Finally, there was accretion of ophiolitic rocks during the mid-Cenozoic. The New Zealand land mass has been built by an extended history of terrane accretion.

Seafloor bathymetry of the Pacific shows the locations of what are termed "large igneous provinces". Those of interest here are Ontong Java Plateau, the Manihiki Plateau, and Hikurangi Plateau. Recent work convincingly argues that the Ontong Java Plateau, the Manihiki Plateau, and Hikurangi Plateau have previously formed a super large igneous province. These fragments were once joined with Robbie Ridge fitting against the Stuart Basin. There is unambiguous evidence of the Osbourn Trough being a fossil mid-ocean ridge system, which has created oceanic crust between the seaward edge of the Hikurangi Plateau and the Manihiki Plateau.

From multi-channel seismic data extending from the Chatham Rise across the Hikurangi Plateau and then out into deep ocean crust, it is observed that the plateau has water depths between 2,000 - 2,500 meters through to 3,500 meters. These data also show the Hikurangi Plateau is partially subducted beneath the Chatham Rise, where we see the Hikurangi Plateau being subducted over 100 kilometers southward beneath the Chatham Rise. The Chatham Rise comprises an upper 18 kilometers of crust, overlying a lower 8 kilometre crustal sequence of the Hikurangi Plateau. Hence the lower third of the Chatham Rise crust records suturing of the Hikurangi Plateau at the fossil Chatham subduction system.

The seaward edge of the plateau is marked by a very large scarp – the Rapuhia Scarp. Bathymetry and geophysical profiles crossing this system show normal deep-ocean crust to the south of the Campbell Plateau, then the elevated Campbell Plateau and Chatham Rise, and then across the Hikurangi Plateau, with a significant descent down onto normal ocean crust to the north.

Multi-channel seismic data across the plateau show the seaward edge of the Rapuhia Scarp, and that the basement rocks of the Hikurangi Plateau are in fact a sequence of shallow basaltic lava eruptions. Much of the sequence has been erupted at water depths of less than one kilometer. In places, we actually observe guyots that rise in the order of 1,500 meters above the Hikurangi Plateau that are interpreted as ephemeral islands that have been since been eroded. Subsequently the Hikurangi Plateau has subsided something like 1,600 meters along the boundary with the Chatham Rise and something like 3,000 meters at the seaward edge.

From inspection of Bouguer anomalies, at the one kilometer high Rapuhia Scarp between the Hikurangi Plateau and normal ocean crust of the deep floor, we observe that the 340-milligal anomaly provides a good proxy for the ocean continent boundary. The sole location where this doesn't work is in the northeast where there is in the order of 2 kilometers of sediment adjacent to the edge of the plateau. Points that are to be made here are the Hikurangi Plateau is a large igneous province, and once part of the super Ontong Java, Manihiki and Hikurangi Plateau. The junction of the Hikurangi Plateau and the Chatham Rise is a fossil subduction system where the Hikurangi Plateau has been sutured to New Zealand between 110 and 100 million years ago.

Now I would like to discuss the volcanic arcs ridges to the north of New Zealand. To recap, there is a series of ridges that form the northern New Zealand margin, comprising Norfolk Ridge Three Kings Ridge, Colville - Lau ridge, and finally the Kermadec - Tonga ridge. Basement rocks sampled in this region comprise a range of Mesozoic basement rocks including granites, diorites and gabbros, and even in some cases, metamorphic core complexes on the Northland Plateau. Over printing these rocks are series of volcanic arc ridges whose ages extend from the early Miocene to the present day.

Between these arc ridges are a series of back-arc basins that have progressively opened during the Oligocene in the South Fiji Basin, and then later in the Miocene in the Norfolk basins. These data, integrated with gravity data provides a series of reconstructions for this volcanic arc system. At 25 to 22 millions years ago, there were two arc systems, along Three Kings Ridge and Norfolk Ridge. The Norfolk basins were closed at this point.

The significant point to be made is that both of these systems extended southward and are recorded as arc volcanism in onshore New Zealand. Between 21 and 20 million years ago, the Norfolk Basin opened. We have continued opening of the South Fiji Basin, and we can document the evolution of the arc system in New Zealand and immediately offshore of New Zealand. Between 20 and 10 million years ago, Three Kings Ridge was the site of active volcanism, coinciding with the development of a volcanic arc along the Northern Peninsula.

During the late Miocene, the Colville-Lau system extended through New Zealand and into offshore Taranaki. From the latest Miocene and through to the present day, we have the continuous, active Tonga-Kermadec system extended into the Central North Island of New Zealand.

The question then arises, is there a record of this arc system through New Zealand? The answer is unquestionably yes. The distribution of volcanic rocks and their ages demonstrate extensive zones of in situ volcanics in the central part of the North Island. Coromandel Peninsula is an extinct volcanic arc. Volcanic arc rocks are also recognized along both coasts of the Northland Peninsula.

From these ages we see that the evolution of this subduction, facing southwest, was active during the late Oligocene, and early Miocene. The arc has subsequently migrated, due to trench rollback, and the orientation of the subduction system has changed with the system facing northwest with volcanism aligned northeast since the late Miocene. Gravity data supports this interpretation with geophysical signatures of volcanism recorded along the Northland Arc, and the line of Lau-Colville volcanism extending through the Coromandel Peninsula.

To summarize, we can see that progressively since the late Eocene, there has been a volcanic arc system that has migrated from Norfolk Ridge, Three Kings Ridge during the Oligocene and early Miocene, including phases of back-arc opening. This Oligocene – early Miocene arc extended into New Zealand. During the late Miocene the arc changed orientation but continued to have an extension into New Zealand. The present day Kermadec arc also extends into New Zealand, forming active volcanoes from Tonga, and southward through the Kermadec Islands. In recent years some 50 new submarine volcanoes have been mapped. Haungaroa is one of these volcanoes, being 25 to 30 kilometers in diameter, and rising nearly 2.5 kilometers in elevation. The line of volcanoes is continuous, moving onshore, with White Island, and ultimately to the southern tip of the line at Ruapehu.

Gravity data and modeling, extending from New Zealand from tip of the Northland along the axis of Three Kings Ridge demonstrates thickened arc crust until the Cook Fracture Zone, where the seafloor steps down on to normal oceanic crust. The other point to be made here is that these volcanic arc systems have a range of compositions, which in this case of a single migrating arc includes basalts through to dacites and rhyodacites. Compositional fields for this arc overlap with onshore volcanics, and composition plots cannot readily distinguish which rocks are from onshore and which are submarine. Again further evidence of the continuation of the volcanic arc system onto New Zealand, with the system migrating eastward since the Eocene. This arc migration has been rooted in, and hinged around continental New Zealand, and there is a concomitant record of this eastward arc migration within the New Zealand land mass.

Unusually in the case of New Zealand, these volcanic arc ridges are aligned perpendicular to the margin, but nevertheless the entire system forms one margin that has evolved through time. More commonly, volcanic arcs are parallel to the margin.

So some final conclusions. The Western Pacific comprises at least 23,000 kilometers of convergent plate boundary. Convergent margins are an integral part of continent formation. In New Zealand, the land mass has sustained a long history of terrane accretion which has been ongoing since the mid-Paleozoic. Penultimate accretion was that of the Hikurangi Plateau between 100 and 100 million years ago. The New Zealand margin also records the evolution and migration of a volcanic arc system since the Eocene, and includes a volcanic imprint in the New Zealand land mass from the early Miocene till the present day. Thank you very much for your attention.

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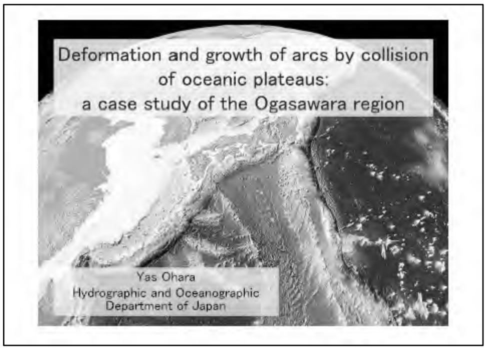
Deformation and Growth of Arcs by Collision of Oceanic Plateaus: a Case Study of the Ogasawara Region[1]

Dr. Yasuhiko Ohara,
Research Scientist, Hydrographic and Oceanographic Department,
Japan Coast Guard, Japan

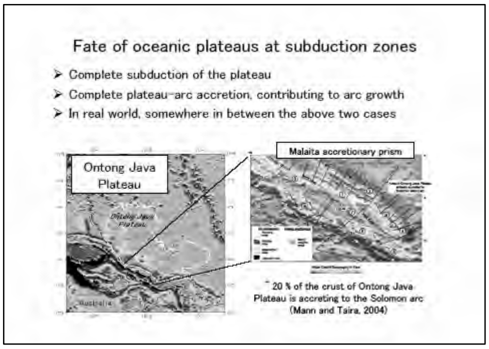
[Slide 1]
Today, as you can imagine from the title, what I'd like to talk this time is to introduce what is happening in the Ogasawara region. In other words, I will talk on collision tectonics of the Ogasawara region.

We are right here in Tokyo, and the Ogasawara region is located some 1000 km away to the south of Tokyo.



[Slide 2]
But, first, I'd like to review what happens to the oceanic plateaus at subduction zones. This will be two extreme cases. One is complete subduction of the plateau beneath the arc. The other is complete plateau-arc accretion. In this case, this process literally contributing to arc crustal growth. However, in reality, this will fall in somewhere in between the above two.

