

The Juridical Continental Shelf In The Bay Of Bengal, According To The Statement Of Understanding

By Mr. Md. Abul Hasan Mridha, Bangladesh Foreign Service;
Ron Macnab, retired marine geophysicist and
Herman Varma, Bedford Institute of Oceanography.



Abstract

In its Final Act, the Third UN Law of the Sea Conference approved a modification of the sediment thickness rule of Article 76, enshrining it in a Statement of Understanding. This paper outlines the provisions of the Statement as they might apply in the Bay of Bengal, comparing the outcome to that derived from a strict implementation of the provisions of Article 76. It also identifies a few problem areas where legal interpretations are needed to clarify the technical criteria of the Statement and their scope of application, e.g. does the Statement apply only in the Bay of Bengal, or can it apply elsewhere?



Résumé

Dans son Acte final, la troisième Conférence des NU sur le droit de la mer a approuvé une modification de l'Article 76, concernant l'épaisseur des sédiments, garantie par un Protocole d'entente. Cet article énonce brièvement les dispositions du Protocole, telles qu'elles pourraient être appliquées dans la Baie du Bengale, en comparant le résultat avec celui obtenu à partir de la stricte mise en application des dispositions de l'Article 76. Il identifie également quelques zones qui posent problème et pour lesquelles des interprétations juridiques sont nécessaires afin de clarifier les critères techniques du Protocole et leur champ d'application, par exemple est-ce que le Protocole s'applique uniquement à la Baie du Bengale, ou bien peut-il être appliqué ailleurs ?



Resumen

En su Acta Final, la Tercera Conferencia de las NN.UU. sobre la Ley del Mar aprobó una modificación a la regla sobre el espesor de los sedimentos del Artículo 76, englobándola en una Declaración de Entendimiento. Este artículo destaca las disposiciones de la Declaración, como podrían aplicarse a la Bahía de Bengala, comparando los resultados con los obtenidos a partir de una implementación estricta de las disposiciones del Artículo 76. También identifica algunas áreas problemáticas en las que se necesitan interpretaciones legales para aclarar los criterios técnicos de la Declaración y el ámbito de su aplicación, pe. ¿acaso se aplica la Declaración sólo en la Bahía de Bengala, o puede aplicarse en otra parte?



Introduction

In the Bay of Bengal, the sediment thickness provision of Article 76 has been modified by a Statement of Understanding, which is contained in Annex II of the Final Act of the Third UN Conference on the Law of the Sea. To avoid a perceived inequity that might arise from the application of the usual one percent sediment thickness formula of Article 76, the Statement introduced a new formula: a qualified State in this region, even if it has a narrow physiographic continental shelf, may establish the outer edge of its continental margin by a line where the thickness of sedimentary rock is not less than one km.

This presentation describes the development of a joint formula line for determining the outer continental shelf limits of all States that border the Bay of Bengal, taking into account the provisions of the Statement of Understanding. For the purposes of this technical analysis, the Bay of Bengal is treated as a semi-enclosed sea that is bounded on three sides by the territory of a single coastal State. This hypothetical approach was adopted so the study could focus on the mechanisms of the procedure, leaving aside for the time being the region's political factors.

The input data sets for this analysis consist of public domain grids of bathymetry and sediment thickness, extracted from the archives of the US National Geophysical Data Center (NGDC, 2005a, 2006). These are not the most accurate depictions of water depth and sediment thickness in the region, but they are considered adequate for a generalized regional investigation such as the one presented here. Also, an assumed Territorial Sea Baseline was derived from the World Vector Shoreline (NGDC, 2005b); while there are likely to be deviations from the official baselines in the region, these are not perceived as significant, given the scale of the analysis.

