

**SUMMARY OF THE RECOMMENDATIONS OF THE COMMISSION ON
THE LIMITS OF THE CONTINENTAL SHELF IN REGARD TO THE
SUBMISSION MADE BY BRAZIL ON 17 MAY 2004 OF INFORMATION
ON THE PROPOSED OUTER LIMITS OF ITS CONTINENTAL SHELF
BEYOND 200 NAUTICAL MILES**

**Summary of the Recommendations prepared by the Subcommittee established
by the Commission on the Limits of the Continental Shelf
to consider the Submission made by Brazil**

**The Recommendations were adopted by the Subcommittee on 23 March 2007 and transmitted
to the Commission on the Limits of the Continental Shelf for consideration and adoption**

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I. INTRODUCTION

1. The Federative Republic of Brazil transmitted a Submission to the Commission on the Limits of the Continental Shelf through the Secretary-General of the United Nations on 17 May 2004. This Submission was made in accordance with the provisions contained in paragraph 8 of article 76 and article 4 of Annex II to the United Nations Convention on the Law of the Sea (hereinafter "the Convention") (United Nations, 1983).
2. The Submission was made in areas where Brazil intends to establish, in accordance with article 76, the outer limits of its continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured (hereinafter "the extended continental shelf"). The Submission contains the particulars of such limits along with supporting scientific and technical data.
3. In addition to the Submission made by Brazil, the Commission received through the Secretary-General of the United Nations a note verbale relating to the Submission issued by the Government of the United States of America.
4. The Commission makes these Recommendations to Brazil in accordance with article 76 and in fulfilment of its mandate established in paragraph 8 of article 76, and articles 3 and 5 of Annex II to the Convention.
5. The Commission prepared these Recommendations following the internal procedures and the methodology outlined in article 5 of Annex II to the Convention, and in the following documents of the Commission:
 - (i) Rules of Procedure (CLCS/40); and
 - (ii) Scientific and Technical Guidelines (CLCS/11; and Add. 1).
6. The Commission makes its Recommendations on the data and other material submitted by Brazil with clarity and certainty in view of the fact that the outer limits of the continental shelf established by a coastal State on the basis of its Recommendations shall be final and binding.
7. In accordance with article 311, paragraph 2 of the Convention, the Recommendations of the Commission do not alter the rights and obligations between Brazil and other States Parties to the Convention which arise from other agreements compatible with the Convention.
8. In accordance with article 76 paragraph 10 and article 9 of Annex II to the Convention, the recommendations and actions of the Commission are without prejudice to matters relating to delimitation of boundaries between States with opposite or adjacent coasts.
9. The Recommendations of the Commission are contained in eight Sections. Section I contains this introduction. Section II describes the contents of the Submission and the procedure followed by the Commission and the Subcommittee in its examination of the Submission. Sections III to VII present the considerations and recommendations of the Subcommittee relating to the outer limits in the Northern and Amazonas Fan Region; the Northern Brazilian

and Fernando de Noronha Ridges Region; the Vitória-Trindade Ridge Region; the São Paulo Plateau Region; and the Southern Region, respectively. Section VIII contains scientific references.

II. THE SUBMISSION OF BRAZIL AND ITS CONSIDERATION BY THE COMMISSION AND THE SUBCOMMISSION

10. The Submission was received by the Secretary-General of the United Nations on 17 May 2004. The Submission was forwarded to the fourteenth session of the Commission which was convened from 30 August to 3 September 2004. The Submission was supported by additional materials provided by Brazil.

A. Additional materials

11. Brazil submitted additional material as a result of extensive consultations which can be classified under three different types of interactions with the Subcommission.
12. First, additional material were provided as a result of questions and requests for clarification and information made by the Subcommission.
13. Second, additional material were presented by the delegation during and after meetings requested by the delegation to the Subcommission.
14. Third, additional material were provided by the delegation in response to exchanges conducted during and after the session held between the Subcommission and the delegation at an advanced stage of the consideration of the Submission in accordance with the provisions of rule 52 and Annex III of the Rules of Procedure of the CLCS.
15. At the fifteenth session of the Commission, Mr. Carrera, Chairman of the Subcommission established to examine the Submission, reported on the work carried out during the intersessional period and during the first week of the fifteenth session. He informed the Commission about additional material received, through the Secretariat, from the Government of Brazil during the intersessional period in October 2004 and February 2005, as well as about the consideration by the Subcommission of additional information transmitted in a letter dated 24 March 2005 from the head of the delegation of Brazil addressed to the Chairman of the Subcommission. Following a request by Mr. Albuquerque, a copy of that letter had been circulated to all members of the Commission. The Chairman emphasized the complexity of the Submission and indicated that the Subcommission would continue its work during the second and third week of the fifteenth session. He noted that the Subcommission was also exploring the possibility of holding additional meetings during the intersessional period.
16. Following the report of the Subcommission, the Commission decided to seek a legal opinion from the Legal Counsel on a matter of a general nature concerning the application of the rules of procedure of the Commission and the relevant provisions of the United Nations Convention on the Law of the Sea. Specifically, the Commission decided to seek a legal opinion from the Legal Counsel on the following question:

“Is it permissible, under the United Nations Convention on the Law of the Sea 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 in the course of the examination by it of the submission, additional material and information relating to the limits of its

continental shelf or substantial part thereof, which constitute a significant departure from the original limits and formulae lines that were given due publicity by the Secretary-General of the United Nations in accordance with rule 50 of the Rules of Procedure of the Commission?”

17. The legal opinion was conveyed as a “Letter dated 25 August 2005 from the Legal Counsel, Under-Secretary-General of the United Nations for Legal Affairs, addressed to the Chairman of the Commission on the Limits of the Continental Shelf” (CLCS/46). The conclusions establish, among others, that:

“Additional material and information relating to the limits of the continental shelf or substantial part thereof, provided by a coastal State to the Commission in response to its requests for additional data, information or clarification in the course of the examination by the Commission of the submission of that coastal State, is expected to support, integrate and clarify the particulars of the limits of the continental shelf contained in the submission.

“However, there is nothing in the Convention that precludes a coastal State from submitting to the Commission, in the course of the examination by it of the submission of that State, revised particulars of the limits of its continental shelf if the State concerned reaches a conclusion, while reassessing in good faith the data contained in its submission, that some of the particulars of the limits of the continental shelf in the original submission should be adjusted, or if it discovers errors or miscalculations in the submission that need to be rectified.

“Likewise, the Convention does not prevent a coastal State from submitting to the Commission, in the course of the examination by it of the submission of that State, new particulars of the limits of its continental shelf, or substantial part thereof, if in the view of the coastal State concerned, acting in good faith, this is justified by additional scientific and technical data obtained by it.

“Consequently, in the cases described above it is permissible 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, in the course of the examination by it of the submission, additional material and information relating to the limits of its continental shelf or substantial part thereof, which constitute a significant departure from the original limits and formulae lines that were given due publicity by the Secretary-General of the United Nations in accordance with rule 50 of the rules of procedure of the Commission.”

18. At the sixteenth session of the Commission, the Legal Counsel referred to a paper, entitled “Clarifications to the Legal Counsel regarding the consultations in the Commission on the Limits of the Continental Shelf contained in CLCS/44”, which had been submitted to him in June 2005 by the representatives of Brazil and which had also been transmitted to the Chairman of the Commission. He noted that that paper raised one question directly related to the legal opinion, namely whether a substantive change in some of the particulars of the outer limit of its continental shelf should be given due publicity. He invited the Commission to take into account the considerations laid out in the legal opinion in reference to the issue.

19. Having subsequently considered the legal opinion, the Commission took note of it and decided to act accordingly. The Commission also decided to forward the legal opinion to the four States that had made Submissions at that time, to post it on the website of the Commission managed by the Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, and to issue it as a document of the Commission. In addition, the Subcommittee examining the Submission of Brazil conveyed the content of the legal opinion to the Brazilian experts at a meeting held on 31 August 2005.
20. The Subcommittee and the delegation of Brazil conducted a total of 20 meetings.

III. NORTHERN AND AMAZONAS FAN REGION

21. Brazil presented in its Submission the outer limit of its continental shelf extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured in the Northern and Amazonas Fan Region. The co-ordinates of the proposed outer limits of the continental shelf are given in Table 1 of Part I of its Submission entitled “Executive Summary” dated 17 May 2004 and Table 1 of the “Addendum to the Executive Summary dated 17 May 2004” dated 1 February 2006.
22. The co-ordinates of the outer limit and materials contained in the Executive Summary were supported with the additional information contained in Parts II and III of its Submission entitled “Main Body” and “Supporting Scientific and Technical Data”, respectively.
23. The outer limit of the extended continental shelf in the Northern and Amazonas Fan Region is proposed by Brazil by means of twelve points joined by eleven contiguous segments. This outer limit is formed in the Submission by a combination of the two formulae lines subject to the application of the 350 nautical mile constraint.

A. Entitlement to the continental shelf beyond 200 nautical miles

24. The Submission of Brazil satisfies the Test of Appurtenance to extend the outer limit of its continental shelf beyond 200 nautical miles in the Northern and Amazonas Fan Region. The Amazonas fan is a submerged prolongation and a natural component of the continental margin. The formulae lines determined by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; and at a distance of 60 nautical miles from the foot of the continental slope, are located beyond the outer limit measured at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.

