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Extended Continental Shelf Under UNCLOS 1982: A Comprehensive Analysis of State Submissions

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Abstract

The United Nations Convention on the Law of the Sea (UNCLOS) establishes a framework for coastal states to confirm their continental shelf beyond 200 nautical miles from baselines, often referred to as the Extended Continental Shelf (ECS). This procedure, outlined in UNCLOS Article 76, requires states to submit extensive scientific and legal documentation to the United Nations Commission on the Limits of the Continental Shelf (UN-CLCS). While the technical and legal aspects of ECS delineation have been widely studied, research focused on the process's broader effects on geospatial governance and marine spatial planning (MSP) is limited. This study aims to examine how the ECS delineation process contributes to geospatial governance and provides a spatial foundation for marine spatial planning. This research addresses this gap by analyzing the executive summaries of 34 successful ECS submissions receiving formal UN-CLCS recommendations. Using qualitative content analysis, the study examines specific criteria states have employed, including their survey methods, data sources, and how they applied UNCLOS formulas and constraints. The data include bathymetric, geophysical, geological, and sediment thickness information from national and international sources. The findings show that bathymetric surveys are used in all submissions, with many states also applying both the Gardiner and Hedberg formulas while consistently adhering to the 350-nautical-mile and 100-nautical-mile-beyond-2,500-m-isobath constraints. The study also highlights the key role of current and former UN-CLCS members in providing expert advice to ensure submissions are scientifically sound and legally valid. Beyond technical aspects, the ECS submission process improves geospatial clarity, decreases jurisdictional uncertainty, and supports sustainable ocean governance.

1. Introduction

The United Nations Convention on the Law of the Sea (UNCLOS), opened for signature in 1982, grants coastal states rights over various maritime zones measured from baselines (UNCLOS, Arts. 3–4, 33, 57, 76). Maritime zones include the territorial sea with a breadth of 12 nautical miles (M), contiguous zone (24 M), exclusive economic zone (EEZ, 200 M), and the continental shelf, which may extend beyond 200 M (UNCLOS, Art. 76). Limits or maritime zones can be measured from normal baselines, which are the low-water line on officially recognized charts (UNCLOS, Art. 5). Alternatively, other types of baselines may apply in complex coastal contexts, such as straight baselines (Art. 7), river closing lines (Art. 9), bay closing lines (Art. 10), or archipelagic baselines (Art. 47). Figure 1 illustrates these baselines and maritime zones based on UNCLOS.

While territorial seas, contiguous zones, and EEZ are defined solely based on distance, it is not the case with continental shelf. It depends on geological and geomorphological conditions of the seabed and may extend beyond 200 M. Unlike the EEZ, continental shelf rights are inherent and relate only to the seabed and subsoil (UNCLOS, Art. 77(3)). The delineation of outer limits beyond 200 M, often referred to as extended continental shelf, requires scientific evidence and assessment by the United Nations Commission on the Limits of the Continental Shelf (UN-CLCS) (Suarez, 2010). It is interesting to observe that the term "Extended Continental Shelf" (ECS), though not in UNCLOS 1982, is widely used in practice, including in UN-CLCS Scientific and Technical Guidelines (United Nations, 2022) and the TALOS Manual (International Hydrographic Organization, 2020). Defining the limits of the extended continental shelf is a crucial step towards clarifying the maritime jurisdiction of coastal states enabling the application of marine spatial planning with a view to delivering enhanced oceans planning and governance for these remote but substantial submarine spaces.