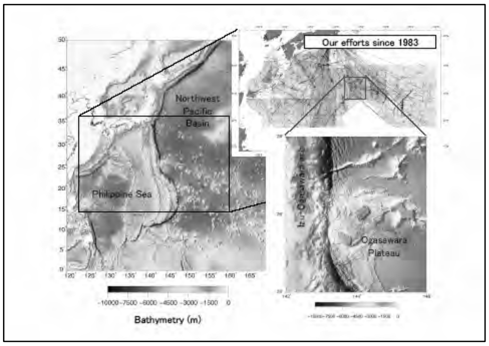
[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.



[Slide 3]
Now, I'd like to summarize the general tectonic setting of the Western Pacific.

This is the subduction zone of the Pacifc. The Pacific ocean floor is actually named "Northwest Pacific Basin". To the west of the subduction zone, there is the Philippine Sea. Since 1983, for more than 20 years, the Japanese continental shelf survey project has mapped this enormous region with narrow-multi beam.

Today, I'd like to focus on this Ogasawara region. Ogasawara Plateau is apparently colliding to the Izu-Ogasawara arc in the Philippine Sea.

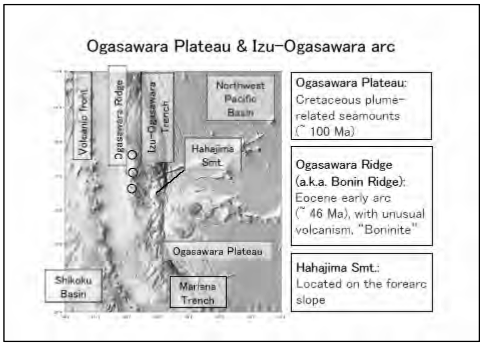


[Slide 4]
Firstly, Ogasawara Plateau is the group of Cretaceous plume-related seamounts, with the age of about 100 million years. Ogasawara Plateau is apparently colliding to the Izu-Ogasawara arc.

In the Izu-Ogasawara arc, the Ogasawara Ridge is the extinct Eocene early arc of the Philippine Sea. The age is about 46 million years. This ridge is also known as "Bonin Ridge", and famous for the unusual volcanism, "Boninite". The Ogasawara Ridge bears several islands, which are called Ogasawara islands. The active volcanic front of the Izu-Ogasawara arc is here. Shikoku Basin is an extinct backarc basin of the Philippine Sea.

The subduction zone is actually truncated at this junction. The trench system has each individual name here. One is Mariana Trench. The other is Izu-Ogasawara Trench.

There is a large seamounts on the forearc slope, named “Hahajima Smt.”. This seamount is named after one of the island of the Ogasawara Ridge.

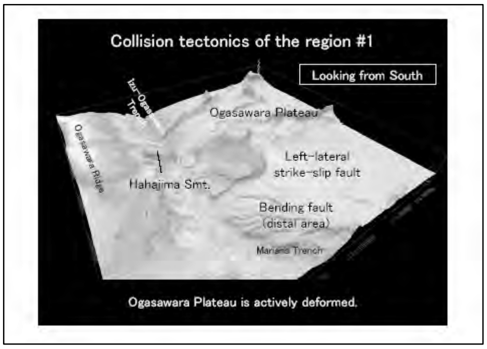


[Slide 5]
I’d like to show you the bathymetric features of the region in 3D images. This picture is looked from the south.

First, I’d like to point out that there is a group of beautiful bending faults. We interpret that, away from the junction, the ocean floor of the distal Ogasawara Plateau is subducting beneath Mariana Trench with normal faults.

On the other hand, we identify a group of left-lateral strike-slip faults in the middle of the plateau. We interpret that this strike-slip motion is caused by compressional stress due to collision of the plateau at the junction.

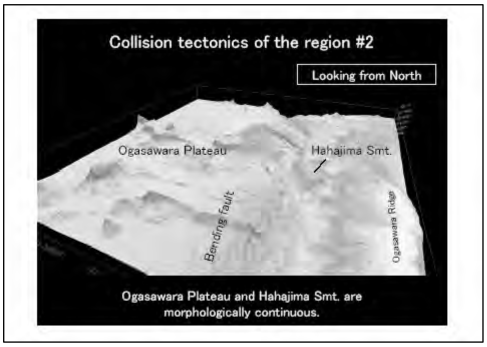
In any case, we can say that Ogasawara Plateau is actively deformed due to collision tectonics.



[Slide 6]
This picture is in turn looked from the north.

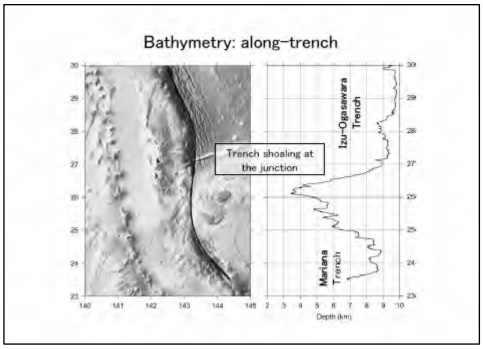
Again, we can easily notice the bending faults here.

In addition, Hahajima Smt. and Ogasawara Plateau look morphologically continuous. In the next two slides, I'm going to check this morphological continuity.



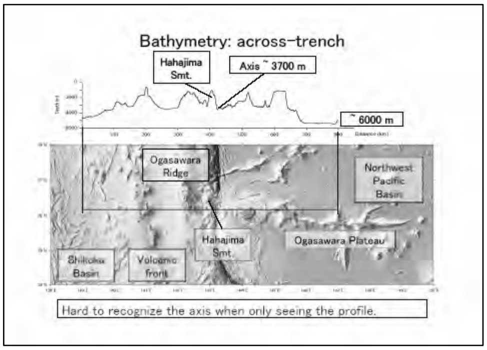
[Slide 7]
This is the along-trench bathymetry.

It is obvious that the trench axis is shoaling at the junction. The deepest part of the Izu-Ogasawara Trench is about 10,000 m, and the junction has about 3.5 km. So the difference is about 6.5 km, which is very large.



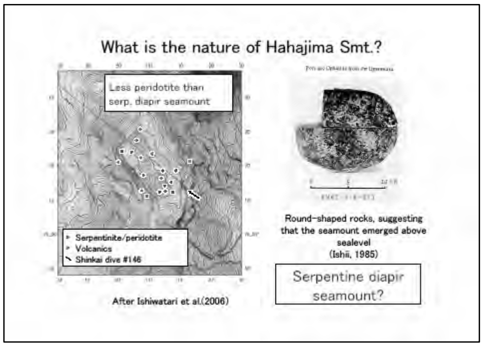
[Slide 8]
Next one is the across-trench bathymetry.

This profile is the transect from Northwest Pacific Basin to Shikoku Basin. The Northwest Pacific Basin has water depth about 6000 m. At the junction, the water depth is 3700 m. The difference is more than 2000 m, which is also large.



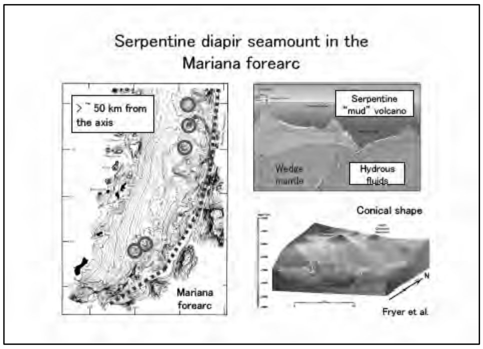
[Slide 9]
In Hahajima Smt., there are many bottom sampling studies. In this map, the red indicates serpentineite or peridotite dredges, and the blue indicates volcanics dredges, which includes boninites and very unusual adakites. Submersible Shinkai 6500 dive was conducted here. Another dive was also conducted at the Ogasawara Plateau. One of the notable features of the rocks from the seamount is that these are round-shaped. This clearly indicates that the seamount was above sealevel in the past. We may speculate that this emergence was due to the collision tectonics.

This map shows that Hahajima Smt. yields peridotite as well as volcanics. Because the seamount yields peridotites, it has long been considered that the seamount can be a serpentine diapir seamount.



[Slide 10]
So, what is serpentine diapir seamount? This is the well-known example from the Mariana forearc.

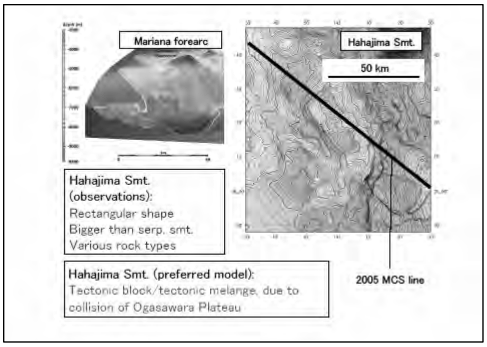
In the Mariana forearc, conical-shaped seamounts are identified. These seamounts are located some 50 km from the trench axis. These are interpreted as "serpentine mud volcano". This is due to hydration of the wedge mantle, cased by hydrous fluids leased from subducted slab.



[Slide 11]
But, Hahajima Smt. has different features than the Marina forearc seamounts. These two pictures are in the same scale. Firstly, Hahajima Smt. is rectangular-shaped. It is bigger than serpentine diapir seamounts. It yields various rock types.

Our interpretation is that it is in fact a tectonic block or tectonic melange, originated by collision of Ogasawara Plateau.