B. The foot of the continental slope

25. The methodology employed in the Submission to determine the base and the foot of the continental slope is described in chapter 8 of the Main Body. The Submission quotes paragraph 4 of article 76 to illustrate the methodology applied to determine the locations of the base and the foot of the continental slope as a two-stage process.
26. The approach applied in the Submission to determine the foot of the continental slope within the base is without a doubt the determination of maximum change in the gradient:

“After identifying the base of the continental slope, a mathematic criteria (described afterwards) was used to determine the points of maximum variation in the bathymetric gradient throughout the region.”
27. Two elements in the Submission that became increasingly relevant in the consideration relating to the determination of the base and the foot of the continental slope in the Amazonas Fan were the uniqueness of its depositional environment and its classification into three components: upper, middle and lower fan.

28. The search for the base and the foot of the continental slope was conducted in the Submission using more than 25 single and combined bathymetric profiles in the Northern and Amazonas Fan Region. Most of these profiles run across the continental margin from the shelf to the rise and the deep ocean floor but a few of them were very short starting at seabed depths of more than 3,500 m (e.g., 5020427 starts at a depth of 3,772 m).
29. The analysis conducted by Brazil produced seven locations of the foot of the continental slope in this region from which the outer limit of the continental shelf is determined in the Submission. These locations are found in the transition zone between the middle and lower fans at depths between 3,600 m and 4,100 m, where a very small change of gradient occurs.
30. The examination was conducted mathematically fitting smooth analytic functions to the bathymetric profiles. These profiles were also compiled in stacks with at least two different vertical exaggerations for the examination of the Subcommission. This procedure was supplemented with the construction of three-dimensional (3D) digital elevation models in order to investigate the lateral consistency of the regions selected as the base of the continental slope along all profiles.
31. This examination by the Subcommission of submitted bathymetric profiles indicated that the base of the continental slope is located where major regional change of gradient occurs at depths between approximately 2,600 m and 3,400 m (Table 1).

Table 1. Base of the continental slope at some of bathymetric profiles submitted by Brazil

Foot of the slope ID	Profile	Base of the slope depth (m)
	5030011A-syn1-5030001	-3100 to -3300
18	5020421	-3100 to -3200
19	5020419	-3100 to -3300
20	5010024	-3000 to -3200
21	5020417	-3200 to -3300
	5020415-5030004	-3200 to -3400
23	5010023A and 5010023B	-3200 to -3400
24	5020413	-3200 to -3300
25	5020411	-3100 to -3400
27	5000535	-3200 to -3400
28	5020408 and 5020409	-3300 to -3400
	5020408-5030011	-3300 to -3400
29	5020406 and 5020405	-3200 to -3400
31	5020402 and 5020403	-3200 to -3300
32	5020400 and 5020499	-3100 to -3200
	5020496-5030010	-3100 to -3300
33	5020496 and 5020497	-3100 to -3300
34	5020494 and 5020493	-3200 to -3400
35	5020490 and 5020491	-3100 to -3300
	5020490-5030008	-3100 to -3300
37	5020488 and 5020487	-3100 to -3300
41	5020484 and 5020485	-2600 to -2800
42	5020482	-2800 to -3100
44	5020480	-2900

32. These morphological findings were then corroborated by the Subcommittee by means of an analysis of seismic sections running along the same transects of some of these bathymetric profiles. These seismic sections confirmed that the base of the continental slope zone found by the Subcommittee following a morphological approach coincide with a general change in the seismic reflection characteristics around this zone. This analysis also confirmed that the base of the continental slope zone presented in the Submission coincided with a regional change in depositional pattern with the character of a continental rise.
33. These findings relating to the differences of views in relation to the location of the base of the continental slope between the Submission and its consideration by the Subcommittee were presented to the delegation of Brazil during the extensive consultations conducted during two weeks of meetings in March 2006 and the additional materials submitted in June 2006. The delegation of Brazil responded that:
- “The Brazilian submission considers the Upper and Middle Fan as analogous to a continental slope and the lower fan analogous to a continental rise, therefore placing the base of the continental slope at the Distal end of the Middle Fan, coinciding with the lobe deposition of the Channel levee systems.
- “This understanding is based on:
- the similarities between erosive and depositional processes;
- the continuous slope downwards without a regional break; and
- the continuous channel levee systems down to the boundary with the Lower Fan.”
34. In its final remarks, the delegation of Brazil expressed that:
- “the continuous slope of the Amazonas Fan can not be compared to the normal passive margin described by Heezen et al. (1959);
- “it is difficult to identify the region of the base of the continental slope and place of the FOS in continuous slope of a unique feature such as the Amazonas Fan;
- “in order to provide an analogy with a normal continental slope and rise, it considered carefully the physiography and the geological processes of erosion and deposition in the Amazonas Fan.”
35. The Subcommittee considered carefully the arguments presented by the delegation of Brazil above and it concluded that there are differences between the sedimentary processes taking place in each of the three major descriptive units of the Amazonas Fan: upper, middle and lower fans even if the exact transition from one unit on to another can not be often determined with great morphological and bathymetric accuracies.
36. Erosion and sediment deposition processes are different in the upper and the middle fan. Pirmez and Flood (1995) found that on the upper fan the levees of the Amazon channel are above the adjacent fan surface (inter-channel low), but the thalweg sits at or below the adjacent fan surface, whereas on the middle fan the thalweg is at the same level or perched above the adjacent fan surface. This indicates that in the upper fan transport of material prevails, whereas in the middle and lower fan deposition of river-born material is dominant.

Pirmez and Flood (1995) also indicate the difference of the channel levee depositional system between middle and lower fan. In the middle fan, larger levees are accumulated and the thalweg is at the same level or perched above the adjacent fan, whereas in the lower fan, only small levees build above the adjacent fan and the thalweg cuts down below the adjacent fan surface.

37. The Subcommittee found that the most significant regional change in the gradient along the fan takes place beneath the upper – middle fan transition zone at depths between 2,600 m and 3,400 m based on its analysis of the bathymetric data in agreement with the available international scientific literature. From a morphological perspective, no other region throughout the entire fan offers with greater clarity the location of the base of the slope, which merges with a conventional passive margin base of the continental slope towards its northern and southern ends.
38. The continuity of the levee systems is not an exact diagnostic tool to determine the transition between the middle and lower fan in an unequivocal manner around the Amazonas Fan. Other important factors, such as the sinuosity and general shape of the channels and the levees are important units that reflect the general gradient of the seabed around them. But ultimately, the change in the gradients of the slope and rise are the factors that become the guiding factors in their classification and the determination of their geographical extent.
39. The Subcommittee agrees with the delegation of Brazil in the sense that a rigid application of a 1:40 gradient of the slope approach, as suggested by Heezen et al. (1959) in a different context, could not be the only or even the most important guiding factor used to determine the geographical extent of the continental slope in a deep sea fan delta region. The Subcommittee did not rely on that methodology to determine its findings. This methodology was implemented in the Submission originally as quoted in paragraphs 61 and 67 of the Recommendations in the context of other geological and geophysical information and it is not one that the Subcommittee recommended in the CLCS Scientific and Technical Guidelines and it was not applied by the Subcommittee in its own consideration of the Submission.
40. The Subcommittee agrees with the view of the delegation that “it is difficult to identify the region of the base of the continental slope and place of the FOS in continuous slope of a unique feature such as the Amazonas Fan”. Fortunately, this is not an impossible problem to solve in this case. The morphological and seismic information provide a solution that can be corroborated against one another. The scientific literature contains a well documented break in the gradient and the stratigraphic record makes it possible to distinguish the continental slope and rise environments.
41. There are different views in the international scientific literature in relation to the classification of certain parts of deep sea fans according to the conventional components in which continental margins are subdivided: shelf, slope and rise. For example, while Babonneau et al. (2002) consider the upper fan as analogous to a continental slope and the middle and lower fans analogous to a rise, Curray et al. (2003) consider the upper, middle and lower fan as equivalent to a continental rise in a different geographical instance. The Subcommittee considers the Amazonas upper fan to be

analogous to a continental slope (although with a smaller gradient), and the middle and lower fans to be analogous to a continental rise based on all the morphologic data and supplemented by the geological and geophysical data contained in the Submission and the information available in the international scientific literature.

42. The methodology described in the Submission to determine the base and the foot of the continental slope throughout its entire Submission is purportedly based on morphological criteria and supplemented by geological and geophysical data. The approach apparently advocated by the delegation of Brazil in the Northern and Amazonas Fan Region during its latest consultations with the Subcommittee would appear to emphasize a geological argument based on some but not all sedimentary processes prevailing over and above the main results found based on morphology and other supplemental geological and geophysical information. This scenario suggested the investigation of this part of the Submission under the provision of evidence to the contrary to the general rule contained in article 76. But when this approach was examined with the existing information in the Submission, it became clear to the Subcommittee that the same location for the base of the continental slope along the profiles listed in Table 1 would be found.

C. The foot of the continental slope plus 60 nautical miles formula

43. The formula line based on the base of the continental slope region identified by the Subcommittee plus 60 nautical miles exceeds the breadth of the outer limit measured at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.

D. The foot of the continental slope plus 1 per cent sediment thickness formula

44. Nine points based on the sediment thickness provision of paragraph 4(a)(i) of article 76 of the Convention were originally submitted by Brazil on 17 May 2004 for the Northern and Amazonas Fan Region. Four of these sediment thickness points (STP 1, 2, 8 and 9) formed fixed points on the proposed outer limit and the remaining five sediment thickness points (STP 3 to 7) lay landward of the line defined by the foot of continental slope plus 60 nautical miles formula, and therefore did not contribute to the outer limit.
45. Brazil located one extra sediment thickness point (STP 0) on the French seismic line GUYAS 59 that lies just northwest of the Brazil/French Guyana maritime boundary, in order to determine the intersection of Brazil's outer limit line with the Brazil/French Guiana maritime boundary. The GUYAS 59 seismic data and related information were submitted to the Commission on 31 March 2005.
46. The velocity analyses used to derive the stacking and interval velocities employed in the reflection time to depth conversion of the LEPLAC seismic interpretations of top of basement were not contained within Brazil's original Submission materials. However, following questions from the Subcommittee, Brazil went to considerable lengths to supply these data where they were available. They reprocessed segments of the seismic lines over the sediment thickness points using the same processing parameters as originally

used in order to reproduce the velocity panels and original velocity functions used in the time to depth conversion.