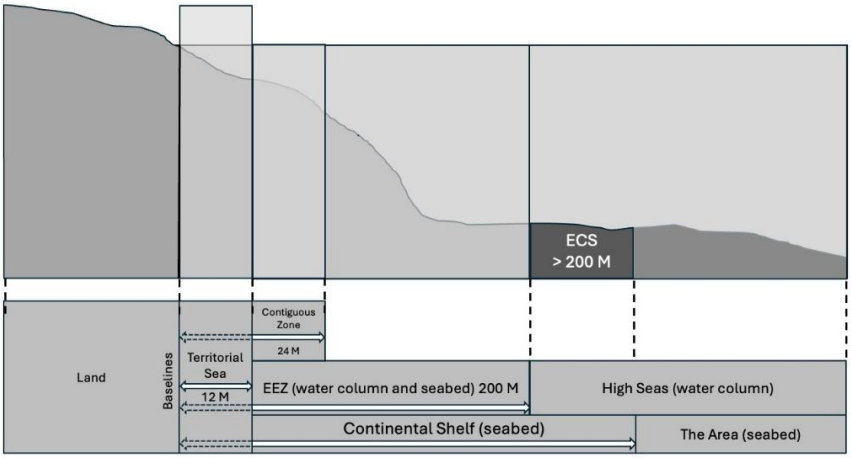


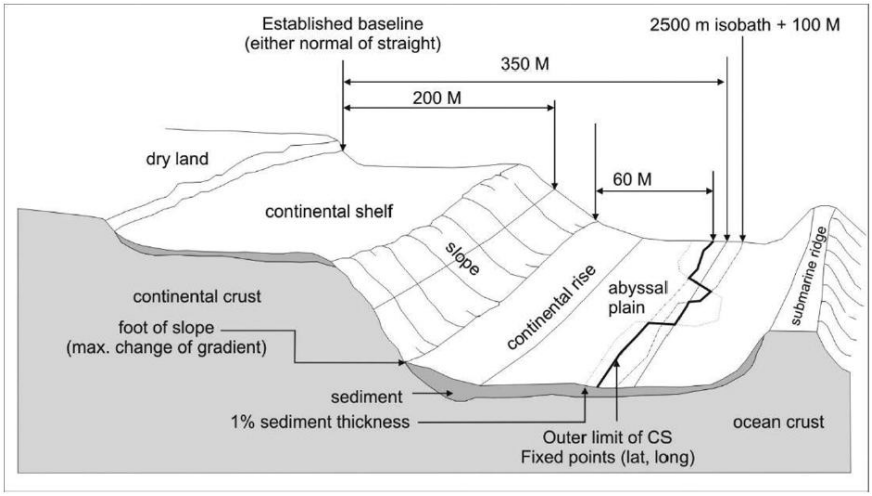
Figure 1. Maritime Zones according to UNCLOS

Article 76 defines the continental shelf as the seabed and subsoil of submarine areas extending beyond the territorial sea to the continental margin's outer edge (UNCLOS, Art. 76(1)). States have inherent rights over the continental shelf (UNCLOS, Art. 77(3)) and are automatically entitled to at least 200 M, even where the margin falls short, but may claim beyond 200 M if supported by scientific data (Matindas & Villanueva, 2017; Schofield et al., 2024; Sutisna & Lokita, 2011). Defining continental shelf limits is multidisciplinary endeavour, combining legal, geological, geomorphological, and geodetic approaches (Earle, 2019; García-Carriazo, 2022; Geddis et al., 2019; Symonds & Moore, 2000). Coastal states employ geodetic surveys, bathymetric mapping, and seismic studies to support submissions.

The ECS lies beyond 200 M from baselines. Its outer limits are determined by two formulae from Article 76, both referenced to the foot of slope (FOS): (1) Gardiner line (Irish formula): sediment thickness ≥1% of the distance from FOS (UNCLOS, Art. 76(4)(a)(i)). (2) Hedberg line: 60 M from the FOS (UNCLOS, Art. 76(4)(a)(ii)). These are constrained by two cut-offs: a maximum distance of 350 M from the baseline or 100 M from the 2,500 m isobath (UNCLOS, Art. 76(5)). For submarine ridges, the 350 M limit applies, except where natural plateaus or elevations occur (UNCLOS, Art. 76(6)) (International Hydrographic Organization, 2020; Pinto, 2020; United Nations Convention on the Law of the Sea, 1982). Formulating ECS submissions requires bathymetric and seismic surveys alongside geodetic measurements. The UN-CLCS reviews the data and issues recommendations, which are considered "final and binding" (UNCLOS, Art. 76(8)). The schematic of the Continental Shelf is shown in Figure 2.

Originally, submissions of a particular state were due within 10 years of the entry into force of UNCLOS for that State (Annex II, Art. 4). However, as the UN-CLCS was only established in 1997 and its guidelines were published only in 1999, the starting point for the 10-year submission requirement was amended to the date of the publication of the Scientific and Technical Guidelines of the UN-CLCS on 13 May 1999 (UN-CLCS, 1999).

Accordingly, the deadline for submissions became 13 May 2009 (Arsana, 2007; Schofield & Arsana, 2009). Recognizing the high cost and complexity of ECS surveys, states parties in 2008 also allowed for the submission of 'preliminary submissions' containing indicative data and timeline indicating future full submission in order to 'stop the clock' on the submission deadline (Baumert, 2017).As of December 2024, 95 full ECS submissions and 11 revisions have been made (Division for Ocean Affairs and the Law of the Sea, 2021) . Submissions may be unilateral or joint. Publicly available executive summaries and maps allow other states to respond, protest, or use the data for research. The UN-CLCS, composed of 21 scientific and technical experts, consults with submitting states before issuing recommendations. These are binding on the coastal state or states making the submission but do not prejudice future maritime boundary delimitations (UNCLOS, Art. 76(10)).