Now, in order to check this idea, I'd like to examine the latest MCS line, which was obtained last year.



[Slide 12]

This is forearc slope, Hahajima Smt., trench axis, and Ogasawara Plateau, from northwest to southeast. This profile is the 60 folds, time-migrated section.

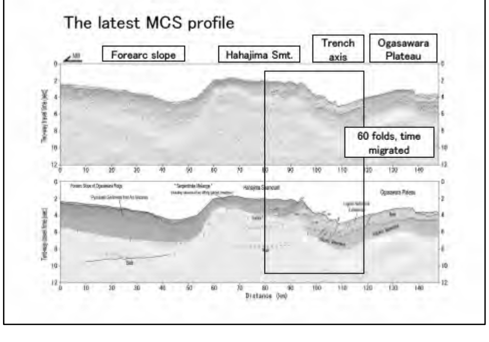
We may easily identify the limestone layer of lagoon origin on the Ogasawara Plateau. Beneath that, we interpret volcanic basement. At the foot of the Hahajima Smt., we identify several imbricate faults. This image indicates that the limestone layer is clearly accreted to Hahajima Smt. We also argue that the volcanic basement of the Ogsawara Plateau is also accreted to Hahajima Smt.

In Hahajima Smt., we identify a duplex structure. We would argue that serpentinite and volcanics were thrust up along the duplex structure, and now forming a serpentinite melange.

We interpret the layer of arc volcanic sediments in the forearc slope. We also identify the top of the subducted slab.

The deeper part of Hahajima Smt. is seismically opaque, possibly due to the presence of serpentinite melange, and thus the top of the slab is not clearly imaged.

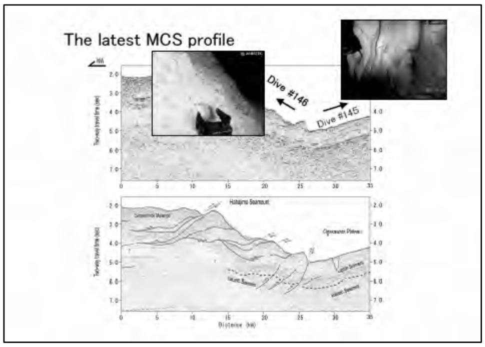
In the next slide, I'd like show the blow-up picture of this part.



[Slide 13]
In this image, again, we can identify several imbricate faults at the foot of the Hahajima Smt. This image indicates that the limestone layer is clearly accreted to Hahajima Smt. Firm evidence came from submersible Shinkai 6500 dives. We observed beautiful limestone layer at the Ogasawara Plateau slope. On the other hand, crushed limestone layer is observed at the slope of Hahajima Smt.

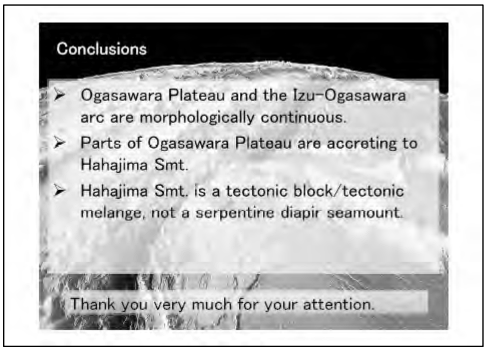
Again, we also argue that the volcanic basement of the Ogasawara Plateau is also accreted to Hahajima Smt.

Again, in Hahajima Smt., we identify a duplex structure. We would argue that serpentinite and volcanics were thrust up along the duplex structure, and now forming a serpentinite melange.



[Slide 14]
Now, it’s time to be on board the Nautilus. For the journey to the Ogasawara region.

[Slide 15]
In conclusion, I’d like to note three points.



Ok, that's all I have to say today. Thank you very much for your kind attention.

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Chapter 3

Updated Scientific Investigations relevant to
the Continental Shelf

Section 2

Further Ahead

Subduction Factory[1]

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Program Director, Institute for Research on Earth Evolution,
Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan

Thanks Larry. What I am going to emphasize here in this talk is Subduction Factory, Subduction zones, where the oceanic lithosphere is being subducted into the deep earth, has been operated as a factory since the first operation of platetronics in the early earth. And I would like to emphasize that Subduction Factory plays a key role in the evolution of solid Earth. Okay my talk includes first what's a Subduction Factory. I would like to introduce a concept of Subduction Factory and then I would like to present a model for the role of Subduction Factory, and continental crust formation, and mantle evolution. And finally, how can we test this model?

What the Subduction Factory is? Here is a cartoon for Subduction Factory, and in this factory raw material is transported including oceanic sediments - oceanic materials such as sediments and oceanic crust and also mantle-wedge material can be processed as raw materials. What's the product from this factory? The major product is magmas/volcanoes and volatiles, and also their solidified product, continental crust. As generally, a factory produces of course products but also produces waste materials. Here we have residues or waste materials from Subduction Factory including chemically modified plate or subducting slab and delaminated lower crust. I will talk this one later in more detail; but anyway, Subduction Factory processed raw material to produce products and also to produce residues or waste materials.

We have a great dilemma that we are facing with and in regard to Subduction Factory. So, there is the compositional difference between basaltic magmas which is produced in the mantle wedge and the product, continental crust. This basaltic magma is produced by dehydration of subducting lithosphere to cause partial melting and to produce these magmas. And these magmas are basaltic in composition having 50 percent SiO2. But the final product of this factory that is the continental crust possessed, silica content around 60 percent. So that is andesitic in composition. We have very clear compositional difference of 60 weight percent silica crust and 50 percent are silica basalt magmas. We may call this difference maybe

[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.

differentiation. Which kind of process is responsible for this differentiation? That is one of the greatest question that we should address.

I would like to introduce our model for the origin of continental crust. Okay, here is a cartoon. There is the subducting lithosphere, and the dehydration releases water to the mantle wedge to cause partial melting in this region and finally to produce basaltic magmas. And such magma will solidify to form an initial arc crust like this way. And again, basaltic magma or mantle-derived basaltic magma intruded into this initial crust to cause crustal melting or anatexis and to produce felsic, silica-rich melt from the initial crust. Okay, of course we have mafic or silica-poor restite after such a melting. Then the mixing between this felsic magma and this basaltic magma can produce andesitic composition, because this felsic magma contains roughly speaking 70 weight percent SiO2, and this basaltic magma contains 50 percent SiO2. So for example, even mixing between these two magmas can produce andesitic compositions of continental crust.

Okay now, we have andesite crust here. So this is a proposed model for the formation of continental crust. This model can be tested by geochemical modeling for trace element. So this diagram shows such a result. So these are the various elements like this way and the horizontal axis indicates the some normalizing element concentrations. So this blue one indicates the mantle-derived basalt which is formed by or produced by dehydration reactions of the subducting lithosphere. And this green one a bit hard to see but this green one indicates crustal melt, which is formed by anatexis or remelting of the initial basaltic crust.

Then we have an even mixture of these two magmas. This red line indicates such magma compositions having andesitic compositions. And the yellow region indicates the average composition of continental crust so we can see very good agreement between these inferred composition of andesites and observed andesitic compositions or continental crust compositions. So this model can explain both trace and major element characteristics of continental crust. But still, we have a very big problem to be addressed. As I told you, initial arc crust is formed by mantle-derived basalt, so initial crust has basaltic compositions. And then our model includes remelting of this initial crust by basaltic underplating and mixing between this felsic magmas and basaltic magmas to produce andesitic compositions here. But this is basaltic composition and this supplied magma is also basalt. So the total crust at this stage should have basaltic in composition not andesite composition. In order to produce continental crust having andesite compositions, we have to separate this mafic or silica-poor component from this initial crust. This process is called delamination. Delamination from these arc crusts can create andesitic continental crust.

Here we introduced a concept of delamination or separation of mafic component. What's the fate of these delaminated materials? These materials should act as waste material from the Subduction Factory. Now, I would like to discuss the fate of waste materials from Subduction Factory. Which kind of waste material? First one is dehydrated sediment which is carrying down along the subduction of the oceanic plate. And second one is dehydrated or fresh oceanic crust itself. That is a major component of the subducting lithosphere. And as I told you before, in order to create andesitic continental crust, we need process including delamination of arc lower crust. So we have now three waste materials like this way from the Subduction Factory. And these waste materials should be transported to the deeper mantle along with the subduction of the lithosphere or delamination from the lower crust. And these waste materials should contribute to the evolution of deep mantle geochemical reservoirs.

Okay, how to test this idea. So-or how to identify the geochemical characteristics of deep mantle. Here we have hot spot. Here at the ocean base and as you know, we have seamount chains like this way and also at the tip of this seamount, we have active volcanoes as shown in the slides like this way. And also from this -- from star or active volcanoes the age of volcanoes decreases with increasing distance from this tip. This observation creates a well known concept of a hot spot which may be called a drill hole to the deep mantle. The seamount changes caused by or produced by magma supply from a stable source like a hot spot and also we have a moving plate. We have seamount chains at the ocean floors like this way. So we can use hot spot magma or chemical characteristics hot spot magmas for the identification of a deep mantle geochemical reservoir.

Based on this concept, we analyze many samples from hot spot and those data are plotted on the space of the isotopic diagram like this way. This is a lead isotope. This is a strontium isotope. Okay, this purple region indicates the composition of variety for ocean island basalt or hot spot in the ocean regions. And this is mid-ocean ridge basalt which is created at the mid-ocean ridges and also which composes of oceanic crust. Okay, now, in order to explain the diversity of these geochemical characteristics of ocean island basalt, we need at least three end member components. The one is called the HIMU and the other one is called EMI, enriched mantle I. And the third one is called EMII, enriched mantle II. Okay now, in order to explain the diversity of geochemical characteristics of hot spot magmas, we need at least three enriched reservoirs as I told you before.