The Bay of Bengal: Regional setting

The Bay of Bengal (Figure 1) is the site of massive depositions of sediment from the Ganges and Brahmaputra River systems. Draining the mountainous interior of the Indian sub-continent, these systems discharge an estimated 2300 million tons

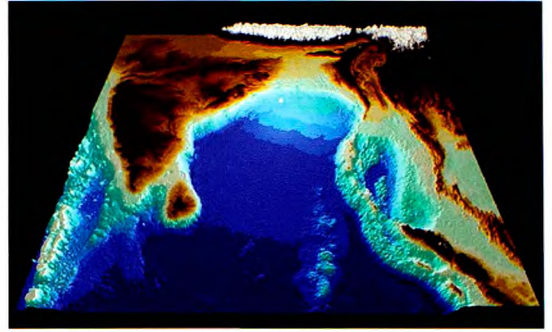


Figure 1: Primary seabed components of the Bay of Bengal.

of material into the Indian Ocean every year through a delta system (the Mouths of the Ganges) that encompasses the entire coast of Bangladesh and a segment of the coast of India. The accumulated material constitutes an enormous wedge of material which extends some 4000km southward.

The major tectonic elements of the Bay of Bengal and surrounding areas are: the passive eastern continental margin of India; the 85E Ridge; the Ninetyeast Ridge; the intervening oceanic crust buried beneath deep sediment; and the Sunda Arc system with the associated back-arc Andaman Basin (Figure 2).

Except for the Nikitin Seamounts which rise above the seabed just south of the Equator, the 85E Ridge is totally covered by thick sediment. The Ninetyeast Ridge, on the other hand, protrudes above the seabed as far north as 10N, where it plunges beneath the thickening sediment and separates the deposits into the Bengal Fan and the smaller Nicobar Fan. The two ridges comprise the most significant relief in the crystalline basement

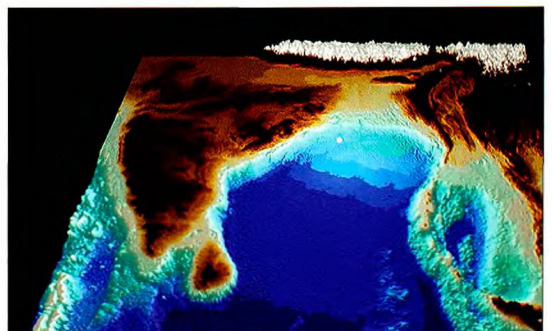


Figure 2: Primary tectonic elements of the Bay of Bengal.

underlying the Bay of Bengal, and it is to be expected that they will figure substantially in any analysis of sediment thickness pursuant to the delimitation of the outer continental shelf.

Article 76 in the Bay of Bengal

In demonstrating the effect of the Statement of Understanding, a useful approach is first to apply the standard provisions of Article 76 throughout the region, and then to compare the result against the outcome of the modified provisions. Accordingly, this section describes the development of a 'standard' outer continental shelf limit, based upon the construction of two cutoff (or constraint) lines and two formula lines, as prescribed by Article 76.

Cutoff lines

Figure 3 portrays the two cutoff lines within the study area. The 350 nautical mile cutoff was developed by constructing an envelope of circular arcs

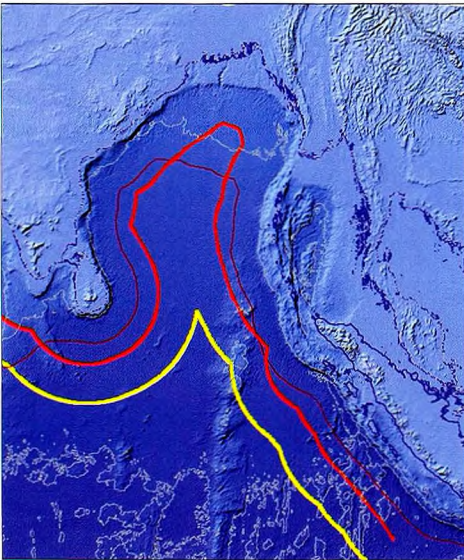


Figure 3: The two cutoff or constraint lines in the Bay of Bengal: the 2500 metre isobath projected 100 nautical miles seaward (thin red line); and the 350 nautical mile limit, measured from the assumed territorial sea baseline (heavy yellow line). The heavy red line is the 200 nautical mile limit.

centred on the assumed territorial sea baseline. The second cutoff line was developed by projecting the 2500 metre isobath 100 nautical miles to sea-

ward. It will be noted that the 350 nautical mile cutoff overrides the 2500 metre plus 100 nautical mile cutoff, because it lies everywhere seaward of the latter.