Source: Schofield et al. (2024)

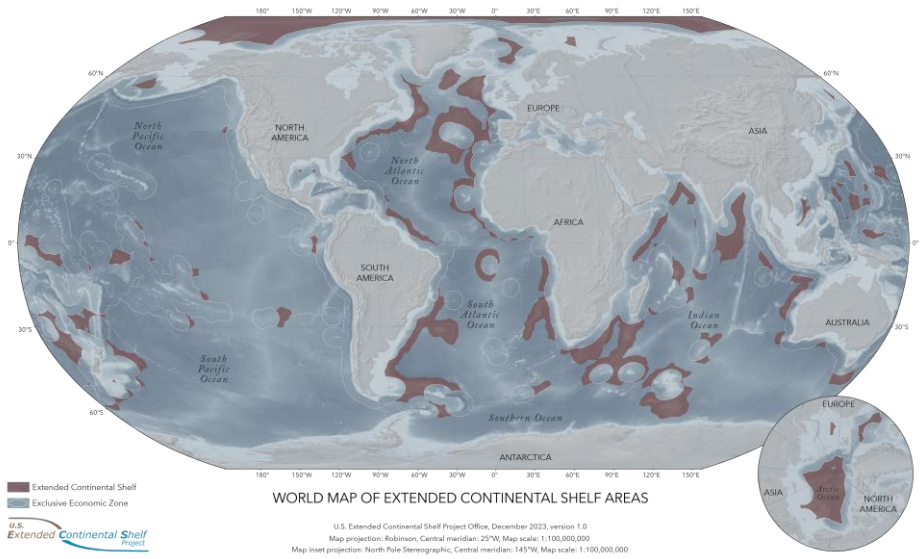
Figure 2. The Schematic of the Continental Shelf

As explained in the introduction section, a coastal state or a group of coastal states needs to submit an ECS document to the UN-CLCS. This submission is made after previously conducting research and scientific studies in determining the potential for an extended continental shelf in that state based on Article 76 of UNCLOS and the rules derived from the Scientific and Technical Guidelines provided by the UN-CLCS (UN-CLCS, 1999). A submission to the UN-CLCS is assessed and evaluated by a sub-Commission of seven UN-CLCS members, meaning that the UN-CLCS, with 21 members, can handle up to three sub-commissions simultaneously. The recommendations prepared by a sub-commission are then voted on by the full Commission (UN-CLCS, 2024, Rules 37, 42 and 51 and UNCLOS, Annex II, Art. 5). In the evaluation and assessment process, the UN-CLCS also use relies on the provisions of Article 76 of UNCLOS and other rules of the UN-CLCS. However, the UNC-CLCS recommendations from the assessment and evaluation of a state's extended continental shelf submission are sometimes inconsistent with the submission made by a state. Therefore, this article will comprehensively explain the criteria used by a coastal state or a group of coastal states in submitting an extended continental shelf document.

