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Securing the Resources of the Deep: Dividing and Governing the Extended Continental Shelf

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Securing the Resources of the Deep: Dividing and Governing the Extended Continental Shelf

Clive Schofield*

Abstract

Half of the world's coastal states are in the process of delineating continental shelf limits seawards of their 200 nautical mile exclusive economic zones. The paper briefly outlines this process and progress towards the finalisation of such limits. Key potential resource opportunities that may arise within the "extended continental shelf" areas are then highlighted and challenges in securing rights over these resources explored.

1. Introduction

Early 2009 saw a flurry of submissions of information on proposed outer continental shelf limits to the relevant specialist body, the United Nations (UN) Commission on the Limits of the Continental Shelf (CLCS). The potential extended continental shelf areas subject to these submissions encompass an enormous area: in excess of 29 million square kilometres of continental shelf, located seawards of the 200 nautical mile (nm) limit from coastal baselines. This vast "extension" of the maritime jurisdictions of many coastal States raises significant potential resource opportunities. Such extended continental shelf areas are arguably more likely to be subject to exploration and development efforts than seabed areas beyond national jurisdiction.

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However, significant threats and challenges also arise in this context. In particular, it is notable that many of the submissions made to the CLCS relate to the same areas of extended continental shelf. These overlapping submissions serve to highlight the existence of multiple potential extended continental shelf boundaries that have yet to be delimited, as well as the prospect of numerous extended continental shelf disputes developing, especially as efforts to access the resources of these areas proceed.

The paper briefly outlines the process by which coastal States delineate outer continental shelf limits before providing an overview and assessment of extended continental shelf submissions. The paper goes on to highlight key potential resource opportunities that may arise in areas of extended continental shelf. A number of the salient challenges that are emerging in respect to both securing and governing continental shelf areas under national jurisdiction beyond 200 nautical miles from the coast are then examined.

2. Defining the Outer Limits of the Continental Shelf

A particular virtue of the United Nations Convention on the Law of the Sea (LOSC)[1] is the spatial framework which it establishes for claims to maritime jurisdiction. Both the Convention and thus the maritime jurisdictional framework that it establishes are now generally accepted[2], and the vast majority of maritime claims are in keeping with its terms. This is particularly the case where clear distance-based limits to maritime claims were defined from relevant baselines, namely 12 nautical miles (nm)[3] as the maximum breadth of for the territorial sea,[4] 24nm for the contiguous zone[5] and 200nm for the exclusive economic zone (EEZ) (see Figure 1).[6]

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1 United Nations, *United Nations Convention on the Law of the Sea*, Publication no.E97.V10, (United Nations, New York, 1983). See 1833 UNTS 3, opened for signature 10 December 1982, Montego Bay, Jamaica (entered into force 16 November 1994) (hereinafter "LOSC" or "the Convention").

2 At the time of writing 163 States plus the European Union were parties to the Convention. See, United Nations, *Status of the United Nations Convention on the Law of the Sea, of the Agreement relating to the implementation of Part XI of the Convention and of the Agreement for the implementation of the Convention relating to the conservation and management of straddling fish stocks and highly migratory fish stocks* (New York: United Nations, updated to 6 November 2012), available at <http://www.un.org/Depts/los/reference_files/status2010.pdf>.

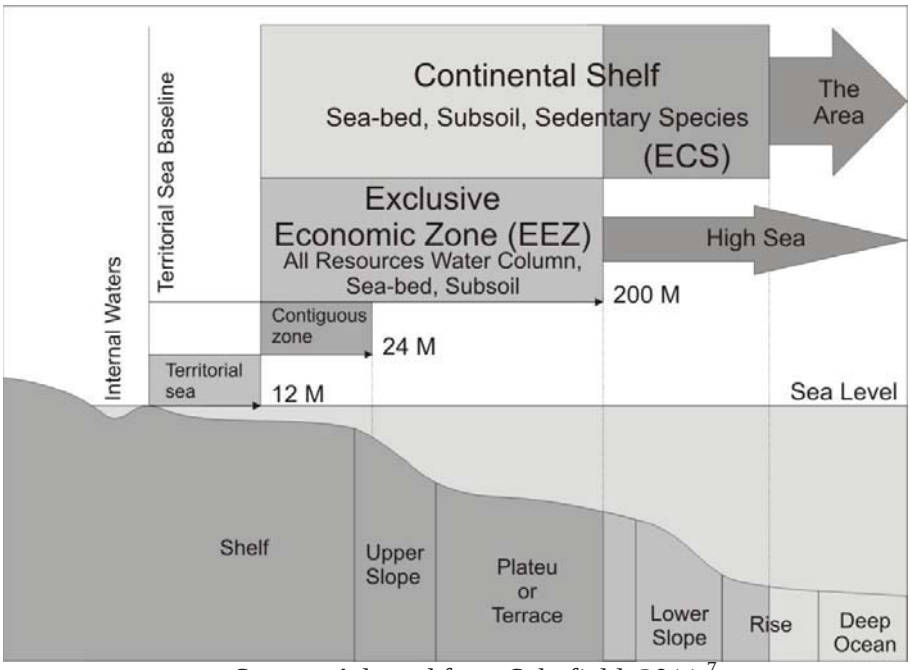
3 It is acknowledged that technically the correct abbreviation for a nautical mile is "M" and that "nm" properly refers to nanometres. However, "nm" is widely used by many authorities (for example the UN Office of Ocean Affairs and the Law of the Sea) and appears to cause less confusion than "M," which is often assumed to be an abbreviation for metres. Consequently "nm" will be used to denote nautical miles herein.