Formula lines

The Hedberg and Gardiner Lines are constructed with reference to the foot of the slope (FOS), which is defined as the point of maximum change of gradient at the base of the continental slope.

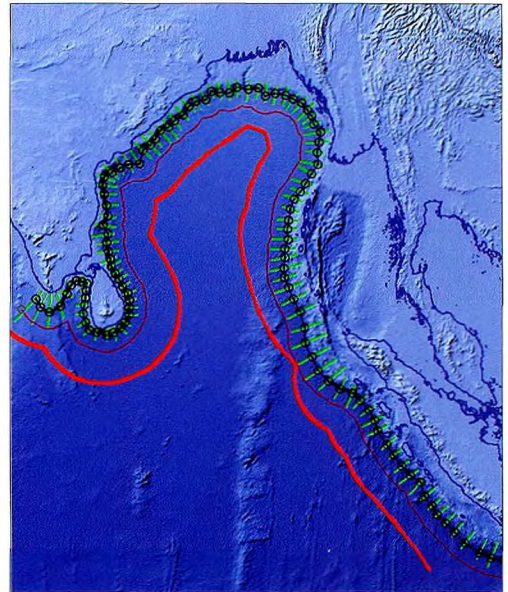


Figure 4: The Hedberg Line in the Bay of Bengal (thin red line), located 60 nautical miles seaward of the Foot of Slope (thin black line). The heavy red line is the 200 nautical mile limit.

Figure 4 portrays a line that joins a series of FOS points throughout the region. Also shown are the 200 nautical mile limit and the Hedberg Line, which was developed by projecting the FOS line 60 nautical miles seaward. It can be seen that the Hedberg Line falls entirely within the 200 nautical mile limit, thereby contributing nothing to the development of an extended continental shelf.

The Gardiner Line, on the other hand, traces points where the thickness of sedimentary material is equal to one percent of the distance back to the nearest FOS point. This was constructed by locating and joining the one percent points on a series of sediment profiles that radiated outward from FOS points on either side of the entrance to the Bay of Bengal (Figure 5). No Gardiner points were

identified inside the main body of the Bay because the sediment was everywhere too thick.

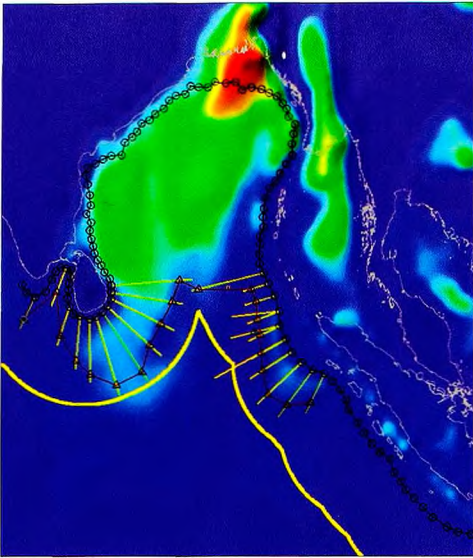


Figure 5: The Gardiner Line in the Bay of Bengal (thin red line), constructed by joining points where the thickness of sedimentary material is equal to one percent of the distance back to the Foot of the Slope (thin black line). The heavy yellow line is the 350 nautical mile limit.

An examination of Figure 5 reveals two characteristics of the Gardiner Line: (1) it features an embayment that protrudes into the southern part of the Bay, as a consequence of the relatively thin depositions of sediment over the 85E Ridge and the buried portion of the Ninetyeast Ridges; (2) it falls everywhere within the 350 nautical mile cutoff. If a comparable situation occurred in any other marginal setting, the Gardiner Line would delineate not only the outer edge of the continental margin, but also the 'standard' outer limit of the extended continental shelf.