2. Data and Methods

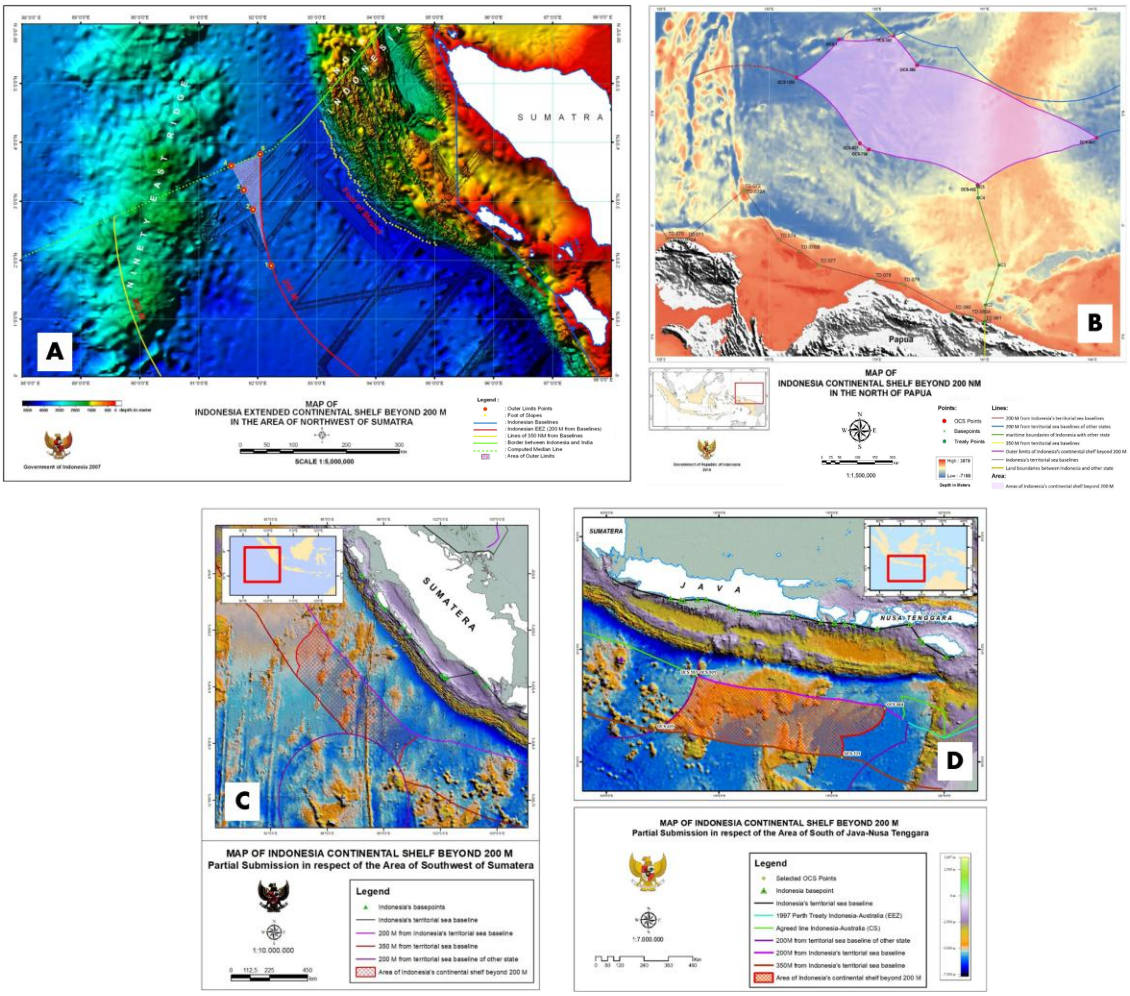
2.1. Research Scope

To provide a comprehensive overview of the global distribution of Extended Continental Shelf (ECS) submissions, Figure 3 presents a world map illustrating all submissions made to the UN-CLCS as of December 2024. The map distinguishes between individual and joint submissions, highlighting the spatial extent and geographic diversity of coastal states that have initiated the ECS process under Article 76 of UNCLOS. This visualization contextualizes the present study by showing how ECS submissions are geographically widespread, encompassing regions from the Arctic to the Southern Ocean, thereby emphasizing the global relevance and multidisciplinary character of continental shelf delineation efforts.



Source: U.S. Extended Continental Shelf Project Office (2023)

Figure 3. The World Map of Extended Continental Shelf



Source: Government of the Republic of Indonesia (2008, 2018, 2020, 2022)

Figure 4. Indonesia ECS Submission to UN-CLCS in the Northwest of Sumatra (A); in the North of Papua (B); in the Southwest of Sumatra (C); in the South of Java and Nusa Tenggara (D)

As an example of these global submissions, Indonesia has submitted four distinct areas of extended continental shelf submissions. The first area, located in the northwest of Sumatra (Fig. 4-A), applies the sediment thickness approach (Gardiner formula) combined with the median line delimitation with India. The second area, the north of Papua (Fig. 4-B), employs the maximum distance constraint of 350 M and considers the continental shelf boundaries of Palau, Federated States of Micronesia, and Papua New Guinea. The third area, located in the southwest of Sumatra (Fig. 4-C), employs the Hedberg line method, incorporating a 350 M constraint and adjoining continental shelf boundaries with Australia. The fourth area, the south of Java and Nusa Tenggara (Fig. 4-D), also applies the Hedberg line approach with the 350 M constraint, adjacent to the outer continental shelf boundary shared with Australia. These examples illustrate Indonesia's systematic application of both geological and geodetic criteria in defining its extended continental shelf, reflecting the complex geomorphological setting of an archipelagic state within the framework of UNCLOS.

This study is developed within a systematic research workflow as illustrated in Figure 5. Within this framework, a coastal state or a group of coastal states may submit information on their continental shelf beyond 200 M to the UN-CLCS. Such submissions are grounded in scientific investigations that demonstrate the potential existence of a natural prolongation of the seabed beyond the national baselines of the submitting states. The UN-CLCS subsequently evaluates and assesses these submissions with reference to Article 76 of UNCLOS. The outcome of this process is a formal recommendation issued by the UN-CLCS regarding the admissibility and extent of the proposed continental shelf extension (United Nations Commission on the Limits of the Continental Shelf, 1999).

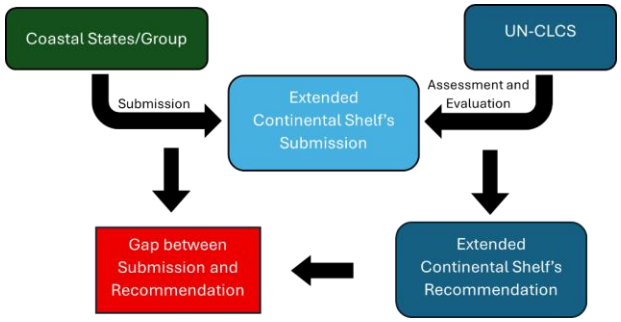


Figure 5. Conceptual Model of Continental Shelf Submissions and Recommendations

Notably, the recommendations provided by the UN-CLCS do not always correspond to the submissions advanced by the coastal states or groups of coastal states. This divergence arises despite the reliance of both parties on identical normative and technical frameworks, namely Article 76 of UNCLOS, the Scientific and Technical Guidelines of the Commission on the Limits of the Continental Shelf (United Nations Commission on the Limits of the Continental Shelf, 1999), and the Rules of Procedure of the Commission on the Limits of the Continental Shelf (United Nations, 2008). Such inconsistencies may generate uncertainty for coastal states, particularly those preparing new submissions or awaiting the assessment of previously submitted claims. Accordingly, this article undertakes a critical examination of the criteria employed by coastal states or groups of coastal states in formulating and submitting their claims for an extended continental shelf to the UN-CLCS.