4 LOSC, Articles 3 and 4.

5 LOSC, Article 33.

6 LOSC, Article 57 states that: "The exclusive economic zone shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured."

Figure 1: Zones of Maritime Jurisdiction



Source: Adapted from Schofield, 2011.[7]

Agreement on the limits of the territorial sea and the introduction of the EEZ regime were especially noteworthy developments. Three decades on from LOSC being opened for signature 12nm territorial seas have become commonplace, although a few exceptions to the rule remain, largely in the form of anachronistic 200nm territorial sea claims.[8] It is perhaps worth recalling what a significant breakthrough general consensus on the maximum

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As most coastal States claim a 12nm territorial sea the actual breadth of the EEZ is usually 188nm seaward of territorial sea limits.

[7] See, Clive Schofield, "The Delimitation of Maritime Boundaries: An Incomplete Mosaic", pp.665-681 in Wastl-Walter, D. (ed.), The Ashgate Research Companion to Border Studies (Farnham: Ashgate, 2011), p.669. The author would like to thank Andi Arsana for his assistance in the preparation of this figure.

[8] Whilst the majority of "excessive" territorial sea claims have been "rolled back" to the international norm of 12nm, a number of coastal States retain claims to 200nm territorial seas (Benin, Congo (Brazzaville), Ecuador, Peru and Somalia). Additionally, Togo maintains a claim to a 30nm territorial sea. Most of these claims date from the period when extended zones of jurisdiction were developing and thus reflect the aspirations of coastal States at that time for extended jurisdiction over offshore resources. In some cases these anachronistic claims are preserved for historical reasons (notably Ecuador and Peru) and in others because of major developmental and governance problems in the states concerned (for example, Somalia). See, J. Ashley Roach and Robert W. Smith, *United States Responses to Excessive Maritime Claims* (The Hague: Martinus Nijhoff Publishers, 1996).

limit of the territorial sea was given the contentious nature of this issue – something which had confounded earlier codification efforts. The codification of the EEZ also represented a major change, essentially transferring rights over resources within 200nm of baselines along the coast from an international regime (the high seas) to national jurisdiction. The significance of this shift is underlined by the fact that in 1984 the UN's Food and Agriculture Organisation (FAO) estimated that 90 per cent of marine fish and shellfish were caught within 200nm of the coast.[9] Similarly, it was estimated that 87 per cent of the world's known submarine oil deposits would fall within 200nm-breadth zones of jurisdiction.[10]

The 1982 Convention's definition, or redefinition, of the limits of the continental shelf was similarly ground-breaking. This is because it marked a distinct shift away from the unsatisfactorily open-ended definition provided through the Convention on the Continental Shelf of 1958.[11] Article 1 of that Convention defined the continental shelf as either "the seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the Territorial Sea to a depth of 200 metres," or, alternatively, "to a depth beyond that limit where exploitation of resources was possible." The latter criteria for the definition of continental shelf limits is clearly dependent on the state of development of the technologies available to enable the exploitation of seabed resources, and, was therefore susceptible to change over time.

LOSC instead offers a complex series of formulae through which the coastal State can establish the outer limit of its continental shelf, seaward of the 200nm limit. While the criteria laid down under LOSC for the delineation of outer continental shelf limits are undoubtedly complex, the critical point is that they provide for a definable outer limit to the continental shelf claims of coastal States. That said, a number of uncertainties and ambiguities are attendant on the critical part of LOSC – Article 76.