47. During its consideration of the Submission of Brazil, the Subcommission adopted the following procedure to verify the seismic data and related information necessary for the determination of sediment thickness formula points based on paragraph 4(a)(i) of article 76 of the Convention:
 - (i) Ensured all necessary seismic information was present;
 - (ii) Examined/assessed quality, consistency and suitability of information;
 - (iii) Verified interpretation of top sediment (seafloor)/top basement (base of sediment);
 - (iv) Verified velocity information;
 - (v) Verified depth conversion approach and computations;
 - (vi) Examined error estimates;
 - (vii) Verified the computation of the sediment thickness point location using different approaches;
 - (viii) Checked the approach and information used to ensure that sediment thickness points were located within the same continuous sediment apron and that there was continuity of sediment to the foot of continental slope; and
 - (ix) Verified distances between sediment thickness points and adjacent fixed points.
48. Given that much of the seismic processing and velocity analysis was carried out over 15 years ago, not all the intermediate input/output data from the various programs used in the computations is still available and therefore an exact replication of the full depth conversion process is difficult to perform. However, in general, the Commission's analyses, verifications and checking of the velocity data and supporting information submitted indicates that plausible stacking velocities, and thus derived interval velocities were utilised by Brazil in the time to depth conversions except in the cases set out below.
49. The quality of the seismic data generally allows reliable interpretation of the top of basement and thus the base of unequivocal sediment. The Commission agrees that, in general, Brazil has submitted plausible seismic interpretations for the Northern and Amazonas Fan Region. There is a greater degree of uncertainty associated with the interpretations of the LEPLAC-XIII seismic data.
50. The LEPLAC and GUYAS 59 seismic data indicates that there is a continuous sedimentary apron along the margin in the Northern and Amazonas Fan Region, and that continuity of sediments exists between the sediment thickness points and the foot of the continental slope.
51. The Commission verified the geodetic calculations that Brazil made in determining the location of the 1 per cent sediment thickness points with respect to the foot of the continental slope points, and the distances between sediment thickness points.

52. Given that the Commission's view of the location of the base of continental slope zone in the Northern and Amazonas Fan Region is different from that adopted by Brazil, detailed issues associated with the derivation of the sediment thickness points are of a secondary nature. However, some implications for the sediment thickness points of a landward shift of the base of slope zone are outlined below:
- (i) The formula line defining the outer edge of the continental margin based on the provisions of paragraph 4 of the Convention will likely be based solely on sediment thickness points;
 - (ii) The new sediment thickness points will generally lie within about 5-15 M of their locations in the original Submission of Brazil, except to the northwest where variations up to 40 M could occur;
 - (iii) The new LEPLAC-XIII seismic lines are unlikely to produce sediment thickness points;
 - (iv) The outer limit line will move landward by less than 40 M, and will mainly be defined by sediment thickness points except in the southeast where such points may extend beyond the 350 M distance constraint. In this area, in association with LEPLAC seismic lines 5000535/5000535A and 5010022/5010022A/ 5010022B/ 5000536/5000536A, the outer limit line will largely remain unchanged;
 - (v) Some of the velocity analysis information provided by Brazil to support the depth conversion of the seismic data at the sediment thickness points will still be applicable; however, in other cases new information on the velocity analyses associated with new sediment thickness point locations will be required; and
 - (vi) No extra seismic lines will be required to produce a valid formula line composed of sediment thickness points, and thus a new outer limit line.
53. The Commission also has some concerns about aspects of the seismic information in the northern part of the Northern and Amazonas Fan Region (LEPLAC-VI lines 510026 and 5100027B) which, given its views on the location of the base of continental slope zone are again of a secondary nature. However, some of these are noted below in order to aid Brazil in any future consideration of the derivation of sediment thickness points in the region.
54. Potentially high values for some of the deeper stacking velocity picks on the northern LEPLAC-VI seismic lines (e.g., 5010027B), and aspects of the interpretation of the top of basement on line 5010026, may have broader implications for the locations of sediment thickness points in this area. In particular, the Subcommission is of the view that:
- (i) the stacking velocity picks around basement level on seismic line 5010027B on VELANS at shot points (SP) 11136 and 11038 on each side of original 1 per cent sediment thickness point 1 may be too high;
 - (ii) the interpretation of basement used for seismic line 5010026 between about SP 125 to 325 around original 1 per cent sediment thickness point 2 appears to be too deep; and

- (iii) the stacking velocity picks around basement level on seismic line 5010026 on VELAN at SP 206 may be too high around top-basement level and within basement, which has in part been interpreted as sedimentary section by Brazil.
55. The above velocity and interpretation matters may have resulted in an increase in the interval velocity and thus thickness of the sedimentary section near the seaward ends of both seismic lines and could thus influence the location of the original sediment thickness points on these lines. In addition, these discrepancies could potentially distort the outer part of the derived interval velocity fields used to support the establishment of a 1 per cent sediment thickness point on the French GUYAS 59 seismic line that influences the location of the final outer limit point on the maritime boundary between Brazil and French Guyana, and new 1 per cent sediment thickness points established on the LEPLAC-XIII seismic lines 5030003 and 5030013.
56. The Commission questions the extrapolation of interval velocity data associated with the LEPLAC-VI lines 5010024, 5010025, 5010026 and 5010027 to well beyond the limits of the survey area using Kriging or other methodologies in order to provide estimates of interval velocities on the LEPLAC-XIII seismic data. The validity of interval velocity estimates based on this unconstrained extrapolation, combined with the velocity and interpretation matters outlined above, add doubt to the location of the new sediment thickness point on LEPLAC-XIII seismic line 5030013 that defines the new outer limit fixed point FP 2.

E. The application of the formulae and the constraints

57. As a result of the remaining uncertainty in the determination of the exact locations of the foot of the continental slope in the base of the slope regions identified by the Subcommittee and the absence of geodetic and seismic information needed to define new formulae lines, it was not possible for the Commission to determine the outer envelope of the formulae lines in accordance with article 76 in the present Submission.
58. The relevant constraint in the region of the continental shelf beyond 200 nautical miles in the Northern and Amazonas Fan Region is the constraint at a distance of 350 nautical miles from which the breadth of the territorial sea is measured. The construction of this constraint throughout the Submission was found to be correct by the Commission.
59. The Subcommittee was unable to determine the outer envelope of the formulae lines subject to the 350 nautical miles constraint.

F. The outer limit of the continental shelf

60. As a result of the remaining uncertainty in the determination of the exact locations of the foot of the continental slope in the base of the continental slope regions identified by the Subcommittee and the absence of geodetic and seismic information needed to define new formulae lines, the Subcommittee was unable to consider the outer limit of the continental shelf beyond 200 nautical miles in the Northern and Amazonas Fan Region.

G. Recommendations

61. The Commission recommends to Brazil to make a revised or new Submission in respect of the outer limits of its continental shelf beyond 200 nautical miles in the Northern and Amazonas Fan Region.
62. The Commission recommends that the foot of the continental slope be determined in a new or revised Submission within the base of the continental slope in agreement with the methodologies applied and results described by the Commission in these Recommendations.
63. The Commission recommends that Brazil give consideration to the findings and implications outlined above with respect to the definition of sediment thickness points in a new or revised Submission, and to the concerns raised with respect to some velocity analysis and seismic interpretation matters in the northern part of the Northern and Amazonas Fan Region.

IV. NORTHERN BRAZILIAN AND FERNANDO DE NORONHA RIDGES REGION

64. Brazil presented in its Submission the outer limit of its continental shelf extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured in the Northern Brazilian Ridge Region. The co-ordinates of the proposed outer limits of the continental shelf are given in Table 1 of Part I of its Submission entitled "Executive Summary" dated 17 May 2004 and Table 1 of the "Addendum to the Executive Summary dated 17 May 2004" dated 1 February 2006.
65. The outer limit of the extended continental shelf in the Northern Brazilian Region is proposed in the Submission by means of fifteen points joined by fourteen contiguous segments. This outer limit is formed in the Submission by a combination of the two formulae lines subject to the application of the 350 nautical mile constraint.

A. Entitlement to the continental shelf beyond 200 nautical miles

66. According to paragraph 3 of article 76:

"The continental margin comprises the submerged prolongation of the land mass of the coastal State, and consists of the sea-bed and subsoil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof."
67. According to the international scientific literature, the genesis of the Northern Brazilian Ridge is related to tectonic and volcanic activity since the Cretaceous (Emery and Uchupi, 1984).
68. According to the international scientific literature, this ridge is not part of the continental slope (Palma et al., 1979; Palma, 1984; Chang et al., 1992; Cainelli and Mohriak, 1999).
69. The examination was conducted mathematically fitting smooth analytic functions to the bathymetric profiles. These profiles were also compiled in stacks with at least two different vertical exaggerations for the examination of the Subcommission. This procedure was supplemented with the construction of 3D digital elevation models in order to investigate the lateral consistency of the regions selected as the base of the continental slope along all profiles.
70. This examination by the Subcommission of submitted bathymetric profiles indicated that the base of the continental slope is located at a depth of approximately 3,000 m adjacent to the continental land mass and it does not encompass the Northern Brazilian Ridge. As a result, the Submission of Brazil does not satisfy the Test of Appurtenance from the Northern Brazilian Ridge to extend the outer limit of its continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.
71. These morphological findings were then corroborated by the Subcommission by means of an analysis of seismic sections running along the same transects of some of these bathymetric profiles. These seismic sections confirmed that the base of the continental slope regions found by the Subcommission following a morphological approach coincide with the seismic reflection character of the base of the continental slope. But this analysis also confirmed that the base of the continental slope region presented in the Submission is really formed by the bottom of the slopes of

volcanic seamounts distributed over the continental rise and the abyssal plain on the deep ocean floor.