Just to remind what I said before. We have three waste materials from Subduction Factory. One is sediments, one is oceanic crust, and the last one is delaminated crust. Again, we have three geochemical reservoirs as deep mantle and the three waste materials from Subduction

Factory, which should be transported to the deeper mantle. What is the relation of these three materials? In order to test this idea, we conducted experiments, high pressure experiments for the mobility of element during subduction of oceanic lithosphere including sediments and oceanic crust, because as I told you before, dehydration processes is key to forming arc magmas. And along with such a dehydration process, elements - certain element or particular element should be transported with such solid phases. So this diagram showed the results of such experiments, ionic radius versus mobility of element for subducted oceanic crust that's with the ocean-ridge basalt. Wwe now know the degree of elemental transport along with the dehydration process. Based on these data, we can calculate the geochemical or isotropic evolution of that waste material that is the dehydrated oceanic crust. So this diagram shows result of such a geochemical modeling on the strontium, neodymium, and lead-lead isopic diagram.

So here we have a diversity of geochemical characteristics of hot spot magmas or deep mantle geochemical reservoirs. And we have HIMU reservoirs here and here. This to indicate the isotopic composition of dehydrated subducting crust at -- formed at two billion years ago,. Okay, here we have a fresh MORB (mid-oceanic ridge basalt) formed at two billion years ago. So the mixing of these two components that consists of the subducting oceanic crust itself can reasonably explain the geochemical characteristics of a geochemical reservoir in the deep mantle called HIMU. This story is also applicable for lead-lead isotopic data. So HIMU geochemical characteristics can be reasonably explained by mixing between the dehydrated and fresh MORB. Okay, so one of the possible causes for producing HIMU geochemical reservoir in the deep mantle is dehydration of subducting oceanic crust and its storage in the deep mantle, for example, two billion years.

Next one we have to address is a fate of subducting sediments. So this is a result for dehydration element transport along with dehydration for sediment. Okay, based on this experimental result, we can calculate the geochemical characteristics or present the geochemical characteristics of ancient subducting sediments. Okay here we have one billion years ago sediment and here we have a plot of - a mantle composition which occupies the major part of the lower mantle. So, mixing between this sediment component with this lower mantle materials can reasonably explain one, geochemical characteristics of EMII. And this story is also true for lead-lead diagram. So we may conclude that the hydrated sediment at one billion years ago can reasonably explain the distance of EMII mantle reservoir in the deeper mantle.

We now have a last one, the delaminated arc crust. Here we have just a result. So this purple one indicates about a 3.5 billion years ago delaminated ancient arc crust. And the mixing between lower mantle with this delaminated component can reasonably explain the EMII, geochemical end member which has also existed at the deeper level of the mantle. And this is also true for lead-lead diagram.

Now we can conclude delaminated arc lower crust can contribute to form EMI mantle reservoirs in the deep mantle. Now I can say Subduction Factory has been operating as a zero emission factory. I understand the concept of a zero emission factory was proposed here in United Nations University and now I will follow this concept and apply this concept to the Subduction Factory, because we have residues from the factory, and the continental or delaminated raw materials, and sediments and oceanic crust. And all these waste materials should be recycled and reused as hot spot sources like Hawaii or other ocean islands. And these waste materials contribute to form geochemical reservoirs in the deep mantle like EMI, EMII and HIMU. So we have three waste materials and we have geochemical end members. They are - these end members are completely recycled materials from Subduction Factory.

This is a model or JAMSTEC model for the formation of continental crust and the geochemical reservoir and also the evolution of the Subduction Factory. How to test this model? We are now focusing our interests on oceanic island arc. We are now thinking that ocean is creating continent, so something like a paradox. Okay, here, our target area is Izu-Bonin-Mariana region to the south of Honshu Island like this way. This Izu-Bonin-Mariana arc is characterized by immature arc with rather thin crusts and also this arc represents the initial stage of arc evolution and also probably Kodaira-san told you this. In this arc, now continental crust at least andesitic composition middle crust is forming. That’s a very suitable target for testing a model.

As probably Kodaira-san showed you long with this cross section we have very characteristic possibly andesitic middle crust layers like this way. So, here an IBM is born in Mariana arc. , now continental crust is forming in the ocean. So in order to test the composition of this middle crust and also in order to test our model including delamination of such a material and also recycling of waste material, we would like to have a deep drill here in IBM oceanic arc. And we would like to get the sample from the deeper crust and possibly or hopefully from the mantle and we would like to test our model, and we would like to know -further know or further understand the role of Subduction Factory in the evolution of solid earth. That’s it. Thank you very much.

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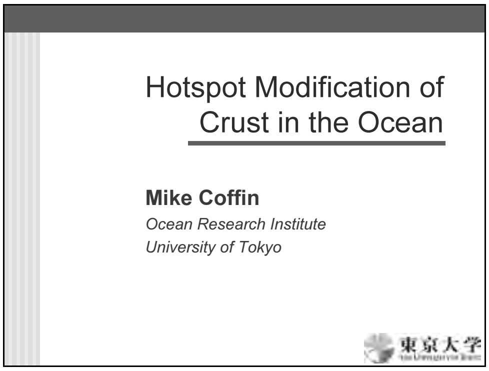
Hotspot Modification of Crust in the Ocean[1]

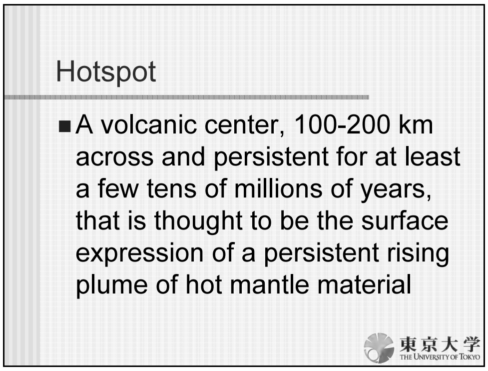
Prof. Millard F. Coffin
Ocean Research Institute, University of Tokyo, Japan

[Slide 1]
Mr. Chairman, distinguished colleagues, and ladies and gentlemen, I am grateful for the opportunity to participate in this timely and important symposium. I thank the Ministry of Foreign Affairs and the United Nations University for their sponsorship, the Director of the University of Tokyo Ocean Research Institute for supporting my participation, and the Ministry of Education, Culture, Sports, Science, and Technology for underwriting the research results included in this presentation. The topic of my address, as indicated in the title, will be how hotspots modify crust in the oceans. First, we will start with a definition of 'hotspot'.

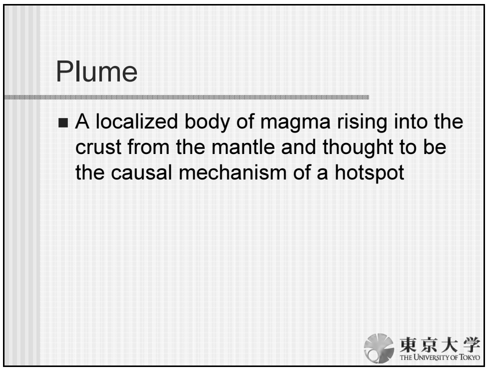


[Slide 2]
A hotspot is a volcanic center, 100 to 200 kilometers across and persistent for at least a few tens of millions of years. Hotspots are thought to be the surface expression of a persistent rising plume of hot mantle material, although the causes of hotspots are currently the subject of lively debate in the earth sciences. Hotspots are observed both in the oceans and on the continents, but we will consider only those in the oceans. Next, we define 'plume'.

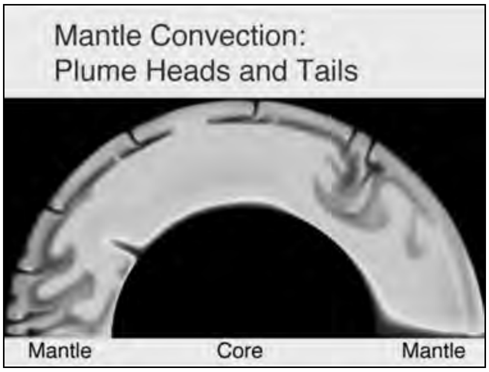
[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.



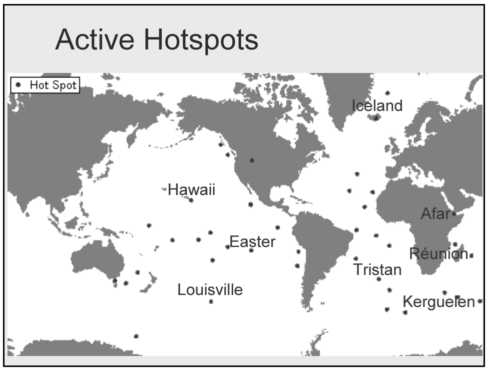
[Slide 3]
A plume is a localized body of magma rising into the crust from the mantle and thought to be the causal mechanism of a hotspot. Although our knowledge of mantle dynamics is relatively primitive, numerical modeling conveys our basic understanding of plumes as well as subduction.