The terms of Article 76

Article 76 essentially provides allows for three options for establishing continental shelf entitlement, coupled with two "cut off" lines. The first of the three entitlement criteria is the 200nm limit with Article 76(1) of LOSC establishing that the continental shelf of a coastal State consists of "the seabed and subsoil of submarine areas," extending to a distance of 200nm from relevant baselines. This is in keeping with the codification of the EEZ which provides every coastal State with the potential to claim sovereign rights over

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9 Quoted in Rachel A. Schurman, "Tuna Dreams: Resource Nationalism and the Pacific Island's Tuna Industry" in *Development and Change*, Vol. 29, 1998, pp. 107-136, at p. 107.

10 Robin Churchill and Vaughan Lowe, *The Law of the Sea*, 3rd Edition, Manchester University Press, Manchester, 1999, p. 162.

11 Convention on the Continental Shelf, opened for signature 29 April 1958, 499 UNTS 311 (entered into force 10 June 1964).

both the seabed and water column out to 200nm, providing that there are no overlapping claims with neighbouring States.[12] With respect to the continental shelf, this applies regardless of whether the continental margin actually extends that distance offshore or not.

The two other options relate to coastal States whose continental margins extend beyond the 200nm limit of the EEZ, and are designed to demonstrate that such shelf areas exist beyond the 200nm limit and form part of the "natural prolongation" of the coastal State in question.[13] Such areas of continental shelf seawards of the 200nm limit are often termed the "outer" or "extended" continental shelf. That said, neither of the terms "outer" or "extended" continental shelf are ideal or have gained universal acceptance. For instance, the term "outer continental shelf" suggests that there are distinct parts of the continental shelf when legally this is not the case. For its part the term "extended continental shelf" gives a somewhat misleading impression that coastal States are somehow extending or advancing claims to additional areas of continental shelf. This is not the case as the sovereign rights enjoyed by the coastal State over the continental shelf are inherent.[14]

Two ways in which coastal States can establish the existence of a continental margin beyond the 200 nm limit which forms part of the State's natural prolongation are provided. These are either the "Gardiner Line," based on reference to the depth or thickness of sedimentary rocks overlying the continental crust, or, the "Hedberg Line" which uses a distance formula of 60nm. Both entitlement formulae are measured from the foot of the continental slope which is defined as the point of maximum change in gradient at the base of the continental slope (unless there is "evidence to the contrary").[15]

The extended continental rights of broad continental margin States are, however, constrained by two maximum "cut-off" lines that are defined as either a distance of 350nm from relevant baselines, or, 100nm from the 2,500 metre isobath.[16] Furthermore, Article 76 provides that the coastal State is to define the outer limits of its continental shelf where it extends beyond 200nm from its baselines "by straight lines not exceeding 60 nautical miles in length, connecting fixed points defined by coordinates of latitude and longitude."[17]

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12 These rights are, however, governed in accordance with Part VI (dealing with the continental shelf) of the Convention rather than Part V (dealing with the EEZ).

13 Article 76(1) states that, as an alternative to the 200nm limit, the continental shelf is defined as extending, "throughout the natural prolongation of its land territory to the outer edge of the continental margin."

14 See, LOSC, Article 77(3) and the Judgment of the International Court of Justice in the North Sea Continental Shelf Cases (ICJ Reports, 1969, 3, at para.19). For convenience the "outer continental shelf" will be used in this paper.

15 See, LOSC, Article 76(4)(b). Whichever of the formulae is most advantageous to the coastal State may be used.

16 See, LOSC, Article 76(5).

17 LOSC, Article 76(7); See also, Peter J. Cook and Chris M. Carleton (eds.), *Continental Shelf Limits*, (Oxford: Oxford University Press, 2000). All the straight lines and distances

The United Nations Commission on the Limits of the Continental Shelf (CLCS)

In order to establish the outer limits of its continental shelf in accordance with Article 76, a coastal State is required to make a submission on its proposed continental shelf limits seawards of the 200nm limit to a specialised United Nations body, the Commission on the Limits of the Continental Shelf (CLCS), established under LOSC.[18] Such submissions need to fulfill the complex requirements of Article 76. Accordingly, coastal States are required to gather information related to the morphology and geological characteristics of its continental margin and its geological characteristics as well as the bathymetric information relating to water depth. Additionally, geodetically robust distance measurements are necessary in order to determine, for example, the location of 200nm and 350nm limit lines.