Provisions of the Statement of Understanding

A copy of the Statement is provided in Appendix A. In essence, four criteria (illustrated in Figure 6) must be met for the Statement to apply:

- The 200 metre isobath must on average be a distance of 20 nautical miles or less from an unspecified feature;

- The bulk of the sedimentary material beneath the continental margin must underlie the rise;
- The average Gardiner thickness must not be less than 3.5km;
- A regular implementation of Article 76 must exclude more than half the continental margin.

If these criteria are met:

- The outer edge of the continental margin may be defined by the 1km sediment isopach;
- The usual cutoff lines are presumed to apply;
- A neighbouring State may apply the same method on a common geological feature.

At least five questions arise from a reading of the Statement. The first two questions concern the definition of the average distance to the 200 metre isobath: To what feature is the distance measured? How is the average distance calculated, and what level of variation is permitted between the location of the isobath and the average distance? Common sense would seem to suggest that the territorial sea baseline is the feature from which distance is to be measured, but no qualification is offered on whether the criterion must apply to the entire 200 metre isobath, or whether segments of the isobath may lie beyond 20 nautical miles.

Similarly, the third question concerns the average

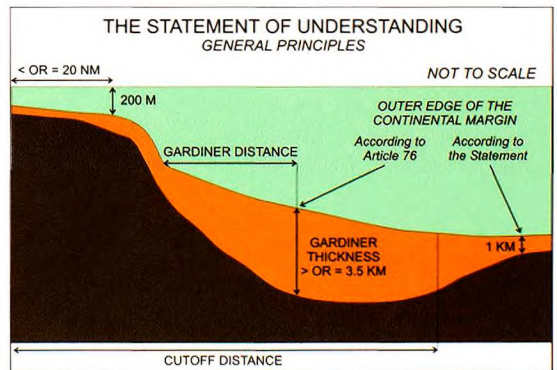


Figure 6: Criteria prescribed in the Statement of Understanding. If: (1) the 200 metre isobath is less than 20 nautical miles from the baseline; (2) the bulk of the sediment lies beneath the continental rise; (3) the average sediment thickness along the Gardiner line is not less than 3.5km; and (4) more than half the continental margin is thereby excluded, then the outer edge of the continental margin may be defined by the one kilometer sediment isopach.

thickness of sediment along the Gardiner Line. Must this criterion apply to the whole of the Gardiner Line, and if not, what are the effects of Line segments where the average sediment thicknesses are less than 3.5km?

The fourth question concerns the circumstances under which the Statement is applicable to a neighbour State which seeks to extend its continental shelf to encompass a portion of a common geological feature. Must this State meet the full set of criteria defined above, or does the eligibility of the first State imply eligibility for the neighbour State?

The fifth question concerns the potential for expanding the geographical scope of the Statement, which has a specific focus on the southern part of the Bay of Bengal. Might the provisions of the Statement prove applicable in similar marginal settings elsewhere? At least one commentator (Prescott, 2000) has suggested that the recognition of a perceived inequity arising from geological circumstances in one region could justify a similar recognition in other regions where similar circumstances prevail; examples offered are the Arabian Sea and the Gulf of Alaska.

The Statement of Understanding in the Bay of Bengal

This section describes an implementation of the Statement where it is assumed hypothetically that the Bay is bounded by the coastline of a single State.

An examination of the public domain bathymetry reveals that the 200 metre isobath is located within 20 nautical miles of the assumed territorial sea baseline in all sections of the Bay of Bengal, except in a region lying off a segment of the north coast that is known as the Mouths of the Ganges. In this area, the isobath skirts the seaward edge of a broad, shallow platform that is at least 100 miles wide in some places. As already stated, there are uncertainties as to what exactly constitutes an 'average distance,' but for the purpose of this analysis, it will be assumed that the distance criterion is satisfied by virtue of the fact that the 200 metre isobath lies within 20 nautical miles of the assumed territorial sea baseline throughout most of the Bay.