[Slide 4]
In this numerical model animation, we see a cross-section of the Earth, which has a radius of approximately 6,400 km. The core is indicated in black, and it is surrounded by the mantle. The crust is the uppermost skin, mostly in dark blue. Color indicates relative temperature and density. We observe ‘plumes’ originating from the D” (D-double-prime) layer at the base of the mantle (approximately 2900 km depth), ascending through the mantle with a bulbous head and narrower tail, and in some cases reaching the crust. Complementary to the rising plumes, plates subduct into the mantle, sometimes reaching the D” layer, which maintains a mass balance in the mantle. Now let us return to the Earth’s surface.



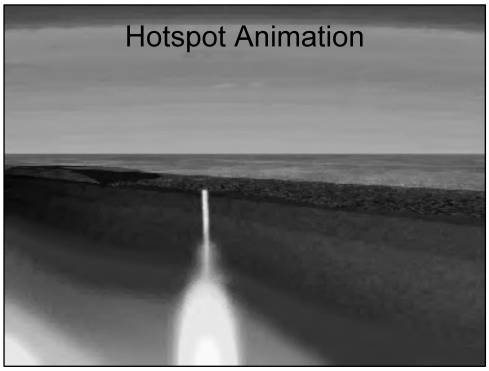
[Slide 5]
Currently the Earth's crust is being created or modified by tens of hotspots. A few of the better known and more robust ones in the ocean are Hawaii, Easter, and Louisville in the Pacific; Iceland and Tristan in the Atlantic; and Afar, Réunion, and Kerguelen in the Indian Ocean.



[Slide 6]
The Iceland hotspot straddles the Mid-Atlantic Ridge and has been active for at least the past 55 million years. Here we can see the birth of the island of Surtsey, just sound of Iceland, in 1963, representative of how hotspots in the ocean create landmasses.

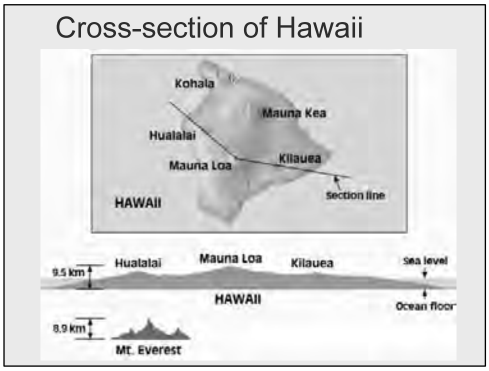
[Slide 7]

The Hawaiian hotspot lies beneath the interior of the Pacific plate and has been active for more than 80 million years. Here we can see the Pacific plate moving over the Hawaiian hotspot. Magma rises from the mantle through the oceanic crust, and creates volcanic islands, which move away from the hotspot with the oceanic plate. Over 80 million years, the Hawaiian hotspot has created a long line of volcanic islands, the Emperor-Hawaiian chain, extending from the northwestern Pacific Ocean to the island of Hawaii. Each island eventually becomes extinct volcanically as it moves away from the hotspot. The bend in the chain has been attributed until recently to a change in Pacific plate motion; recent evidence suggests that motion of the hotspot itself may account for the bend. Currently the hotspot is active on the island of Hawaii and the submarine island Loihi to the south. Eventually Loihi will probably grow above sea level.



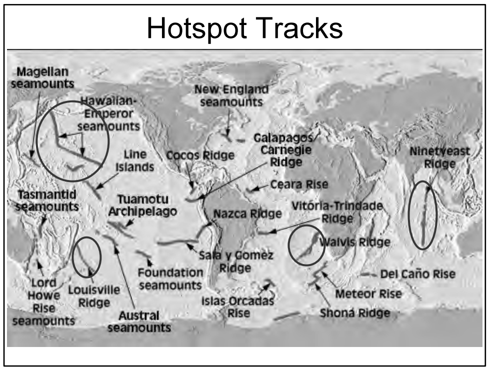
[Slide 8]

Hawaii is currently the most active hotspot on the Earth's surface, and this cross-section conveys the scale of the big island of Hawaii that has formed in the last 500,000 years. However, as we will see shortly, this large volcanic edifice is several orders of magnitude smaller than the great flood basalt provinces that have been produced by hotspots in the past, and attributed to the surfacing of mantle plume heads.



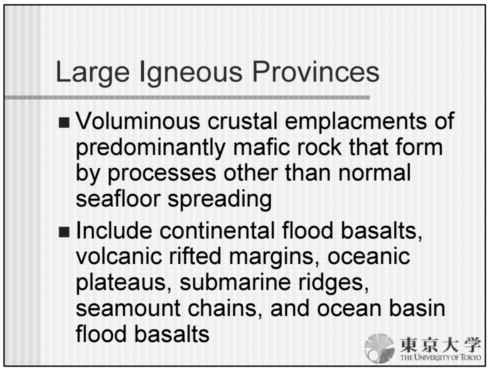
[Slide 9]

In addition to the Hawaiian-Emperor seamount chain, other hotspots have produced tracks as various tectonic plates have passed over them. Some of the more prominent of these include the Louisville Ridge in the Pacific, the Walvis Ridge in the Atlantic, and the Ninetyeast Ridge in the Indian Ocean. Such seamount chains and submarine ridges belong to a larger class of major volcanic features known as large igneous provinces, or LIPs.



[Slide 10]

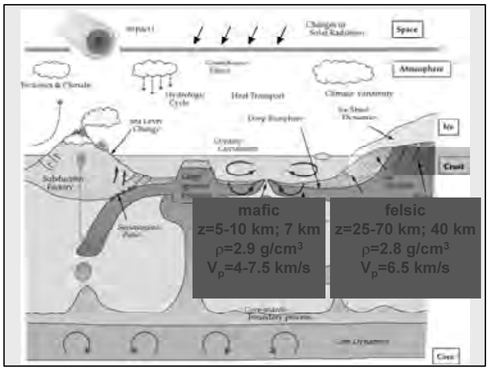
Large igneous provinces are voluminous crustal emplacements of predominantly mafic (magnesium- and iron-rich) rock that form by processes other than normal seafloor spreading. They include continental flood basalt provinces on the continents, and volcanic rifted margins, oceanic plateaus, submarine ridges, seamount chains, and ocean basin flood basalts in the oceans. Now, let us turn to the two fundamental types of crust on Earth, both of which may be affected by hotspot activity resulting in the formation of large igneous provinces.



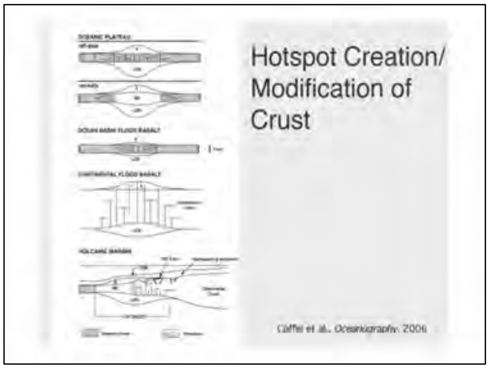
[Slide 11]

The Earth's crust may be divided into continental and oceanic types. As depicted in this Earth system cartoon, the thicknesses of continental crust, on the right, and ocean crust, in the center, differ. Geophysical methods, primarily seismic and gravimetric, are commonly used to investigate and characterize the crustal structure of both types of crust. 'Normal' magnesium- and iron-rich oceanic crust is 5 to 10 kilometers thick, averaging 7 kilometers. Its density averages 2.9 grams/cubic centimeter, and compressional seismic wave velocities are 4 to 7.5 kilometers/second.

'Normal' feldspar- and silica-rich continental crust is 25 to 70 kilometers thick, averaging 40 kilometers. Its density averages 2.8 grams/cubic centimeter (2.7 grams/cubic centimeter in the upper crust), and compressional seismic wave velocities average 6.5 kilometers/second. Although both types of crust are found in the oceans, oceanic crust predominates. As described earlier, crust created or modified by hotspot activity comprises features known collectively as large igneous provinces, or LIPs, as depicted in the center of this cartoon.

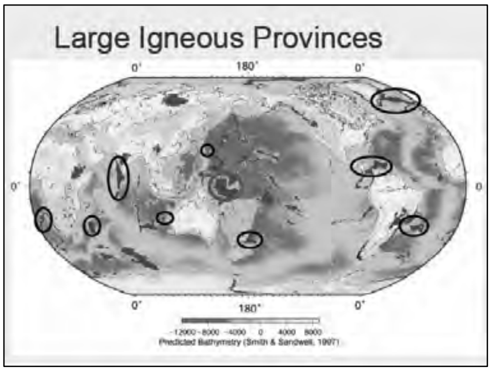


[Slide 12]
Here, in cross section, we depict how hotspots create new crust or modify existing oceanic or continental crust. If a hotspot impinges upon pre-existing crust, it thickens it by adding extrusives at the top of the crust, intruding the pre-existing crust, and adding a lower crustal body. If a hotspot intersects a mid-ocean ridge, it creates a mafic crust thicker than 'normal' oceanic crust.