The process of gathering the necessary scientific and technical information, analysing and interpreting this data and then preparing a submission for and presenting it to the CLCS, represents a complex, time-consuming and expensive process. This observation is borne out and underscored by the fact that Japan reportedly devoted well in excess of US$500 million on preparing its submission.[19] Formulating a submission therefore almost inevitably requires a multi-disciplinary team to be assembled. This was certainly the case for Australia, for example, where a "whole-of-government" approach was adopted involving the participation of multiple government agencies.[20] The commitment towards preparing and delivering a submission to the CLCS is also frequently a long-term one. In Australia's case this team devoted over a decade to the task of preparing, delivering and defending its submissions.[21]

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referred to in the Convention are geodesics, that is, straight lines on the surface of a mathematical model (reference ellipsoid) of the Earth.

18 See, <http://www.un.org/Depts/los/clcs_new/clcs_home.htm> (hereinafter, "CLCS" or "the Commission").

19 Reportedly over 52 billion yen. See, Shin Tani, "Continental Shelf Survey of Japan," paper presented on 16 October 2008 at the Advisory Board on the Law of the Sea (ABLOS) Conference on Difficulties in Implementing the Provisions of UNCLOS, 15-17 October 2008, Monaco, available at: <http://www.gmat.unsw.edu.au/ablos/ABLOS08Folder/Session4-Paper4-Tani.pdf>. See also, Clive H. Schofield and Andi Arsana (2009) "Beyond the Limits?: Outer Continental Shelf Opportunities and Challenges in East and Southeast Asia," *Contemporary Southeast Asia*, Vol.31, no.1: 28-63, at p.44.

20 The project team being led by Geoscience Australia (scientific/technical issues) but also including significant contributions from the Department of Foreign and Trade (diplomatic) and Attorney General's Department (legal), together with support from the Royal Australian Navy Hydrographic Service (hydrographic charting), and the Department of the Environment, Water, Heritage and the Arts (environmental issues and territorial sea baselines in external territories).

21 Australia became a party to LOSC on 5 October 1994 and the Convention itself came into force on 16 November the same year (a year subsequent to the submission of its 60th

The Commission is a body consisting of 21 scientists. The CLCS assesses the submissions made to it and makes "recommendations" to the coastal State in question, on the basis of which, the coastal State can establish limits that are "final and binding."[22] An important consideration in this context is that the provisions of Article 76 are specifically without prejudice to the delimitation of continental shelf between neighbouring states, and, the Commission lacks the mandate to consider the relative merits of competing and overlapping submissions.[23] Instead, the CLCS plays, or was intended to play, a technical role, evaluating whether coastal States through their submissions have fulfilled the requirements of Article 76.

It can be observed that coastal States making such submissions are not claiming outer continental shelf areas as such. As noted above, coastal State rights over the continental shelf are inherent. The submissions made to the CLCS concern the outer limits of the continental shelf beyond the 200nm limit rather than outer continental shelf areas *per se*. That said, the establishment of those limits based on the Commission's recommendations in effect confirms the rights of a particular coastal State to areas of extended continental shelf.

The Commission's consideration of submissions from coastal States and the subsequent fixing of final and binding outer continental shelf limits also takes considerable time and requires the coastal State to present and defend its submission. This process has raised a number of issues in respect to of the Commission's interpretation of certain aspects of Article 76. For example, Article 76(6) contains specific, though potentially problematic, provisions concerning how the constraint lines mentioned above are to be applied to submarine ridges and analogous features which have been termed "a masterpiece of ambiguity"[24] and "manifestly unhelpful."[25] This issue has not been substantially clarified by the Commission's Scientific and Technical Guidelines, which merely state, rather unhelpfully, that "the issue of ridges will be examined on a case-by-case basis."[26]

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ratification). Australia made its submission to the CLCS on 15 November 2004, one day prior to the original deadline. In one sense, therefore, Australia took around a decade to make its submission. However, if the time taken to present and defend that submission is included this time span is nearer to a decade and a half. Similarly, New Zealand's submission took around 10 years to prepare at a cost of NZ$44 million. See, <http://www.mfat.govt.nz/Treaties-and-International-Law/04-Law-of-the-Sea-and-Fisheries/NZ-Continental-Shelf-and-Maritime-Boundaries.php>. See, for example, Schofield, C.H. (2008) "Australia's Final Frontiers?: Developments in Australian Delimitation," *Maritime Studies*, 158 (January/February): 2-21.

22 See, LOSC, Article 76(8).

23 LOSC art 76(10).

24 J.R. Victor Prescott and Clive H. Schofield, *The Maritime Political Boundaries of the World* (Leiden/Boston: Martinus Nijhoff Publishers, 2005), p. 197.