72. These findings relating to the differences of views in relation to the location of the base of the continental slope in the Northern Brazilian and Fernando de Noronha Ridges region between the Submission and its consideration by the Subcommission were presented to the delegation of Brazil during the extensive consultations conducted during two weeks of meetings in March 2006. The delegation of Brazil responded that:
- (i) “The North Brazilian Ridge constitutes a marginal ridge of a transform Atlantic type continental margin.
 - (ii) “The margin compartments bounded by the Northern Brazilian Ridge segments are a natural prolongation of the Brazilian land mass through its sediments.
 - (iii) “The margin compartments constitute embryonary plateaus and their sediments, barred by the segments of the Northern Brazilian Ridge, did not have a substantial role in forming the Ceara Abyssal Plain.
 - (iv) “The Ceara Abyssal Plain sediments have their principal provenance from the Amazonas Deep Sea Fan.”
73. The delegation of Brazil supplemented their presentation with additional materials and a further presentation made on 24 August 2006. The delegation further added that:
- “The North Brazilian Ridge is composed of “sheared segments formed as W-E graben and horst structures in the continent and evolved to marginal ridges and troughs with later extensive volcanism.”
74. The Subcommission considered carefully the arguments presented by the delegation of Brazil above and it concluded that although the Northern Brazilian Ridge may be regarded as a feature resulting from the natural rifting processes affecting Atlantic type continental margins, the origin of the sediments surrounding them or their potential embryonic character as potential plateaus a few millions of years into the future is not dissimilar to many other continental rises and other seafloor highs that do not form part of the shelf and slope of the continental margin at present.
75. The Northern Brazilian Ridge lacks a continuous natural prolongation of the morphology and geology from the continental land mass of Brazil and its continental shelf and slope. Clearly, the delegation of Brazil was aware of the morphologic separation between the Ridge, and the shelf and internal slope as they expressed it in their final remarks to the Subcommission:
- “The NBR with its W-E segments starts in the southern end of the Amazonas Fan very close to the foot of the slope and goes eastwards, separating itself from the shelf and the internal slope to form the margin compartment Para-Maranhao Sector. This compartment ends eastward through the NW-SE segment of the NBR.”
76. The methodology described in the Submission to determine the base and the foot of the continental slope throughout its entire Submission is purportedly based on morphological criteria and supplemented by geological and geophysical data. The approach apparently advocated by the delegation of Brazil in the Northern

Brazilian Ridge during its later consultations with the Subcommittee would appear to emphasize a geological argument based on tectonic and sedimentary processes prevailing over and above the main results found based on morphology and other supplemental geological and geophysical information. This scenario suggested the investigation of this part of the Submission under the provision of evidence to the contrary to the general rule contained in article 76. But when this approach was examined with the existing information in the Submission, it became clear to the Subcommittee that the base of the continental slope would be determined in locations adjacent to the main land mass of Brazil and its continental shelf and slope at a depth of approximately 3,000 m.

B. The outer limit of the continental shelf

77. Even if the Northern Brazilian Ridge does not meet the legal entitlement to pass the Test of Appurtenance, it is not clear to the Commission whether Brazil might or might not be able to extend the outer limits of its continental shelf in this region from the base of the continental slope found at a depth of approximately 3,000 m identified as the proper natural prolongation from the land mass of Brazil.
78. If the Test of Appurtenance is passed from the actual foot of the continental slope, the envelope of arcs at 100 nautical miles from the 2,500 m isobath does not exceed at any location the breadth of the 350 nautical miles constraint line at any point throughout this region. Thus, the envelope of arcs defined at a distance of 350 nautical miles from the baselines from which the breadth of the territorial sea is measured is the only effective constraint throughout this region.

C. Recommendations

79. The Commission recommends to Brazil to investigate whether the Test of Appurtenance can be satisfied from the base of the continental slope locations adjacent to the continental shelf and slope of the main land mass of Brazil at a depth of approximately 3,000 m.
80. The Commission recommends to Brazil to investigate whether the sedimentary apron is continuous from the foot of the continental slope to any potential sediment thickness points located beyond the outer limit at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.
81. The Commission recommends to Brazil to investigate whether additional geophysical data and information might be required to support a Submission for the determination of the outer limits of the continental shelf beyond 200 nautical miles.

V. VITÓRIA-TRINDADE RIDGE REGION

82. Brazil presented in its Submission the outer limit of its continental shelf extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured in the Vitória-Trindade Region. The co-ordinates of the proposed outer limits of the continental shelf are given in Table 1 of Part I of its Submission entitled “Executive Summary” dated 17 May 2004 and Table 1 of the “Addendum to the Executive Summary dated 17 May 2004” dated 1 February 2006.
83. The outer limit of the extended continental shelf in the Vitória-Trindade Region is proposed in the Submission by means of 16 points joined by 14 contiguous segments. This outer limit is formed in the Submission by a combination of the two formulae lines subject to the application of the 350 nautical mile and the 2,500 m isobath plus 100 nautical miles constraints.

A. Entitlement to the continental shelf beyond 200 nautical miles

84. The Submission of Brazil satisfies the Test of Appurtenance to extend the outer limit of its continental shelf beyond 200 nautical miles in the Minerva Region. The Minerva seafloor high is a natural prolongation and an integral part of the continental margin. The formula line determined by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope is located beyond the outer limit measured at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.
85. While it is possible to find several 1 per cent sediment thickness points beyond 200 nautical miles from several locations of the foot of the continental slope around the Minerva sea floor high, the outermost foot of the continental slope point is only supported by a synthetic bathymetric profile. The Commission is not satisfied with the determination of the coordinates of the outermost foot of the continental slope due to the absence of actual bathymetric information supporting its determination.
86. Based on the data contained in the Submission of Brazil, the Commission remains uncertain about the exact nature of the Vitória-Trindade Ridge and criteria to be applied to extend the outer limit of the continental shelf beyond 200 nautical miles.
87. The Vitória-Trindade Ridge (chain) is an igneous feature regarded as a physiographic entity which runs through the continental rise (Palma et al., 1979; Palma, 1984; Chang et al., 1992; Cainelli and Mohriak, 1999). It is composed of several flat top seamounts forming a distinct east-west trend. It is an outcome of widespread volcanic magmatism. This magmatic activity occurred on (a) the South America continent during the period of 85 – 55 Ma before present; (b) offshore on rifted crust of passive margin in the period of 55 – 40 Ma ago; and (c) the oceanic crust since 40 Ma ago (Meisling et al., 2001). The Vitória-Trindade volcanic islands chain were extruded from the oceanic crust in a pattern of eastward-younging age progression since 40 Ma ago (Karner, 2000; Meisling, 2001; Dickson et al., 2003).
88. The Vitória-Trindade Ridge extends from the continent through the transition zone to oceanic crust (Chang et al., 1992). The

continent-ocean boundary in the region of the São Paulo Plateau and Vitória-Trindade delineates approximately the eastern limit of the synrift continental margin including the Abrolhos volcanic edifice built 55 – 40 Ma (Karner, 2000).

89. The international scientific literature reflects a variety of understandings about the development and current nature of this sea floor high (Cainelli and Mohriak, 1999; Chang et al, 1992; Karner, 2000).
90. Other than the Abrolhos Bank, which is a submarine elevation, the broad international scientific literature does not seem to consider the Vitória-Trindade Ridge as a submarine elevation in the same sense as plateaux, rises, caps, banks or spurs are regarded under the Convention.
91. The Commission concludes from a geological perspective that the part of the Vitória-Trindade Ridge is an igneous sea floor high that rises from continental and oceanic crust. But its most potentially relevant part in this Submission runs through the continental rise and beyond the continent/ocean crust transition zone.
92. From a morphological perspective, the Vitória-Trindade Ridge is a discontinuous igneous feature different from a submarine elevation (such as a plateau, rise, cap, bank or spur) under the Convention.
93. In accordance with the evidence provided by Brazil, the Commission considers that it is a submarine ridge under the Convention but it remains uncertain about its status and the exact position of the outer limit of the continental shelf in this region.

B. The outer limit of the continental shelf

94. The outer limit of the continental shelf beyond 200 nautical miles in this region remains to be determined in light of the information submitted by Brazil.

C. Recommendations

95. The Commission recommends to Brazil to make a revised or new Submission in respect of the outer limits of its continental shelf beyond 200 nautical miles in the Vitória-Trindade Region.
96. The Commission recommends that a new bathymetric line be measured from the continental shelf break along the continental slope in to the position and direction of the synthetic profile produced in the Submission for the Minerva sea floor high.
97. The Commission recommends that in a revised or new Submission with additional scientific data, the Vitória-Trindade Ridge be considered by Brazil as a submarine ridge under the Convention.

VI. SÃO PAULO PLATEAU REGION

98. Brazil presented in its Submission the outer limit of its continental shelf extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured in the São Paulo Plateau Region. The co-ordinates of the proposed outer limits of the continental shelf are given in Table 1 of Part I of its Submission entitled “Executive Summary” dated 17 May 2004 and Table 1 of the “Addendum to the Executive Summary dated 17 May 2004” dated 1 February 2006.
99. The outer limit of the extended continental shelf in the São Paulo Plateau Region is proposed in the Submission by means of 171 points joined by 170 contiguous segments. This outer limit is formed in the Submission by a combination of the two formulae lines (the 1 per cent sediment thickness formula – six points; the 60 nautical miles distance formula – one point) subject to the application of the 350 nautical mile constraint (164 points).