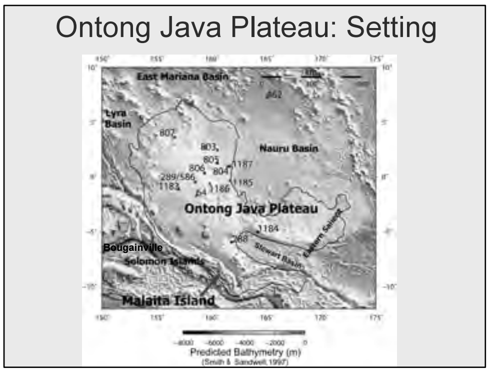
[Slide 13]

Here we see, in red, large igneous provinces in the oceans and on the continents that have mostly formed during the last 150 million years. Many of the oceanic large igneous provinces are juxtaposed with continents or islands, for example: Ogasawara Plateau & Bonin Islands, Ontong Java Plateau & Solomon Islands/Bougainville (Papua New Guinea), and Hikurangi Plateau & New Zealand in the Pacific; Madagascar Ridge & Madagascar, Chagos-Laccadive Ridge & India, Wallaby (Cuvier) Plateau & Australia in the Indian Ocean; and Greenland-Iceland-Faeroe Ridge & Denmark & Scotland, Caribbean & Caribbean/Central/South American nations, Rio Grande Rise/Sao Paulo Plateau & Brazil, and Walvis Ridge & Namibia in the Atlantic. Let us examine the geological and geophysical details of one of these juxtapositions as a case study: the Ontong Java Plateau & Solomon Islands/Bougainville (Papua New Guinea).



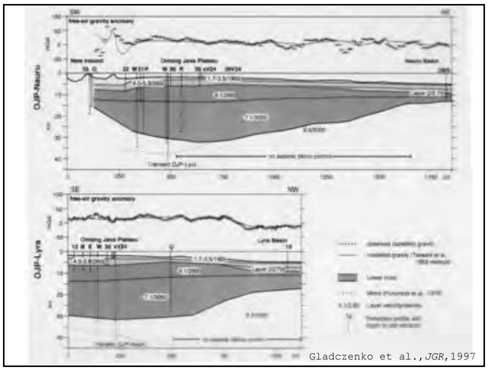
[Slide 14]

The Ontong Java Plateau, in the western equatorial Pacific, is juxtaposed with the Solomon Islands, with Malaita highlighted, and Bougainville (Papua New Guinea). The Plateau encompasses an area of nearly two million square kilometers, or about four times the size of subaerial Japan. It has been the focus of two dedicated scientific drilling expeditions, as well as previous reconnaissance drilling; drill sites are indicated by numbers and squares. It has also been the focus of four dedicated multi-channel seismic reflection cruises, two of which included wide-angle seismic work, as well as previous single-channel seismic work.



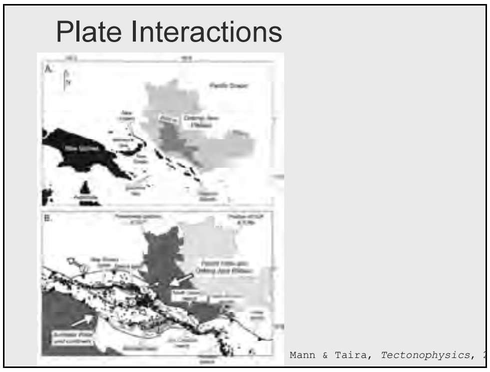
[Slide 15]

Crust of the Ontong Java Plateau and adjacent ocean basins, as investigated using wide-angle seismic data and gravity modeling, has a maximum thickness of approximately 35 km, and in this respect much more closely resembles continental crust than oceanic crust. Notice the scale of these NE-SW and NW-SE cross sections, zero to 40 kilometers on the vertical axis and 1000 kilometers on the horizontal axis. Also note the velocities and densities indicated in white boxes.



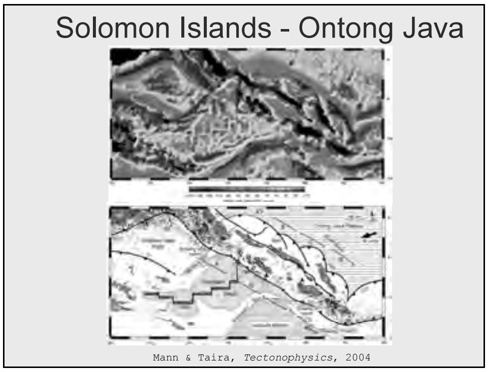
[Slide 16]

Here is the geography of the Ontong Java Plateau, Solomon Islands, and Papua New Guinea(above). The Ontong Java Plateau and Solomon Island arc commenced a ‘hard’ collision about four million years ago (below). A series of trenches lies between the Pacific plate, including Ontong Java, and the Solomon-Bougainville-New Ireland arc.

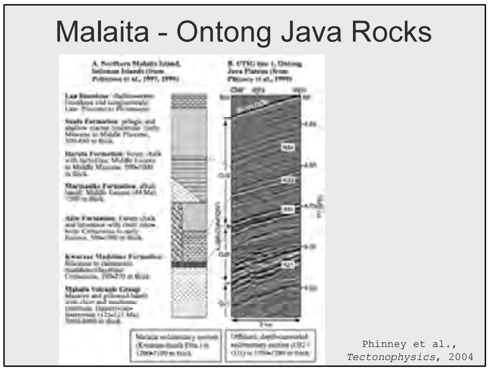


[Slide 17]

Focusing on the region of interaction between the Ontong Java Plateau and the Solomon Islands, we see a complex free-air gravity field (above) as well as a complex tectonic setting (below). Both the Ontong Java Plateau and the Louisiade Plateau (horizontal stripes) are converging with the Solomon Island arc, marked by the North Solomon and San Cristobal trenches (barbed lines), respectively, frequent earthquakes (small dots), and volcanoes (yellow circles and red triangles). At the same time, new crust is being created at the Woodlark spreading center (gray). Pacific-Australia plate convergence is 10 centimeters per year in the direction of the arrow.

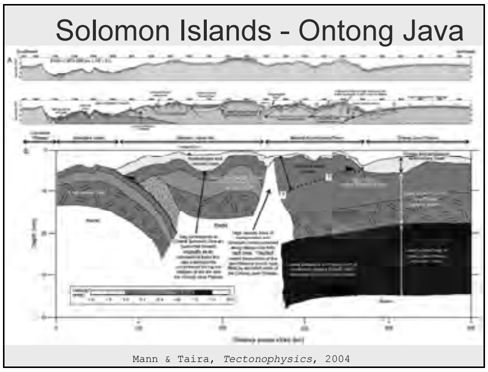


[Slide 18]
Both the marine sediment and igneous stratigraphy of Malaita Island in the Solomons and the Ontong Java Plateau (from drilling) are similar, indicating that sediment and rocks of the Ontong Java Plateau have been thrust onto the Solomon Islands.

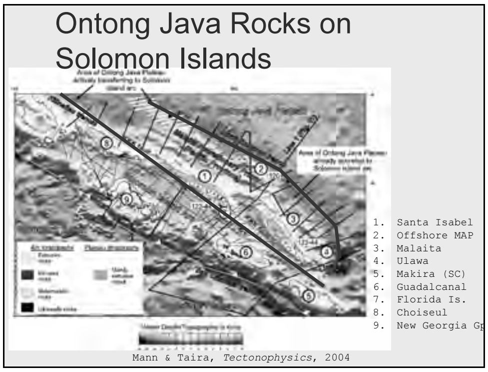


[Slide 19]
A cross section of the Ontong Java Plateau and Solomon Islands, interpreted from seismic data, demonstrates tectonic complexities resulting from the collision. The majority of Ontong Java Plateau crust has subducted, but at least four to five kilometers of the upper basaltic crust has been accreted to the Solomon Island arc. Notice the scale of these NE-SW cross sections, zero

to 40 kilometers on the vertical axis and 500 kilometers on the horizontal axis.

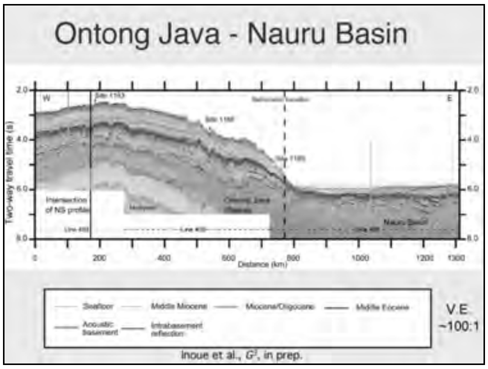


[Slide 20]
In map view, the area outlined in red has been transferred from the Ontong Java Plateau to the Solomon Island arc, or Malaita accretionary prism (MAP). Geology is coded by color, with pink indicating mainly Ontong Java basalts, yellow extrusive rocks, red intrusive rocks, green metamorphic rocks, and black ultramafic rocks. Individual islands of the arc are keyed to numbers:
1) Santa Isabel and 3) Malaita contain significant Ontong Java basalts and sediments.



[Slide 21]
The transitions between the Ontong Java Plateau and its neighboring ocean basins are also intriguing. In this example, a multichannel seismic reflection cross-section with a high vertical exaggeration of approximately 100:1, we can observe a marked change in slope between the Plateau and the Nauru Basin, but acoustic basement is essentially continuous between the two. We believe that lava flows emanating from the Ontong Java Plateau flowed into the Nauru Basin when the Plateau formed about 120 million years ago. The oceanic crust of the Nauru

Basin is older, and probably sediment lies between it and the lava flows. Notice the scale of these NE-SW cross sections, 2 to 8 seconds (1 second equals 750 meters in water) on the vertical axis and 1000 kilometers on the horizontal axis.