2.2. Data

The primary data employed in this study are the executive summary documents of ECS submissions made available by the UN-CLCS which can be accessed via the following link https://www.un.org/depts/los/clcs_new/commission_submissions.htm. This article systematically examines each executive summary issued by the UN-CLCS to individual coastal states or groups of coastal states in response to their submissions. From a total of 95 submissions originating from both single coastal states and joint submissions by groups of states, 34 are identified as significant due to their receipt of formal recommendations from the UN-CLCS. These 34 submissions are considered to have met the established criteria and to follow the procedural and substantive requirements of the UN-CLCS. Importantly, the submissions are geographically diverse in character,

encompassing both archipelagic states and continental coastal states, thus providing a balanced representation of different maritime contexts.

This study is global in scope, encompassing a wide geographical distribution of states. For instance, Norway, the United Kingdom, and France represent submissions from the European continent; Brazil, Uruguay, and Suriname represent the Americas; while Japan, the Philippines, and Indonesia represent Asia. South Africa represents the African continent, and Australia and New Zealand represent the Oceania. In addition, the study incorporates submissions from archipelagic states, such as Indonesia, the Philippines, and Papua New Guinea. Moreover, both individual and joint submissions are considered. For example, the joint submission by Papua New Guinea, the Federated States of Micronesia, and the Solomon Islands illustrates a case of multistate collaboration evaluated in this study.

2.3. Methods

The methodological approach of this study follows a sequential process as illustrated in the flowchart (Figure 6). Each step reflects the stages of submission and evaluation of the ECS submission under the UNCLOS 1982 and the practices of the UN-CLCS. The process begins with the collection of executive summary documents prepared by coastal states or groups of states when submitting their ECS to the UN-CLCS. These summaries provide a condensed version of the full technical and scientific submission, outlining the geographical context, survey data, geological and geomorphological characteristics, and justification for the claimed outer continental shelf limits. Since full submissions are generally confidential, the executive summary represents the only publicly accessible source of official information.

Submissions are then classified based on whether or not they have received formal recommendations from the UN-CLCS. A recommendation indicates that the UN-CLCS has reviewed the evidence, conducted a technical evaluation, and concluded that the proposed outer limits of the continental shelf are consistent with Article 76 of UNCLOS. This classification helps to distinguish between pending cases and those already assessed, ensuring that the analysis focuses on submissions that have successfully passed the evaluation process.

Each executive summary document is systematically reviewed against the relevant international legal and technical instruments. These include: (1) UNCLOS, particularly Article 76 and Annex II, which establish the rights of coastal states to extend their continental shelf and the mandate of the UN-CLCS; (2)The Technical Aspects of the Law of the Sea (TALOS) Manual, which provides cartographic and geodetic guidance for maritime boundary determination; (3) The Scientific and Technical Guidelines of the UN-CLCS outline the methodologies for applying geological and geophysical criteria in continental shelf delineation; (4) The Rules of Procedure of the UN-CLCS govern submission format, timelines, and the interaction between the UN-CLCS and submitting states; (5) This review ensures that each submission is evaluated considering recognized international standards.

The analysis identifies the methodological criteria states use in their ECS submissions. These criteria include selecting formulas from Article 76—such as the Gardiner formula (1% sediment thickness) or the Hedberg formula (60 M from the foot of the slope)—and applying constraints like a maximum of 350 M from baselines or 100 M from the 2,500 m isobath. The analysis also looks at the geodetic and bathymetric methods used, the integration of geological and geophysical survey data, and the justification for the natural prolongation of the continental margin.

The findings are organized into five analytical dimensions: (1) Survey methods employed include multibeam bathymetric surveys, seismic reflection profiles, and geodetic observations; (2) Data sources utilized, ranging from shipborne surveys and satellite altimetry to previously published geological datasets; (3) Formulas for determining the ECS, including which Article 76 formula lines were applied and how they were combined. (4) Constraints applied, ensuring that the outer limits do not exceed the maximum allowances under UNCLOS; (5) Involvement of UN-CLCS members, including the role of sub-commissions in technical evaluation and the interaction between the submitting state and the UN-CLCS during the consideration process.

The analysis employs qualitative content analysis to identify patterns and insights across these submissions. The findings provide a framework for understanding successful ECS submissions, with potential applicability for future coastal state submissions.