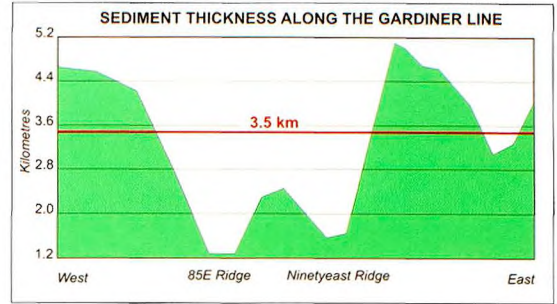


Figure 7: Profile of sediment thickness along the Gardiner Line. Average thickness is 3.3km, .2km less than the specified threshold value of 3.5km.

A cross section along the Gardiner Line (Figure 7) portrays a highly variable sediment thickness that ranges from 1.3 to 5.0km. Thick sediments lie at both ends of the profile, where they exceed 3.5km. Thinner sediments occupy the middle section of the profile, where it intersects the 85E and Ninetyeast Ridges. The average thickness along the entire Line is 3.3km, which is .2km short of the threshold value that is specified in the Statement. Recalling the uncertainty related to the third question of the preceding section, it is not immediately clear what effect this outcome has on the applica-

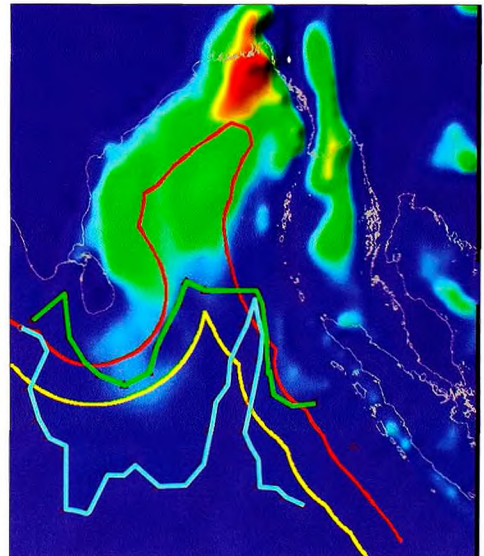


Figure 8: A comparison of the outer edges of the continental margin, as defined by the Gardiner Line of Article 76 (heavy green line), and the one kilometer isopach of the Statement of Understanding (heavy blue line). The heavy red line is the 200 nautical mile limit. The heavy yellow line is the 350 nautical mile limit.

tion of the Statement, and whether in consequence its provisions will be invalidated in whole or in part. This question will be sidestepped for the time being, and the analysis will proceed as though the average sediment thickness were everywhere equal to or greater than 3.5km.

Figure 8 portrays the location of the sediment isopach where the thickness of the sedimentary material reduces to one kilometer, as prescribed in the Statement. South of the Bay of Bengal, this isopach is situated well past the 350 nautical mile cutoff, except on the eastern side where a slender incursion traces the axis of the Ninetyeast Ridge. For comparison purposes, Figure 8 also portrays the Gardiner Line, and it can be readily noted that if all criteria were satisfied, the provisions of the Statement would indeed support the definition of a more extensive continental margin, followed by the establishment of a larger outer continental shelf.

Discussion and Conclusions

If the Bay of Bengal were bounded by the land mass of a single hypothetical State, the outcome of this investigation could provide partial grounds for defining a continental margin that virtually filled the entire Bay, with a substantial southward extension into the northeast Indian Ocean. This would be the effect of the criteria and of the modified formula line that are prescribed in the Statement of Understanding. Applying the 350 nautical mile constraint line to this extended margin would moreover establish the entire floor of the Bay of Bengal as a juridical continental shelf, except for a wedge-shaped area overlying the Ninetyeast Ridge.

This conclusion needs to be qualified by several caveats. The first is that the public-domain data sets used in the analysis are highly generalized representations of bathymetry and sediment thickness in the region. Lacking the necessary resolution and accuracy, these representations may contribute to a non-trivial skewing of results, and it is recommended that the analysis be repeated with better quality data sets when they become available.