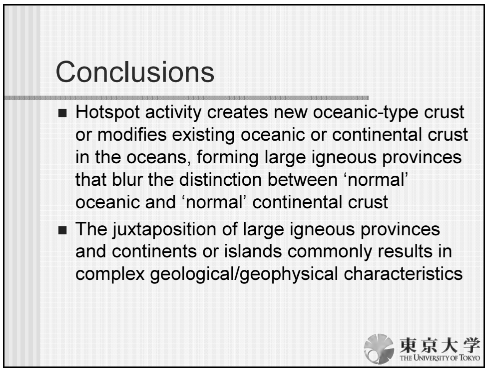


[Slide 22]

In conclusion, I would like to emphasize two points:

1. Hotspot activity may create new oceanic-type, I.e., mafic, crust, or modify existing oceanic or continental crust in the oceans. The resultant large igneous provinces blur the distinction between 'normal' oceanic and 'normal' continental crust.

2. The juxtaposition of large igneous provinces and continents or islands commonly results in complex geological and geophysical characteristics.



Mr. Chairman, distinguished colleagues, and ladies and gentlemen, thank you for your attention.

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Chikyu and IODP[1]

Dr. Asahiko Taira
Director General, Center for Deep Earth Exploration,
Japan Agency for Marine-Earth Science and Technology, Japan

Introduction

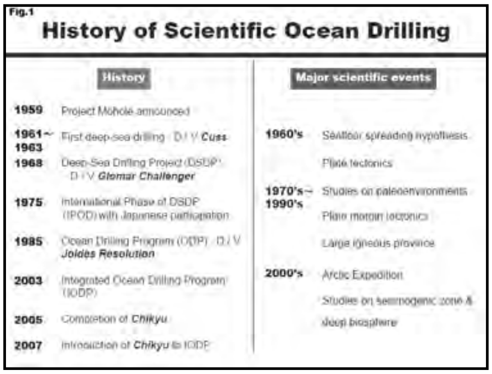
First of all, I'd like to extend my gratitude to the all of relevant organizations who put together a lot of effort to host this important symposium.

What I am going to present today is about a new drilling vessel, the Chikyu that was constructed in 2005 and its role in the Integrated Ocean Drilling Program.

Before going into the details of Chikyu technology, it may be useful to quickly review the history of the scientific ocean drilling. As you know, the ocean drilling history dated back to the early 60s when the US launched a very ambitious project called Mohole project, a project which try to drilling to the Moho where the crust and mantle boundary resides. The project was so expensive and also challenging in terms of the technological limitation. The Mohole project was eventually abandoned and replaced by a project whose target is to drill many shallow holes. This is the beginning of Deep Sea Drilling Project using D/V Glomar Challenger. DSDP, then changed to the international mode of operation called IPOD. Then 1985, Ocean Drilling Program using Joides Resolution started (Fig.1).

During those three decades of the scientific ocean drilling, there were fantastic progresses being made including the proof of sea floor spreading which later became the theory plate tectonics. Professor Le Pichon, today's invited keynote speaker was one of those who contributed significantly to the construction of this theory. And later, paleo-environmental studies, plate margin tectonics, and exploration of large igneous provinces and studies on deep biosphere and gas hydrates were among the important subjects of ocean drilling.

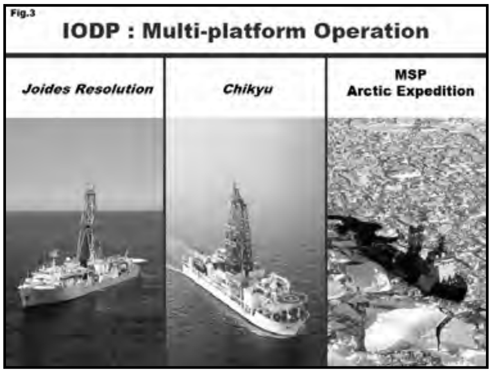
[1] This was presented in International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.



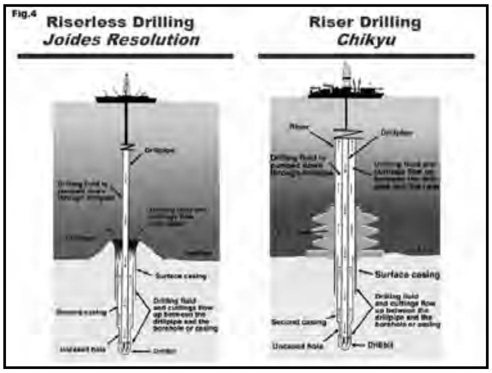
In the early nineties, Japanese scientists felt strongly because we live in a country of earthquakes and volcanoes, where the concentration of earth activity is most vigorous, that understanding of the interior process of the earth by deep drilling is a essential part of the future Japanese science and technology. So, we put together a proposal and submitted through the Japan Marine Science and Technology Center (currently renamed as Japan Agency for Marine-Earth Science and Technology: JAMSTEC) to the government. With the support from the international community, it began to be processed seriously. After five years of the design and the construction, the construction of the Chikyu that means “the earth”, completed on July 29 in 2005 at the dock year of Mitsubishi Heavy Industry in Nagasaki (Fig.2). Since then, we’ve been testing the Chikyu through the various modes of operation including robustness of Dynamic Positioning System, riser pipe handling and the capability of blowout preventer. And this year, we are going to test the riser drilling capability of Chikyu offshore of Northeast Japan. And the current plan is to introduce Chikyu into the Integrated Ocean Drilling Program (IODP) in 2007 and the initial target is planned to be a study of seismogenic zone in the Nankai Trough.

The Chikyu Technology

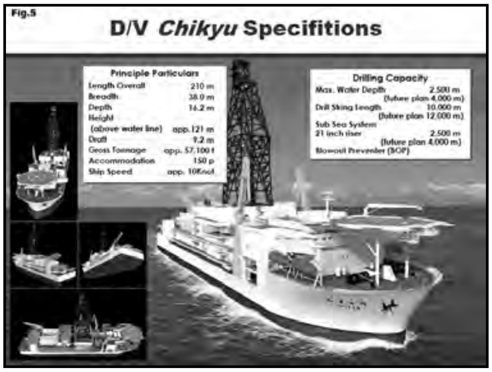
Let me start a little bit of introduction of IODP. IODP is the first multi-drilling-platform operation of the scientific ocean drilling. The program embraces the Joides Resolution type non-riser or riser vessel operated by US and a mission specific platform operated by the European Consortium, like an artic drilling vessel featured and the Chikyu, a riser technology vessel operated by JAMSTEC (Fig.3).



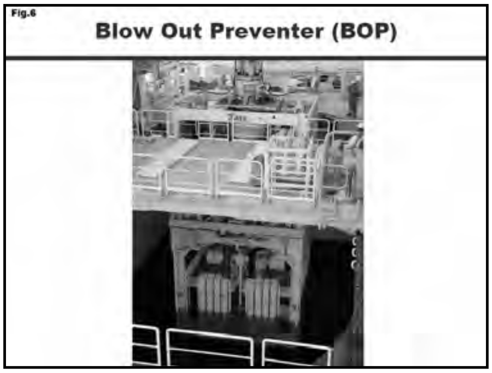
Here, I would like to explain what is riser technology. In a simpler explanation, Joides Resolution, a non-riser vessel uses drill pipe and seawater circulation for drilling. Seawater is circulated through the drilling pipe and the cuttings are brought to the seafloor surface(Fig.4). But in this kind of operation, because of the high pressure of ambient pore water in the rocks, the hole drilled is not stable and tends to collapse. It is very difficult to drill deep say more than 3km using this technology. In order to overcome this difficulty, it is necessary to circulate heavy liquid and to bring all the cuttings back to the ship. For maintaining closed circulation, a larger diameter pipe connecting from the seafloor to all the way back to the drill ship should be installed (Fig.4). The pipe is called riser pipe.

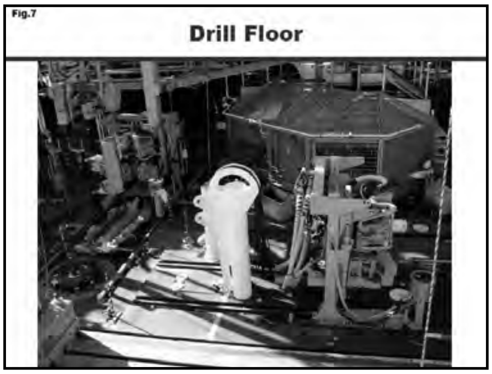


The Chikyu's main body is composed of three parts: the main aft part is a residential and laboratory area; mid part houses drilling components and the stern part accommodates materials and pipes. The Chikyu is 210 meters long and 38 meter wide. Grosse tonnage is 57,100 tons (Fig.5). The maximum water depth of the riser operation is initially 2.5 kilometers and drill string length is 10 kilometer. Therefore, it can potentially drill 7.5 kilometers below the sea floor that is 2.5 kilometers deep.



A characteristic equipment of the Chikyu is a large hydrocarbon blowout preventer (Fig.6). The drill-floor installs various robotic instruments such as iron roughnecks and other pipe handling systems (Fig.7). A stock of riser pipes occupies the stern part of the vessel (Fig.8). Each pipe is 27 meters long and covered by floating materials



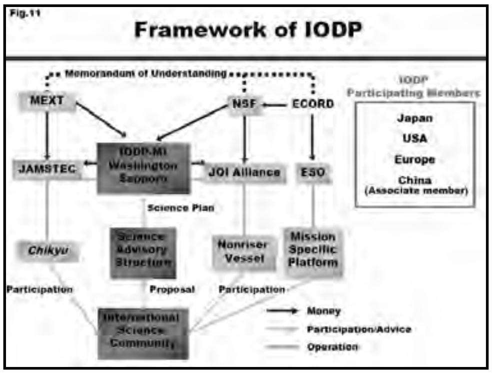


The Chikyu positions itself using the signals from the GPS satellite network as a reference with a dynamic position system of six Azimuth Thrusters which rotate 360 degrees (see Fig.5).