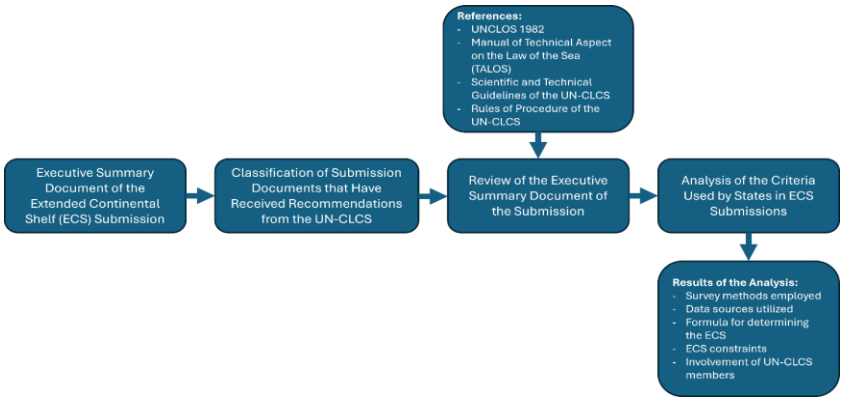


Figure 6. Study Flowchart

3. Results and Discussion

Based on the results of the analysis and examination conducted, this section presents the findings and discussion concerning extended continental shelf submissions. The discussion encompasses the survey methodologies and data sources employed, the formulas and criteria applied by coastal states or groups of states in delineating their extended continental shelf, the legal and technical constraints that define the outer limits of such submissions, and the role of UN-CLCS members in the evaluation process.

3.1. Continental Shelf Survey Methodology

The executive summary of each submission outlines the crucial role of four survey activities in determining the extension of a continental shelf. These activities, hydrographic (bathymetric) surveys, geophysical surveys, geological surveys, and sediment thickness surveys, are the cornerstone of the process, as detailed in the executive summary document and TALOS.

Of the 34 states that submitted, all states (100%) used bathymetric surveys to determine the continental shelf. The primary goal of this hydrographic/bathymetric survey is to obtain the contour of the seabed/continental shelf. The seabed contour is used to determine the Foot of Continental Slope (FOS); this contour is the fundamental reference point when applying the Gardiner or Hedberg formula to determine a state's extended continental shelf. Understanding the FOS is, therefore, a crucial step in the survey process. Furthermore, 30 coastal states use geophysical surveys, 25 apply geological surveys, and 22 conduct sediment thickness surveys, as demonstrated in Table 1. While distinct, these three types of surveys are complementary activities that collectively contribute to the analysis of the outer limits of the extended continental shelf that a state can submit.

Table 1. Continental Shelf Survey

Survey Type	Number of States	Percentage (%)
Bathymetric Surveys	34	100.00
Geophysical Surveys	30	88.24
Geological Surveys	25	73.53
Sediment Thickness Surveys	22	64.71

Source: Analysis, 2025

Since continental shelf surveys are complicated and expensive, some states use survey data from third parties or international institutions and their internal data. The results show that 14 coastal states (41.2%) use internal data surveys. However, most other coastal states use internal and international data, 20 coastal states (58.8%), as provided in Table 2. In this case, no submitting state has to date used only international data.

Table 2. Data Source Type

Data Source Type	Number of States	Percentage (%)
Internal/National Data Only	14	41.18
Both Internal/National and International Data	20	58.82
International Data Only	0	0.00

Source: Analysis, 2025

The internal data obtained by each coastal state is acquired from surveys, as presented in Table 1. However, international data used includes data from the General Bathymetric Chart of the Oceans (GEBCO), Earth Topography 2 Arc-Minute Grid (ETOPO2), and international expeditions. For instance, Brazil conducted surveys using national research ships, while the Cook Islands relied on support from international organizations such as SOPAC and Geoscience Australia (Lebrec et al., 2021).

3.2. Formulae Used to Determine the Extended Continental Shelf

Based on Article 76 (4) (i) and (ii) of UNCLOS, two provisions are explained in TALOS for determining the continental shelf extension: the Gardiner Line and the Hedberg Line. As previously mentioned, the Gardiner line relates to sediment thickness, where the outermost boundary is drawn at points where the sedimentary rock thickness is at least 1% of the shortest distance to the foot of the continental slope (FOS). The Hedberg Line relates to a fixed distance approach, which allows states to draw a limit of 60 M from the foot of the continental slope.

Table 3. Application of Formulae

Formulae	Number of States	Percentage (%)
Gardiner Line	7	20.60
Hedberg Line	9	26.50
Both the Gardiner and Hedberg Line	18	52.90

Source: Analysis, 2025

The application of the Gardiner and Hedberg lines is contingent on the availability of supporting data. As mentioned, all coastal states conduct hydrographic surveys, which are instrumental in determining the FOS. This FOS, a crucial factor for coastal states, is used to implement the Gardiner and Hedberg lines. However, implementing the Gardiner line is more complex, as it necessitates the collection of additional data from sediment thickness, which can be obtained from geophysical or geological surveys. On the other hand, the Hedberg line formula is less complex in that it 'only' requires data processing results from hydrographic surveys, namely the FOS. From the FOS, measured as far as 60 M to obtain the outermost point of the extended continental shelf. Analysis of the application of the formula for determining the ECS is presented in Table 3.

3.3. Constraints to Limit the Extended Continental Shelf

Article 76(5) of UNCLOS states that certain limitations apply to determining the Gardiner line and Hedberg line. The limitations are 350 M from the baseline or 100 M from a depth of 2,500 m isobath. Table 4 presents the analysis results of the extended continental shelf submission document. Table 4 shows that 82.35% of coastal states (28 states) apply both constraints together. A small number apply only one of the constraints. Four states (11.76%) apply the 350 M distance constraint, and two states (5.88%) apply the 100 M distance constraint from a depth of 2,500 m isobath.