A. Entitlement to the continental shelf beyond 200 nautical miles

100. The Submission of Brazil satisfies the Test of Appurtenance to extend the outer limit of its continental shelf beyond 200 nautical miles in the São Paulo Plateau Region. The São Paulo Plateau is a submerged prolongation and a natural component of the continental margin.
101. The formulae lines determined by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; and at a distance of 60 nautical miles from the foot of the continental slope, are located beyond the outer limit measured at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured. Accordingly, the Commission recognises Brazil’s entitlement to delineate the outer limit of its continental shelf beyond 200 nautical miles in this region.
102. In the literature, the São Paulo Plateau is generally regarded as a physiographic province that lies between the upper continental slope and continental rise – that is, part of the lower slope (Palma, 1984; Mello et al., 1992; Cainelli & Mohriak, 1999).
103. The formation of the São Paulo Plateau is genetically related to the break-up of Gondwana and the formation of the South Atlantic passive margin in the Early Cretaceous (see discussion of geodynamic evolution of the South Atlantic margins in Mohriak et al., 2002), and its general configuration is the result of the interaction of tectonic, magmatic and sedimentary processes that began in the Late Jurassic/Early Cretaceous (Emery and Uchupi, 1984, Mello et al., 1992). The plateau is underlain by extended, thinned and magmatically-modified continental crust resulting from the rifting and breakup processes. It is associated with ubiquitous late-synrift evaporites that were deposited in the period leading up to Early Cretaceous breakup and seafloor spreading in this region (Davison, 1997; Karner & Driscoll, 1999; Karner, 2000).

B. The foot of the continental slope

104. In accordance with its general approach to the determination of the foot of the continental slope throughout its Submission, as referred

to in paragraph 27 of these Recommendations, Brazil used morphology supported by other geological and geophysical information to determine the zone corresponding to the base of the continental slope in the São Paulo Plateau Region. It then employed purpose-designed programs to determine the second derivative of re-sampled and filtered bathymetric data along single-beam LEPLAC bathymetric profiles to locate the point of maximum change in gradient within the base of slope zone as discussed in paragraph 26 of these Recommendations. Brazil selected this point of maximum change in gradient as the foot of the continental slope for article 76 purposes.

105. In its original Submission of 17 May 2004, Brazil defined a base of slope zone throughout the São Paulo Plateau Region using more than 40 single and combined, single-beam bathymetric profiles mainly acquired during the LEPLAC-XI, -IX/IXA surveys. These profiles, which were oriented approximately perpendicular to the bathymetric contours, were relatively short varying from about 60-220 km in length (e.g., 5000737, approximately 60 km long; 5000286, approximately 220 km long). The bathymetric profiles generally only crossed the outer part of the continental margin, and therefore did not illustrate the full extent and character of the margin.
106. In its original Submission, Brazil defined ten locations of the foot of the continental slope in the São Paulo Plateau Region from which the outer limit of the continental shelf was determined. These locations were consistently located at a major regional change in gradient at depths of approximately 3,400-3,900 m in the north to about 4,500 m in the south adjacent to the São Paulo Ridge. The base of slope zone defined by Brazil marks a significant change on the seafloor gradient map as supplied by Brazil on 14 September 2004.
107. The Subcommission supplemented its understanding of the base of the continental slope zone by creating composite regional bathymetric profiles using the LEPLAC data, and by preparing 3D TIN (triangulated irregular network) bathymetric models based on all bathymetric data included within the Submission of Brazil, and supplemented by other data in some areas. The 3D TIN model shows that the base of slope zone defined by Brazil is a prominent regional change in gradient at the outer edge of a lower slope terrace – the northern extension of the São Paulo Plateau.
108. The Commission agrees with the base of continental slope zone and the foot of slope points used by Brazil in constructing the formula line in the São Paulo Plateau Region.

C. The foot of the continental slope plus 60 nautical miles formula

109. The formula line based on the foot of the continental slope plus 60 nautical miles as submitted by Brazil generally lies inside the formula line based on the foot of the continental slope plus 1 per cent sediment thickness.

D. The foot of the continental slope plus 1 per cent sediment thickness formula

110. Fourteen points based on the sediment thickness provision of paragraph 4(a)(i) of article 76 of the Convention were originally submitted by Brazil on 17 May 2004 for the São Paulo Plateau

Region. Five of these sediment thickness points (STP 44 to 48) formed fixed points on the proposed outer limit and the remaining nine sediment thickness points (STP 49 to 57) lay beyond the maximum constraint line - the 350 nautical miles distance constraint.

111. The formula line defining the outer edge of the continental margin in this region is largely based on these sediment thickness points except in the vicinity of STP 50, which lies just inside the line defined by the foot of the continental slope plus 60 nautical miles formula.
112. These sediment thickness points were established using LEPLAC-I, -IV and -VII multi-channel seismic lines, with the five points that contribute to the original outer limit line utilising only LEPLAC-I seismic data – lines 5000035, 5000036, 5000037, 5000038, and 5000039. The five sediment thickness points on these LEPLAC-I seismic lines define outer limit fixed points FP 42 to 46, respectively, in the original Submission, but were re-numbered FP 194 to 198, respectively, following Brazil's revision of the outer limit as submitted on 31 March 2005, and publicised by Brazil in an Addendum to its Executive Summary dated 1 February 2006, and submitted on 1 March 2006.
113. In addition, during this revision an adjustment to the outer limit was made in the vicinity of STP 49 on LEPLAC-I seismic line 5000040. STP 49 and 48 originally lay at each end of the formula line segment that intersected with the 350 nautical miles constraint to form outer limit fixed point FP 47; however, this formula line segment was invalid as the distance between STP 48 and 49 was greater than 60 nautical miles in length. During the revision of the outer limit line, Brazil adjusted the location of STP 49 northwest along seismic line 5000040 to an alternative sediment thickness point location, and this new location for STP 49 now defines new fixed point FP 199 on the outer limit. STP 50 on LEPLAC-I seismic line 5000041 has been used in conjunction with the 60 nautical miles formula point that defines outer limit fixed point FP 200 to construct the intersection point of the formula line and the 350 nautical miles constraint. This intersection point defines outer limit fixed point FP 201.
114. The remainder of the formula line in the São Paulo Plateau Region associated with sediment thickness points STP 51 to 57, lies beyond the 350 nautical miles constraint. As both the 60 nautical miles and sediment thickness formula lines lie beyond the constraint throughout much of this area there was no requirement for verification of the information and computations used to define the portion of the sediment thickness formula line from STP 51 to 55. However, in the southernmost part of this region only the formula line associated with sediment thickness points STP 56 and 57 on LEPLAC-IV lines 5000045 and 5000046, respectively, lies beyond the 350 nautical miles constraint line, and thus in order to confirm the 350 nautical miles constraint as the outer limit, the seismic data and related information necessary for the determination of these sediment thickness formula points was verified.
115. The seismic data are generally of good quality and are considered acceptable in terms of defining sediment thickness points.
116. The velocity analyses used to derive the stacking and interval velocities employed in the reflection time to depth conversion of

the LEPLAC seismic interpretations of top of basement were not contained within Brazil's original Submission materials. However, following questions from the Subcommittee, Brazil went to considerable lengths to supply these data where they were accessible.

117. During its consideration of the Submission of Brazil, the Commission adopted the procedure set out in paragraph 48 of the Recommendations to verify the seismic data and related information necessary for the determination of sediment thickness formula points according to the provisions of paragraph 4(a)(i) of article 76 of the Convention.
118. The reflection time to depth conversion for the LEPLAC-I, -IV and -VII seismic lines was conducted using interval velocities derived from seismic stacking velocities using the Dix equation at each velocity analysis location, and summarised in the communications from Brazil.
119. In general, the Commission's analyses, verifications and checking of the velocity data and supporting information submitted indicates that plausible stacking velocities and thus derived interval velocities, and valid approaches were utilised by Brazil in the time to depth conversions in the São Paulo Plateau Region. Apparent minor discrepancies noted at some sediment thickness points will not affect the construction of the outer limit of the continental shelf as these points are only used to justify the involvement of the 350 nautical miles constraint, and generally lie a considerable distance beyond this limit.
120. The quality of the seismic data generally allows reliable interpretation of the top of basement, and thus the base of unequivocal sediment. The Commission agrees that, in general, Brazil has submitted plausible seismic interpretations for the São Paulo Plateau Region, particularly for those sediment thickness points that are critical to the construction of the outer limit.
121. The LEPLAC-I, -IV and -VII seismic data indicates that in general there is a continuous sedimentary apron along the margin in the São Paulo Plateau Region, and that continuity of sediments exists between the sediment thickness points and the foot of the continental slope. The only exception to this occurs on the eastern margin of the São Paulo Plateau in the vicinity of the Jean Charcot Seamounts. 3D bathymetric TIN models, potential field data and the regional seismic dip and strike lines indicate that these seamounts are largely isolated or coalescing features and do not disrupt the general continuity of the sediments from the sediment thickness points to the foot of the continental slope.
122. The Commission verified the geodetic calculations performed by Brazil to determine the location of the 1 per cent sediment thickness points with respect to the FOS points, and the distances between sediment thickness points. The Commission notes that on a number of seismic lines to the northeast and east of the São Paulo Plateau proper, in particular LEPLAC-I seismic lines 5000037, 5000038, and 5000039, the sediment thickness point was located 3-30 km landward of the outermost point. It seems that Brazil adopted a conservative approach in this area to ensure that the distance between sediment thickness points that would ultimately define the outer limit of the continental shelf was always less than or equal to 60 nautical miles.