The Chikyu houses a state-of-art laboratory equipments(Fig.9). There will be about 30 scientists onboard working 24 hours a day, and 20 marine technicians supporting this laboratory. So this is a great area for capacity building of young scientists. The core samples obtained by the Chikyu are further measured and stored at the Shore-based research facility of Kochi Core Center. We run this facility together with Kochi University (Fig.10).

The Framework and Science Plan of IODP

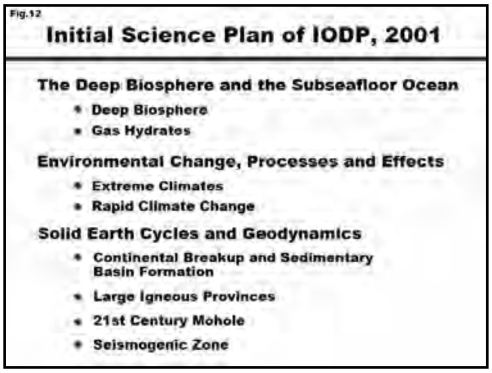
How is the IODP going to work? The Ministry of Education, Culture, Sports, Science and Technology (MEXT) provides the fund for the JAMSTEC for the Chikyu operation. National Science Foundation (NSF) provides the fund for the JOI Alliance to operate a non-riser vessel. European Consortium provides the money to the European Science Operator (ESO) for mission-specific platform operation. The successful Arctic drilling expedition was executed by the ESO. The operation of those platforms will be driven by scientific proposal received from global science community. The proposals are reviewed by the Science Advisory Structure and the best science will be selected. The planning and management will be implemented by the organization called IODP Management International. Inc.(Fig. 11).



Currently participating members are Japan, US, Europe, China and Korea. We hope more countries will join IODP in the future.

What is the science behind IODP? In 2001, a group of scientists put together a kind of document called the Initial Science Plan for IODP. The plan includes three major themes, the biosphere, environmental changes and solid earth cycles (Fig.12).

Sub-seafloor ocean represents a notion that there is a lots of fluids beneath seafloor including mantle and oceanic crust and the zone is inhabited by deep biospheres. One of prominent products of such microbial activity is gas hydrate.

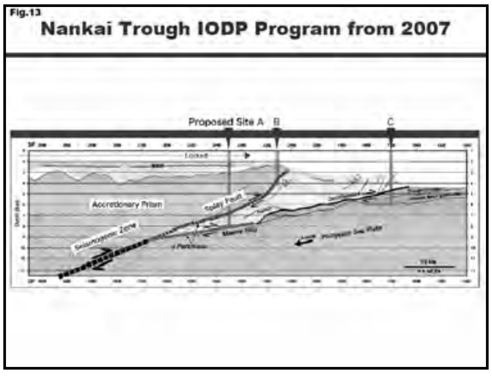


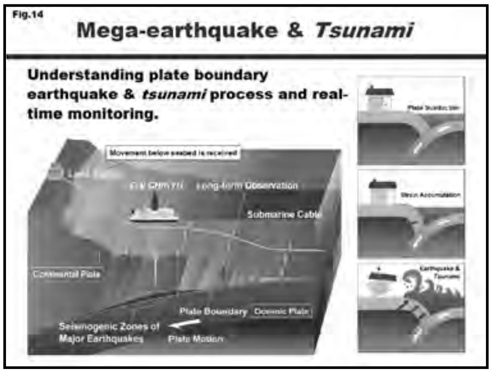
We believe the future prediction of environment on the earth would be a major theme for us. Understanding the past environmental changes, processes and effects, recovering the continuous record of the sediments and testing the climatic models are important themes for IODP.

Solid earth cycles and geodynamics represent various geological activities including mantle convection, magma generation, breakup and segmentation of continents and plate subduction zone processes.

This auditorium is situated on a plate subduction zone: underneath there is the Philippine sea plate subducting about 30 kilometer deep here and potentially can generate a mega-earthquake as has been the case in 1923 Great Kanto Earthquake.

We are very interested in to study the seismogenic zone of plate subdcution zone. In the fall of 2007, Chikyu is going to drill the Nankai Trough that is famous for well-documented history repeated subduction earthquake and tsunami occurrence. Understanding plate-boundary earthquake and tsunami-generation processes should be advanced obtaining core samples from the fault zone(Fig.13). Installation of real-time monitoring system in the borehole should provide useful warning information for mitigation of disasters(Fig.14). Deep drilling in the Nankai Trough is not easy task. The drilling targets are composed of geologically complex and structurally unstable accretionary prism.





The final message is that I am convinced that the Chikyu and IODP will open the frontier of earth science and technology not just for academic interest also for resource exploitation or hazard mitigation. The Chikyu technology will be used for the welfare of human being. It is our wish to the Chikyu and IODP will facilitate the capacity and human resource building activities in a global scale.

Reference

IODP Home Page: http://www.iodp.org/

Chikyu Home Page: http://www.jamstec.go.jp/chikyu/

Concluding remarks[1]

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I have been asked to give a few personal comments, and I insist that they are mine and represent the opinion of no official body of any sort including from France. First, I want to thank the organizers, because I feel this has been an extremely useful meeting. It has made us realize that there are urgent needs, and I think it sounds and it should sound like a wakeup call. When I was at school, I learnt a fable from Jean de La Fontaine, a French poet. It is the story of a running competition between a hare and a tortoise. And the hare is so persuaded that he is going to win that he waits and let the tortoise go first. But when the hare wakes up and decides to run, it's too late. The tortoise has already won the race.

Well, listening to the different reports in this conference I had the impression of a competition between hares and tortoises but with the difference that the hares started first, 10 years, 15 years ago. The hares are the developed countries. They started long ago working very hard on their shelf. For example, we heard that Australia and New Zealand have already worked for more than 10 to 15 years and have already accumulated a vast amount of sophisticated data. On the other hand, some of the countries with much smaller technical possibilities that I compare to tortoises have not yet started. We heard that technical and scientific help is already offered to these countries, but my personal impression is that they are in a very difficult situation. And this meeting should act as a wakeup call to the international community.

I would like to make a second point, which is also quite important. When countries begin to investigate their shelves in order to deposit their submission to the United Nations commission, it generally leads them to undertake a much more systematic inventory of their waters. And this is extremely important. So being the first to submit what they consider to be the limits of their shelves has enabled them to build up a systematic inventory of the wealth of their waters. But this inventory is a necessity for all countries and quite a few of them have not even started working on it. They do not know the wealth that is hidden in their waters. And that is an additional large problem.

[1] This was presented as Comment at the end of International Symposium on Scientific and Technical Aspects on the Establishment of the Outer Limits of the Continental Shelf beyond 200 Nautical Miles on 7th March 2006.

My third point concerns the Law of the Sea. The way this Law has been defined reflects the science of the 1970s and is not up-to-date with the present day science. Science, we heard that yesterday and especially today, advances very rapidly with very dramatic means. I am not saying that the text of the Law should be changed. I am just saying that we should keep in mind that science is bringing us every day new observations about the structure and nature of the deep seafloor and in particular the prolongations of the shelves within it, which are extremely important and that are changing our whole vision. These new observations come in particular from scientific programs like the deep drilling one that Asahiko Taira just described. We know that use of new technology leads to significant changes in our scientific vision of the world. And these changes have to be taken into account.

I conclude that this meeting should be and probably is going to be a wakeup call that tells the governments of the different countries and the people in charge at the United Nations that for some countries it is going to be very difficult to meet the deadline of the Law of the Sea. Some major initiatives should be considered to palliate this problem.

My second conclusion is that we should not forget that the Law of the Sea is important, but it concerns what we have in our waters. There is an absolute necessity of a systematic inventory of our waters. What do we have in our waters? If we want to protect the rights of our people, the rights of our country, we need to know what we have in our waters. And some countries have not yet begun this inventory in any way. The problem of the inventory will extend much beyond 2009. What do we have in our waters? What do we have in the international waters for these countries that are cut off from the sea?

My third and final conclusion concerns the importance of keeping inline with the advancement of research. We are changing our vision of the ocean floor and the margins that constitute what is called in the Law of the Sea, the shelf. It is changing very rapidly. And new technologies are being introduced that are going to change this vision even more. As a result, as discussed by Asahiko Taira, some countries have access to powerful technologies that are not open to other countries, creating a dangerous imbalance. So the idea of opening up major important technological programs more widely, as we heard from several speakers such as Larry Mayer and Asahiko Taira, is a very important problem. But this opening can only be done if the countries outside the programs have experts able to understand the data to which they are given access.

I will illustrate it with an example I will take from the recent evolution of major oil companies. These companies decided that they needed a younger staff. So they replaced older people by new young recruits. As a result, they lost a lot of their expertise. And now that they outsource the research that they used to do themselves, they may not even have the expertise necessary to fully benefit from the results of this outsourced research. A similar problem exists in many developing countries. They do not have the people able to understand the significance of the results obtained with the latest technologies. How do we face this problem? The key answer is education. UNEP in Norway gives an embryonic response but we certainly need much more.

So again, I want to congratulate the organizers and I do hope that this conference will be a real wakeup call for all those who are concerned by these problems. Thank you.