Table 4. Application of Constraint

Formulae	Number of States	Percentage (%)
Only the 350 Nautical Mile Constraint	4	11.76
Only the 100 Nautical Miles from 2500 depth- Isobath	2	5.88
Both Constraints	28	82.35

Source: Analysis, 2024

3.4. Involvement of Members or Former Members of UN-CLCS.

The following analysis concerns whether there are members or former members of UN-CLCS who assist in coastal states in submitting their extended continental shelf information to UN-CLCS. Members or former members of UN-CLCS are well-positioned to provide technical, legal, and practical assistance to states by providing input to the ECS submission documentation. Table 5 presents the list of UN-CLCS members and former members who helped and assisted the coastal states in preparing the submission documents.

Table 5. Member or Former Member of UN-CLCS

Name	States or Joint Submissions Assisted
Mr. Osvaldo Pedro Astiz	Argentina
Dr. Karl Hinz	Argentina; Côte d'Ivoire; Ghana; Kenya; Mauritius & Seychelles; Nigeria; Pakistan
Mr. Philip Alexander Symonds	Australia; Cook Islands; Federated States of Micronesia, Papua New Guinea, Solomon Islands
Mr. Peter F. Croker	France, Ireland, Spain, UK (Celtic Sea & Bay of Biscay); Ireland
Mr. Harald Brekke	Iceland; Kenya; Mauritius & Seychelles; Norway; Norway (Arctic Ocean, the Barents Sea and the Norwegian Sea); Seychelles; South Africa
Prof. Kensaku Tamaki	Japan
Mr. Michael Rosette	Mauritius & Seychelles
Dr. Galo Carrera-Hurtado	Mauritius & Seychelles; Mexico; Nigeria; Philippines; Tonga; Uruguay
Dr. Andre Chan Chim Yuk	Mauritius & Seychelles
Mr. Lawrence Awosika	Nigeria
Dr. Walter Roest	Pakistan
Dr. Richard Haworth	Pakistan

Source: Analysis, 2024

The role of members or former members of the UN-CLCS in assisting states with their submissions for the extended continental shelf is primarily advisory and technical. Their involvement includes providing scientific, technical, and legal guidance to ensure that submissions comply with the requirements of Article 76 of UNCLOS and the UN-CLCS Scientific and Technical Guidelines. Specifically, the role of a member or a former member of UN-CLCS is to provide scientific and technical advice, guidance on submission preparation, capacity building, ensuring adherence to UN-CLCS guidelines, and facilitating international cooperation. The advice provided by members and former members can also be very helpful in terms of shaping and informing a submission so that it meets the requirements of UNCLOS, the UN-CLCS Scientific and Technical Guidelines, and the expectations of the UN-CLCS. Ordinarily, members of the Commission who are nationals of the coastal state making a submission or who provided scientific and technical advice in the preparation of a submission will not serve as members of the sub-commission considering that submission (UNCLOS, Annex II, Article 5).

Determining the outer limits to an area of extended continental shelf under UNCLOS Article 76 is a rigorous and multidisciplinary process, with hydrographic (bathymetric) surveys playing a central role. All 34 submissions by coastal states or joint states analysed utilized bathymetric surveys to establish the Foot of Continental Slope (FOS), a key reference point for applying the Gardiner and Hedberg formulae. The location of the FOS is of fundamental importance, as it is key to multiple formulae within the process. This study makes it clear that many states also employed geophysical, geological, and sediment thickness surveys to enhance the accuracy of submissions. Data sources for these surveys often combine internal efforts and international collaborations, with 58.8% of states using both. This use of multiple data sources highlights the importance of global cooperation in accessing resources like GEBCO and ETOPO2 data. Based on sediment thickness, the Gardiner formula is more data-intensive than the Hedberg formula, which relies solely on FOS measurements derived from hydrographic surveys. Constraints outlined in UNCLOS Article 76(5)—350 M from baseline along the coast or 100 M from the 2,500 m isobath—further regulate the extent of claims, with most states (82.35%) applying both limits.

Moreover, the involvement of members or former members of the UN-CLCS is crucial. They play a pivotal role in assisting states with scientific, technical, and legal guidance during submission preparation. Their involvement ensures compliance with international standards and fosters capacity building among coastal states. While, as noted above, members of the UN-CLCS who are nationals of or provide expert advice to a state will usually not serve on the sub-commission examining that state's submission, nonetheless as Commission members they are able to vote when the recommendations of the sub-commission are presented to the full Commission (Suarez, 2013). The entire process, which balances scientific rigor, legal frameworks, and international collaboration, is designed to delineate the outer limits of the continental shelf where it extends beyond 200 M from baselines along the coast in an equitable manner in keeping with the relevant provisions of UNCLOS with confidence.