123. In summary, the Commission agrees that the data, information and approaches used by Brazil to establish the location of sediment thickness points in the São Paulo Plateau Region are acceptable and consistent with standard industry practice. Given that the Commission agrees with the location of the base of the continental slope zone that Brazil has adopted in the São Paulo Plateau Region and with the foot of slope locations used to define the sediment thickness points, these sediment thickness points can be used to construct the line defining the outer edge of the continental margin in this region.
124. The formula line based on the foot of the continental slope plus 1 per cent sediment thickness formula as submitted by Brazil generally lies beyond the formula line based on the foot of the continental slope plus 60 nautical miles throughout São Paulo Plateau Region. There is only one area – between sediment thickness points STP 49 and 50 – where a single point based on the foot of continental slope plus 60 nautical miles formula is relevant to the construction of the combined formula line.

E. The application of the constraints

125. The constraint defined by the envelope of arcs constructed 100 nautical miles beyond the 2500 m isobath (the depth constraint) does not exceed the breadth of the envelope of arcs constructed 350 nautical miles from the baselines from which the territorial sea is measured (the distance constraint) at any location throughout the São Paulo Plateau Region.
126. The 350 nautical miles distance constraint, which defines the outer constraint line throughout the São Paulo Plateau Region, was verified and agreed.

F. The outer limit of the continental shelf

127. In the northern part of the São Paulo Plateau Region to the northeast of the Jean Charcot Seamounts, the 1 per cent sediment thickness formula line exceeds the breadth of the foot of continental slope plus 60 nautical miles formula line. As the sediment thickness formula line also lies inside the 350 nautical miles distance constraint, the sediment thickness points that define this line also form fixed points on the outer limit of the continental shelf (FP 194 to 199) as contained in Brazil's revision of the outer limit submitted on 31 March 2005, and publicised by Brazil in an Addendum to its Executive Summary dated 1 February 2006, and submitted on 1 March 2006.
128. To the southeast of the Jean Charcot Seamounts, one point on the foot of continental slope plus 60 nautical miles formula line is required to construct a continuous formula line in this area. As the point on the 60 nautical miles formula line also lies inside the 350 nautical miles distance constraint, it will also form a fixed point on the outer limit of the continental shelf (FP 200) as contained in Brazil's revision of the outer limit submitted on 31 March 2005.
129. Throughout the rest of the São Paulo Plateau Region to the south and southwest of the São Paulo Plateau proper, the formula line lies beyond the 350 nautical miles distance constraint, and points on the constraint line itself form fixed points on the outer limit of the

continental shelf (FP 201 on) as contained in Brazil's revision of the outer limit submitted on 31 March 2005.

G. Recommendations

130. The Commission recommends that Brazil establishes the outer limit of its continental shelf beyond 200 nautical miles in the São Paulo Plateau Region on the basis of the data, information and procedures contained in its Submission, and according to the co-ordinates for fixed points FP 194 to FP 341. These coordinates are contained within Brazil's revision of the outer limit submitted on 31 March 2005, and publicised by Brazil in the Addendum to its Executive Summary dated 1 February 2006, and submitted on 1 March 2006.

VII. SOUTHERN REGION

131. Brazil presented in its Submission the outer limit of its continental shelf extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured in the Southern Region. The co-ordinates of the proposed outer limits of the continental shelf are given in Table 1 of Part I of its Submission entitled “Executive Summary” dated 17 May 2004 and Table 1 of the “Addendum to the Executive Summary dated 17 May 2004” dated 1 February 2006.
132. The outer limit of the extended continental shelf in the Southern Region is proposed in the Submission by means of 12 points joined by 11 contiguous segments. This outer limit is formed in the Submission by a combination of one formula line (the 1 per cent sediment thickness formula - ten points) subject to the application of the 350 nautical mile constraint (one point), with one additional point lying on the maritime boundary between Brazil and Uruguay.
133. The outer limit of the extended continental shelf in the Southern Region as contained within the “Addendum to the Executive Summary” consists of 174 fixed points joined by 173 straight line segments. This outer limit was constructed by one formula line (the 1 per cent sediment thickness formula – three points) subject to the application of the 350 nautical mile constraint (166 points), with one additional point lying on the maritime boundary between Brazil and Uruguay.

A. Entitlement to the continental shelf beyond 200 nautical miles

134. The Submission of Brazil satisfies the Test of Appurtenance to extend the outer limit of its continental shelf beyond 200 nautical miles in the Southern Region. This Region is the submerged prolongation of the continental margin. Accordingly, the Commission recognises Brazil’s entitlement to delineate the outer limit of its continental shelf beyond 200 nautical miles in the Southern Region.
135. The Submission of Brazil in the Southern Region extends along a 1,000 km, northeast-trending segment of continental margin to the south of the São Paulo Plateau and is one of the least studied parts of the Brazilian continental margin.
136. The Southern Region is a rifted continental margin that was strongly modified by magmatism leading to break-up. It represents the northern part of the South Atlantic Volcanic province (Mohriak et al., 2002). This is a highly-sedimented continental margin and its form is largely controlled by deposition modified by bottom current processes (Mello et al., 1998).
137. The formulae lines determined by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; and at a distance of 60 nautical miles from the foot of the continental slope, are located beyond the outer limit measured at a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.

B. The foot of the continental slope

138. In accordance with its general approach to the determination of the foot of the continental slope throughout its Submission, as referred

to in paragraph 27 of these Recommendations, Brazil used bathymetry supported by other geological and geophysical information to determine the zone corresponding to the base of the continental slope in the Southern Region. It then employed purpose-designed programs to determine the second derivative of re-sampled and filtered bathymetric data along single-beam LEPLAC bathymetric profiles to locate the point of maximum change in gradient within the base of slope zone as discussed in paragraph 26 of these Recommendations. Brazil selected this point of maximum change in gradient as the foot of the continental slope for article 76 purposes.

139. In its original Submission of 17 May 2004 Brazil defined a base of slope zone throughout the Southern Region using more than 30 single and combined, single-beam bathymetric profiles mainly acquired during the LEPLAC-XI survey. These profiles, which were oriented approximately perpendicular to the bathymetric contours, varied from about 250-300 km in length and extended from the outer geomorphic continental shelf to water depths of about 3500 m. (e.g., bathymetric profiles 5000257 and 5000252/5000253 across the Florianópolis High; profile 5000302/5000227 across the Rio Grande Fan), but never across the full extent of the broad continental rise to the deep ocean floor lying at a depth of about 4-5,000 m. Thus, these profiles did not illustrate the full extent and character of the margin.
140. In its original Submission Brazil defined six locations of the foot of the continental slope in the Southern Region from which the outer limit of the continental shelf was determined. These locations were consistently located at a major regional change in gradient at depths of approximately 2,500-3,300 m. The original base of slope zone defined by Brazil marks a significant change on the seafloor gradient map as supplied by Brazil on 14 September 2004, and is the most prominent change in gradient at the base of the slope on the 3D TIN (triangulated irregular network) bathymetric models prepared by the Subcommission using all the bathymetric data included within the Submission of Brazil.
141. Following a review of all its bathymetric data and related information in the Southern Region in late 2004, Brazil conducted a new regional analysis in search of the base and the foot of the continental slope using long (620-740 km) composite bathymetric profiles produced by combining the original inboard profiles with those acquired on the seismic lines during the LEPLAC-IV seismic survey. Brazil concluded that:

“A regional analysis of the bathymetric profiles derived from the coupling of bathymetric and seismic data showed that the base of the continental slope should be displaced seaward as compared to the locations originally proposed. New points of the foot of the continental slope were determined by considering both the longer and the shorter profiles instead of the shorter bathymetric profiles only.”
142. The new base of slope zone exhibited considerable variability along the margin in association with three regions that Brazil defined as the Rio Grande Fan, the Marginal Plateau and the São Paulo Plateau Transition (embayment). The foot of the continental slopes located within the new base of slope zone generally lay at depths of 4,000 - 4,500 m at the base of a low regional gradient (approx. 0.2-0.4°).

143. Following consideration of the long composite bathymetric profiles in conjunction with the associated multi-channel reflection seismic data, the Subcommittee concluded that the base of slope zone was more appropriately placed at the location given in Brazil's original Submission. Further support for this location was provided by the seismic data that showed:
- (i) The low-gradient zone seaward of the original base of slope is generally associated with a wedged-shaped sedimentary section overlying oceanic crust. The seismic character of the sedimentary wedge and the associated seafloor is indicative of continental rise and sediment drift deposition controlled by deep bottom currents;
 - (ii) On some seismic profiles (e.g., 500047, 500052) the original base of slope zone is underlain by seaward dipping reflector sequences (SDRS) that merge seaward with oceanic crust. Such SDRS are typical of rifted volcanic margins, and the landward limit of the volcanic margin transition zone "...might be considered by the Commission as an equivalent of the foot of the continental slope.." using an "evidence to the contrary approach" to determine the foot of the continental slope (paragraph 6.3.11 of the CLCS Scientific and Technical Guidelines); and
 - (iii) The morphologic character of base of slope zone at the outer edge of the 'Marginal Plateau' (e.g. seismic line 5000047) has more to do with the effects of bottom current erosion around volcanic highs rather than marking the outer edge of a structural feature within the margin at this location.
144. These observations reflecting a difference of views between the amended Submission and its consideration by the Subcommittee in relation to the location of the base of the continental slope in the Southern Region were presented to the delegation of Brazil during the extensive consultations conducted during two weeks of meetings in March 2006. The delegation of Brazil responded to these matters specifically and in general in the document "Brazilian Meridional Margin - Statement by the Brazilian Government" mentioning that:
- (i) "The sediment transport processes of the deep ocean environment (continental rise and abyssal plains) usually associated to bottom currents, can also be found in the upper slope and even in the continental shelf of the Southern Continental Margin...";
 - (ii) "It should be noted that the SDR indicated by the Subcommittee (24 March 2006, slide 50) in the profile 5000047 can also be identified in more than one position along the same profile...";
 - (iii) "The structural basement map ... and the seismic profiles 5000059 ... show the basement high underlying and linking the Marginal Plateau to the continent. For this reason the Marginal Plateau is considered a natural prolongation of the Brazilian Southern Margin."; and
 - (iv) "Regarding the 3D digital terrain model of the Brazilian Southern Continental Margin showed in ... (slide 31 presented by the Subcommittee on 24 March 2006), the interpretation of the Brazilian delegation is that the features

of the Brazilian Margin were not adequately scaled, as only those on the upper slope were emphasized.”