The second caveat is that a number of legal interpretations will be needed to clarify the technical criteria of the Statement and their scopes of application, i.e. the average distance of the 200 metre

isobath, and the average thickness of sediment along the Gardiner Line. Legal opinions will also be necessary to determine (a) whether a State is bound by the same criteria if its neighbour has grounds for implementing the Statement on a common geological feature, and (b) whether the principle of the Statement can be invoked in other regions where similar conditions exist.

Lastly, it needs to be emphasized that this study is predicated on the simplifying assumption that the Bay of Bengal is bounded by the land mass of a single hypothetical State. This is clearly an artificial condition: in reality, the Bay of Bengal is fragmented by the Exclusive Economic Zones of several neighbouring States. It is beyond the scope of this paper to comment on the status of the bilateral boundaries that separate these EEZs, and on the potential for contention as these States seek to project their sovereign rights onto extended continental shelves that lie beyond those EEZs. Clearly this is a situation that calls for a political solution, which could alter or perhaps even nullify the effects of the technical provisions contained in the Statement of Understanding.

In the final analysis, the intention that underlies the Statement of Understanding could prove difficult or impossible to realize in light of the technical uncertainties, and taking into account the region's political complexities.

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of Dartmouth (Canada) offered a loan of their HHView program for constructing oblique views that facilitated interpretation.

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Biography

Mr. Md. Abul Hasan Mridha joined the Bangladesh Foreign Service in 2003; Assistant Secretary, Ministry of Foreign Affairs of Bangladesh. Member, Bangladesh Article 76 Desktop Study at Center for Coastal & Ocean Mapping, University of New Hampshire, Durham, NH, USA.

Ron Macnab is a retired marine geophysicist who maintains an active interest in matters relating to the delimitation of the outer continental shelf according to the provisions of Article 76 of UNCLOS. Included among his affiliations, are memberships in the IAG/IHO/IOC Advisory Board on the Law of the Sea (ABLOS) and in the Canadian Polar Commission.

Employed by the Canadian Hydrographic Service since 1973, **Herman Varma** is currently Head of Cartographic Research at the Bedford Institute of Oceanography. His duties include the research, development and modification of computer assisted techniques, database management, software development and cartographic communications. Herman Varma is author of numerous published papers concerning relational spatial/temporal databases, Hydrographic acquisition and processing systems.

Appendix A

Annex II of the final of the final act of the third United Nations conference on the law of the sea

Statement of Understanding concerning a specific method to be used in establishing the outer edge of the continental margin

The Third United Nations Conference on the Law of the Sea,

Considering the special characteristics of a State's continental margin where: (1) the average distance at which the 200 metre isobath occurs is not more than 20 nautical miles; (2) the greater proportion of the sedimentary rock of the continental margin lies beneath the rise; and

Taking into account the inequity that would result to that State from the application to its continental margin of article 76 of the Convention, in that, the mathematical average of the thickness of sedimentary rock along a line established at the maximum distance permissible in accordance with the provisions of paragraph 4(a)(i) and (ii) of that article as representing the entire outer edge of the continental margin would not be less than 3.5 kilometres; and that more than half of the margin would be excluded thereby;

Recognizes that such State may, notwithstanding the provisions of article 76, establish the outer edge of its continental margin by straight lines not exceeding 60 nautical miles in length connecting fixed points, defined by latitude and longitude, at each of which the thickness of sedimentary rock is not less than 1 kilometre,

Where a State establishes the outer edge of its continental margin by applying the method set forth in the preceding paragraph of this statement, this method may also be utilized by a neighbouring State for delineating the outer edge of its continental margin on a common geological feature, where its outer edge would lie on such feature

on a line established at the maximum distance permissible in accordance with article 76, paragraph 4(a)(i) and (ii), along which the mathematical average of the thickness of sedimentary rock is not less than 3.5 kilometres,

The Conference requests the Commission on the Limits of the Continental Shelf set up pursuant to Annex II of the Convention, to be governed by the terms of this Statement when making its recommendations on matters related to the establishment of the outer edge of the continental margins of these States in the southern part of the Bay of Bengal.