3.5. Geospatial Clarity and Marine Spatial Planning

The submission and subsequent recommendation of the outer limits of the extended continental shelf play a pivotal role in enhancing geospatial clarity over these inherently remote from shore, submarine maritime spaces. By establishing scientifically validated and legally recognized outer limits of the continental shelf beyond 200 M EEZ limits, states are able to create a more precise spatial framework that defines rights and obligations under international law. This clarity reduces ambiguity over jurisdiction, mitigates the risk of overlapping claims, and strengthens legal certainty in ocean governance (United Nations, 2022; United Nations Convention on the Law of the Sea, 1982; United Nations Commission on the Limits of the Continental Shelf, 1999).

From a geospatial perspective, ECS establishment contributes to a clearer spatial arrangement of maritime entitlements, providing coastal states with defined zones for exercising sovereign rights over seabed resources, while also clarifying their responsibilities for environmental protection in these areas. Such precision is fundamental not only for the equitable application of UNCLOS but also for fostering trust and cooperation among neighbouring states (Magnússon, 2015).

Moreover, the establishment of clear ECS limits has direct implications for marine spatial planning (MSP). Once outer continental shelf limits are defined, states are enabled with respect to the design and application of comprehensive management strategies for ocean utilization, resource exploration, and conservation (Altvater et al., 2019; Jay et al., 2016; Roberts et al., 2025). The implications of delineating these and applying MSP to ECS areas include (1) Utilization: enabling informed decisions on offshore resource exploration, including hydrocarbons and minerals, within legally recognized maritime zones; (2) Protection: facilitating the implementation of environmental safeguards and biodiversity conservation measures in deep-sea ecosystems (Douvere, 2008); and (3) Management: supporting integrated approaches that balance economic use, ecological sustainability, and geopolitical stability (Ehler & Douvere, 2009).

Since the first ECS submission by the Russian Federation in 2001, the process of submission, examination, and recommendation has profoundly shaped global understanding of the continental shelf. Over the past twenty-four years (2001–2025), coastal states have generated an unprecedented body of scientific surveys, legal arguments, and technical documentation, which has significantly advanced the academic and practical knowledge of seabed entitlement (Baumert, 2024; Evans, 2001). However, while the literature has extensively examined the scientific and legal methodologies of ECS delineation, the geospatial governance dimension has received far less scholarly attention. Specifically, academic discourse has not adequately addressed how ECS submissions and recommendations contribute to geospatial clarity, spatial justice, and marine spatial planning in the broader context of ocean governance.

This study makes a novel contribution by bridging that gap. By systematically analyzing executive summaries of ECS submissions, it demonstrates that the process does not merely establish legal limits but also creates the geospatial foundation for sustainable ocean governance. The findings show that ECS delineation enhances the ability of states to organize and manage maritime space, providing the opportunity to integrate MSP approaches, and balance resource utilization with environmental stewardship. In this sense, the ECS submission process has evolved from being a technical-legal procedure to becoming a critical enabler of marine spatial governance, thereby expanding the academic discourse on maritime geodesy, geomatics, and international ocean law.

4. Conclusion

This study has demonstrated that the delineation of an extended continental shelf (ECS) under Article 76 of UNCLOS is a rigorous, multidisciplinary process requiring the integration of hydrographic, geophysical, geological, and sediment thickness surveys. All 34 analyzed submissions relied on bathymetric surveys to identify the Foot of the Continental Slope (FOS), a critical reference point for applying the Gardiner and Hedberg formulae. The findings further confirm that while the Hedberg line offers a relatively straightforward approach, the Gardiner line demands more complex sediment thickness data. The application of legal constraints, either 350 nautical miles from baselines or 100 nautical miles from the 2,500-meter isobath, ensures consistency across submissions. Moreover, the involvement of UN-CLCS members and former members has been instrumental in providing scientific and technical guidance to states, helping to shape submissions that are both scientifically robust and legally defensible.

Beyond these technical aspects, this study highlights the broader significance of ECS submissions in contributing to geospatial clarity in maritime spaces. The recognition of ECS boundaries reduces ambiguity, provides legal certainty for resource entitlements, and strengthens the allocation of rights and obligations under international law. More importantly, this clarity enhances the foundation for MSP by supporting more effective strategies for ocean utilization, environmental protection, and sustainable management. In this way, ECS submissions serve not only as a mechanism for extending sovereign rights but also as a crucial step in advancing spatial justice and integrated ocean governance.

Finally, the analysis underscores the evolving academic and policy relevance of ECS submissions since the first case in 2001. Over the past twenty-four years, the submission and evaluation process has generated a substantial body of scientific data, technical reports, and legal arguments that have advanced global understanding of the continental shelf. However, while academic literature has predominantly focused on the scientific and legal dimensions of ECS, this study contributes a new perspective by situating ECS submissions within the discourse of geospatial governance and marine spatial planning. By doing so, it expands the body of knowledge in geodesy, geomatics, and maritime law, positioning ECS delineation not only as a technical-legal exercise but also as a foundation for sustainable and equitable ocean governance.

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