145. In its final remarks on these matters Brazil stated:

“Regarding the location of the base of the continental slope and the foot of the continental slope points on the Brazilian Southern Continental Margin, the Brazilian delegation maintains the interpretation that the Brazilian Continental Shelf Outer Limit is the one presented in the Addendum to the Brazilian Submission Executive Summary dated 01 February 2006 and delivered to the CLCS on 01 March 2006.”

146. The Subcommittee considered carefully the arguments presented by the delegation of Brazil above and it concluded that while some of the individual points are worth noting, they do not support a shift of the base of the continental slope seaward of Brazil’s original location. For example:

- (i) While the effects of bottom currents can occur on both the slope and the rise, the general morphologic and seismic character of the area in question is more typical of a rise than a slope.
- (ii) The outer SDRS on line 5000047 is more typical of the short flow lengths commonly observed in SDRSs at the outer edge of the volcanic margin transition or in oceanic crust. The character of the more landward SDRS on this line is similar to that observed globally for such features near the inner, continental edge of the volcanic transition zone.
- (iii) Continental, oceanic or magmatic basement highs trending perpendicular to the margin can occur for a variety of reasons and may lie beneath the continental rise and influence the depositional character and morphology of the overlying rise sediments.
- (iv) The vertical exaggeration on the Subcommittee’s TIN model was deliberately set at twenty times to provide a less dramatic impression of the form of the margin. Tests by the Subcommittee suggest that the vertical exaggeration of the 3D views provided by Brazil are considered too large. The Subcommittee is aware that such exaggerations can significantly distort perceptions when examining 3D bathymetric images.

147. The Subcommittee also considered carefully the views presented by the delegation of Brazil with respect to the foot of continental slope location on profile 5000205/5000057 adjacent to the maritime boundary with Uruguay. The Subcommittee concluded that although a foot of continental slope based on a maximum change in gradient is difficult to locate, there is a change in regional gradient at the foot of continental slope point as contained within the original Submission of Brazil, and it supports this point.

148. The methodology described in the Submission to determine the base and the foot of the continental slope is purportedly based on morphological criteria and supplemented by geological and geophysical data. The Subcommittee remains of the view that when this approach is implemented, the base of slope zone that Brazil originally defined for the Southern Region is the most

plausible location utilising the data and information submitted by Brazil.

C. The foot of the continental slope plus 60 nautical miles formula

149. The formula line based on the original base of the continental slope zone supported by the Subcommission plus 60 nautical miles extends beyond 200 nautical miles in some places. It never exceeds the breadth of the formula line based on the foot of the continental slope plus 1 per cent sediment thickness, and thus never contributes to the determination of the outer limit of the continental shelf in the Southern Region.

D. The foot of the continental slope plus 1 per cent sediment thickness formula

150. Eleven points based on the sediment thickness provision of paragraph 4(a)(i) of article 76 of the Convention were originally submitted by Brazil on 17 May 2004 for the Southern Region. Eight of these sediment thickness points (STP 60 to 67) formed fixed points on the proposed outer limit; one (STP 68) lay just southwest of the Brazil/Uruguay maritime boundary, in order to determine the intersection of Brazil's outer limit line with the Brazil/Uruguay boundary; and the remaining two sediment thickness points (STP 58 and 59) did not appear to contribute in any way to the formula line defining the outer edge of the continental margin.
151. The formula line defined by these sediment thickness points lay substantially seaward of the line defined by the foot of continental slope plus 60 nautical miles formula, and inside the maximum constraint line of 350 M, and therefore contributed directly to the outer limit.
152. These sediment thickness points were all established using LEPLAC-IV multi-channel seismic lines 5000047, 5000048, 5000049, 5000050, 5000051, 5000052, 5000053, 5000054, 5000055, 5000056, 5000057A/57B. The eight critical sediment thickness points (STP 60 to 67) on these LEPLAC-IV seismic lines defined outer limit fixed points FP 67 to 74, respectively, in the original Submission. None of these original sediment thickness points were relevant to Brazil's amended outer limit in the Southern Region as submitted on 31 March 2005.
153. Brazil submitted a substantial amendment to the outer limit of the continental shelf on 31 March 2005, and, at the request of the Commission, this was publicised by Brazil in an Addendum to its Executive Summary dated 1 February 2006, and submitted on 1 March 2006. The most significant aspects of this amendment were the changes to the outer limit in the Southern Region as a result of re-definition by Brazil of the base of slope zone in this region, and a substantial south-eastward shift in the foot of continental slope and a consequent south-eastward shift of the new sediment thickness points.
154. The amendment defined eleven new sediment thickness points: five (STP 58 to 62) lie beyond or just on the 350 nautical miles constraint but inside the foot of the continental slope plus 60 nautical miles formula line; one (STP 63) lies inside both the 350 nautical miles constraint and the 60 nautical miles formula line; two (STP 64 and 65) lie on or beyond the 350 nautical miles constraint and beyond the 60 nautical miles formula line; and three

(STP 66 to 68) lie inside the 350 nautical miles constraint but beyond the 60 nautical miles formula line.

155. As a result of the amendment, the northern part of the formula line is defined by the foot of the continental slope plus 60 nautical miles line, and the southern part by sediment thickness formula points. Much of the formula line lies beyond the 350 nautical miles constraint and new sediment thickness points STP 64, 66 and 67 are the only ones that are now critical to the outer limit, defining new outer limit fixed points FP 505, 536 and 537. New point STP 68 lies southwest of the Brazilian/Uruguay maritime boundary and is used to define new outer limit fixed point FP 538 at the boundary through its intersection with the formula line defined by sediment thickness points STP 67 and 68.
156. The LEPLAC-IV seismic data are generally of good quality, and normally provide a clear image of the top of basement and thus the base of unequivocal sediment, and good resolution of the seismic characteristics of the sedimentary section.
157. The velocity analyses used to derive the stacking and interval velocities employed in the reflection time to depth conversion of the LEPLAC-IV seismic interpretations of the top of basement were not contained within Brazil's original Submission materials. However, following questions from and interactions with the Subcommittee, Brazil went to considerable lengths to supply these data where they were accessible. It is important to note that although these data were submitted for the original sediment thickness points, they were not provided for the new sediment thickness points that contributed to the outer limit contained within the amendment submitted on 31 March 2005.
158. During its consideration of the Submission of Brazil, the Commission adopted the procedure set out in paragraph 48 above to verify the seismic data and related information necessary for the determination of sediment thickness formula points based on paragraph 4(a)(i) of article 76 of the Convention.
159. The reflection time to depth conversion for the LEPLAC-IV seismic lines was conducted using interval velocities derived from seismic stacking velocities using the Dix equation at each velocity analysis location, and summarised in the communications from Brazil.
160. In general, the Commission's analyses, verifications and checking of the velocity data and supporting information submitted indicates that plausible stacking velocities and thus derived interval velocities, and valid approaches were utilised by Brazil in the time to depth conversions associated with the sediment thickness points originally submitted for the Southern Region. Importantly, this verification was not possible for the revised sediment thickness points associated with the amended outer limit of 31 March 2005, as no velocity analysis information was submitted over these locations.
161. Comparative studies between the velocity information from the LEPLAC-IV survey lines and other multi-channel seismic data acquired in 1990 just north of the Brazil/Uruguay maritime boundary, showed good agreement between the interval velocities of the sediments derived from the stacking velocities obtained during the processing of both seismic data sets.

162. The quality of the seismic data generally allows reliable interpretation of the top of basement and thus the base of unequivocal sediment. The Commission agrees that, in general, Brazil has submitted plausible seismic interpretations for the Southern Region, particularly for the original sediment thickness points that are directly relevant to the construction of the outer limit as initially submitted in May 2004.
163. The LEPLAC-IV seismic data indicates that in general there is a continuous sedimentary apron along the margin in the Southern Region, and that continuity of sediments exists between the sediment thickness points and the foot of the continental slope. The only minor exceptions to this occur in the northeast on seismic lines 5000047 and 5000048, where volcanic seamounts break through the seafloor. 3D bathymetric TIN models, potential field data and the regional seismic dip and strike lines indicate that these seamounts are largely isolated features and do not disrupt the general continuity of the sediments from the sediment thickness points to the foot of the continental slope.
164. The Commission agrees with the approach used by Brazil, but notes that on two seismic lines, LEPLAC-IV 5000048 and 5000057A/57B, the sediment thickness point was located approximately 45 km and 53 km, respectively, landward of the outermost point. In the case of line 5000048, it seems that the wrong sediment thickness point may have been included in the original Submission, as the outermost point coincides exactly with outer limit fixed point FP 66. However, for line 5000057A/57B the reason for not using the outermost point remains unclear. Given that there were some concerns about the stacking velocity picks and interpretation of the base of sediment at this sediment thickness point, the Subcommittee believes that the more conservative location submitted is warranted and supported.
165. A valid formula line consisting of straight line segments less than or equal to 60 nautical miles in length can be constructed from the information contained in the amendment to the Submission for the Southern Region of 31 March 2005 using either all sediment thickness points, or a combination of both sediment thickness points and foot of continental slope plus 60 nautical miles points. However, this is not the case for the original Submission, and, as outlined below, neither a valid formula nor outer limit line can be constructed using the various fixed points contained in the original Submission.
166. Given that the Commission does not support the location of the revised base of slope zone that Brazil utilised for the Southern Region in its amendment of 31 March 2005, detailed issues associated with the derivation of the sediment thickness points are of a secondary nature.
167. Some implications for the sediment thickness points of using the base of slope zone contained in the original Submission must be highlighted. The line defining the outer edge of the continental margin (the formula line) based on the provisions of paragraph 4(a) of the Convention will be based solely on the sediment thickness points originally submitted. The velocity analysis information provided by Brazil only supports the depth conversion of the seismic data at the original sediment thickness points.

168. A valid formula or outer limit line consisting of straight line segments less than or equal to 60 nautical miles in length cannot be constructed for the Southern Region using the various fixed points contained in the original Submission, for reasons outlined below:
- (i) The original outer limit fixed point FP 65, which appears to lie on LEPLAC-IV seismic line 5000059, is not based on a valid sediment thickness point;
 - (ii) The formula line segment connecting outer limit fixed point FP 65 to the previous sediment thickness point STP 57 is substantially greater than 60 nautical miles in length and is therefore invalid;
 - (iii) The outer limit fixed point FP 64 is defined by the intersection of the invalid sediment thickness line above with the 350 nautical miles constraint, and therefore it is also invalid; and
 - (iv) There is not a continuous formula or outer limit line through this area connecting original sediment thickness points STP 57 and 59, and original outer limit fixed points FP 61 and 66, respectively.
169. The analysis of the Subcommission of the submitted seismic and velocity information in this area indicates that it is possible to construct a valid sediment thickness formula line through this area using sediment thickness points located on tie-line 5000059 to link sediment thickness points on lines 5000048 to 5000046. This construction, which will validate the formula and outer limit lines of the original Submission, is incorporated into Table 2 of the Recommendations.
170. In summary, the Commission agrees that the data, information and approaches used by Brazil to establish the location of the sediment thickness points for the Southern Region in the original Submission are acceptable and consistent with standard industry practice and reliability. Given that the Commission also supports the location of the base of slope zone that Brazil originally adopted for the Southern Region, the resulting sediment thickness points can be used to construct the line defining the outer edge of the continental margin in the Southern Region.

E. The application of the constraints

171. The envelope of arcs at 100 nautical miles from the 2,500 m isobath does not extend beyond the 350 nautical miles constraint line at any point throughout the Southern Region.
172. The envelope of arcs defined at a distance of 350 nautical miles from the baselines from which the territorial sea is measured is the only effective constraint throughout this region. This constraint line was verified and agreed.

F. The outer limit of the continental shelf

173. The formula line based on the amended base of the continental slope zone utilised by Brazil in the Addendum to its Executive Summary submitted on 1 March 2006 contributes both directly to the amended outer limit through the foot of continental slope plus 1 per cent sediment thickness formula, and indirectly through both formulae provisions variously exceeding the breadth of the

350 nautical mile distance constraint in the Southern Region. However, the base of slope zone used to construct this outer limit in this region is not supported by the Commission.

174. The formula line based on the foot of continental slope plus 1 per cent sediment thickness provision as included in the original Submission of Brazil either directly, or indirectly where it exceeds the breadth of the 350 nautical mile constraint, contributes to the outer limit of the continental shelf beyond 200 nautical miles in the Southern Region. The sediment thickness points used to delineate this outer limit are derived from a base of slope zone and foot of continental slope that is supported by the Commission.
175. As mentioned in paragraph 169 of these Recommendations, a continuous, valid outer limit delineated by straight lines not exceeding 60 nautical miles cannot be constructed through the northern portion of the Southern Region using the fixed points contained within Brazils' original Submission. However, using the seismic data for lines 5000046, 5000048 and 5000059A contained within the Submission, combined with the understanding of the Subcommittee of the approaches and velocities used by Brazil, a valid outer limit line can be delineated based on the points contained in Table 2.

Table 2. Foot of continental slope plus 1 per cent sediment thickness fixed points to be used in delineating the outer limit of the continental shelf in the Southern Region.

Sediment thickness point ID	Latitude	Longitude	Seismic Line	Shotpoint	Article 76
57A (new)	-30.885100	-42.437517	5000046	8320	1 % sediment
57B (new)	-30.956814	-43.596889	5000059A	17550	1 % sediment
59 (original)	-31.78944222	-43.95444445	5000048	5320	1 % sediment
59A (original outer limit FP 66)	-32.11194	-43.62666	5000048	6260	1 % sediment
60 (original)	-32.39194167	-44.50000278	5000049	2160	1 % sediment
61 (original)	-33.36861111	-44.62971944	5000050	6690	1 % sediment
62 (original)	-33.56666389	-45.65944722	5000051	2070	1 % sediment
63 (original)	-34.16249722	-46.13305833	5000052	9230	1 % sediment
64 (original)	-34.77310000	-46.44612222	5000053	1670	1 % sediment
65 (original)	-35.33361389	-47.01249722	5000054	2220	1 % sediment
66 (original)	-35.97277778	-47.51583333	5000055	5100	1 % sediment
67 (original)	-36.50444722	-48.09610833	5000056	1900	1 % sediment
68 (original)	-36.98305556	-48.82472500	5000057B	6940	1 % sediment

G. Recommendations

176. The Commission recommends that Brazil utilizes the foot of the continental slope locations as contained in its original Submission for the Southern Region when delineating the outer limit of the continental shelf where it extends beyond 200 nautical miles.
177. The Commission recommends that Brazil delineate this outer limit line using the foot of the continental slope plus 1 per cent sediment thickness formula points set out in Table 2, as the fixed points with which to construct the various straight line segments no longer than 60 nautical miles.

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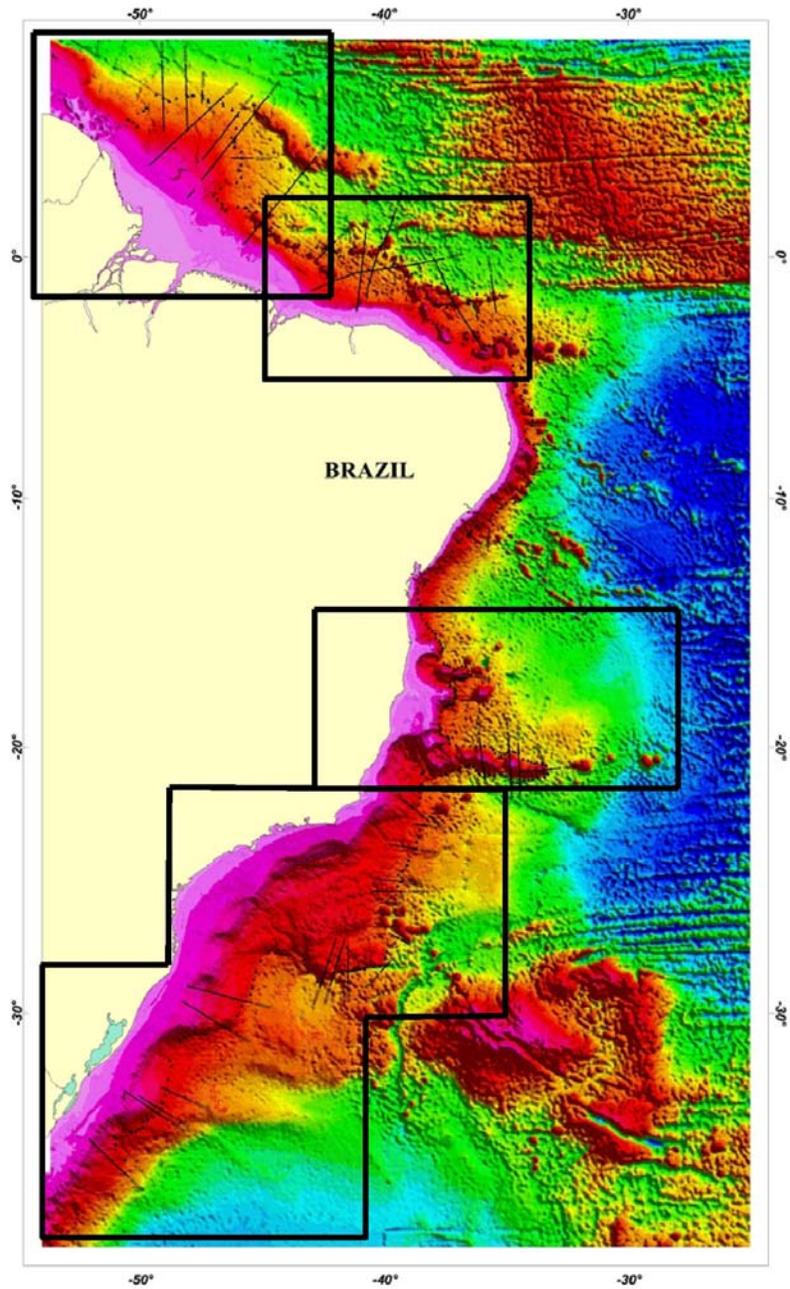


Figure 1. Four Regions considered separately by the Subcommittee from North to South: Northern and Amazonas Fan Region; Northern Brazilian and Fernando de Noronha Region; Vitória-Trindade Region; and São Paulo Plateau and Southern Region.