25 Ron Macnab, "Submarine Elevations and Ridges: Wild Cards in the Poker Game of Article 76," *Ocean Development and International Law*, Vol.39 (2008): pp.223-234, at p.223.

26 Available at: <http://www.un.org/Depts/los/clcs_new/commission_documents.htm#Guidelines>.

Further, the work and practice of the Commission itself has excited considerable debate, especially with respect to the apparently rigorous nature of its assessment of submissions; issues related to data gathering, baselines and maritime disputes; the time that is required by the Commission for the consideration of each submission; and, in respect of confidentiality issues.[27]

3. Deadlines and Progress Towards Fixing Limits

According to LOSC, as it was originally drafted, the deadline for the submission of information on the outer limits of the continental shelf was defined as "10 years of the entry into force of this Convention for that State."[28] As the Convention entered into force on 16 November 1994, the ten-year deadline, applicable to coastal States that had ratified the Convention by the date when it entered into force, was set as 16 November 2004. However, it became clear as this deadline approached that many interested coastal States would struggle to formulate submissions in time – something perhaps not surprising given the complexity of the terms of Article 76 and the exacting nature of the task of gathering the required information. Further, the Commission itself was only established in 1997, three years after the entry into force of the Convention, and the CLCS did not adopt its Scientific and Technical Guidelines of the Commission until 1999.[29] In light of concerns expressed over the approaching deadline, coupled with the fact that the Commission's Guidelines provide a key source of official guidance on how to delineate the outer limits of their continental shelf for coastal States, led the State Parties to the Convention in 2001 took the decision to push the deadline back. In effect the ten year "clock" was reset to the date that the Commission's Guidelines were adopted. As this took place on 13 May 1999, the new deadline for submissions was 13 May 2009.[30]

As this deadline, in turn, approached, it once again became clear that many coastal States with potential extended continental shelf entitlements would struggle to make their submissions in time. In order to address these concerns, rather than once again revising the deadline, a meeting of the State Parties to the Convention in June 2008 opted to relax the terms for meeting the deadline. As a consequence of this decision, instead of a full submission, States have the alternative option of submitting "preliminary information

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27 The debates are beyond the scope of the present paper but see, for example, Ted L. McDorman, "The Role of the Commission on the Limits of the Continental Shelf: A technical body in a political world," *International Journal of Marine and Coastal Law* 17, no. 3 (2002): 301-324; and, Macnab, "Submarine Elevations and Ridges: Wild Cards in the Poker Game of Article 76". See also, Schofield and Arsana, "Beyond the Limits?" 33-41.

28 LOSC, Annex II, Article 4.

29 See: <http://www.un.org/Depts/los/clcs_new/commission_members_1997_2002.htm>.

30 See: <http://www.un.org/Depts/los/clcs_new/issues_ten_years.htm>. See also: SPLOS/72 at, <http://www.un.org/Depts/los/meeting_states_parties/SPLOS_documents.htm>.

indicative of the outer limits of the continental shelf beyond 200 nautical miles and a description of the status of preparation and intended date of making a submission."[31]

The May 2009 deadline induced a notable surge in submissions to the CLCS. From eleven submissions a year prior to the May 2009 deadline, the Commission was faced with 51 full submissions and 41 submissions of preliminary information in the immediate aftermath of the deadline. These figures have since expanded to 100 submissions overall (61 full and 39 preliminary) involving 78 coastal States.[32]

These submissions collectively encompass an enormous area, of approximately 29,417,052 square kilometres.[33] As coastal States have made their submissions, it has become clear that numerous overlapping claims to the same areas of outer continental shelf exist. These overlaps encompass approximately 3,227,110 square kilometres of potential outer continental shelf areas.[34]

It is worth noting that these figures on the areas covered by submissions and the areas of overlapping claims are likely to grow significantly over time. For example, the figure provided above with regard to the areas included in submissions does not include outer continental shelf areas for Chile, China, the Comoros and Vanuatu, as these States have yet to supply any indication of the extent of their areas of continental shelf located seawards of the 200nm limit from their baselines.[35] Further, the process is not yet at an end, and additional submissions can be anticipated. Further submissions are also highly likely to result in additional overlaps between submissions. An additional seven States are likely to (or may yet decide to) make submissions in due course, but, have yet to do so because the deadline for their submissions has yet to pass. The States that have yet to make submissions are: Canada, Ecuador, Liberia, Morocco, Peru, USA and Venezuela.[36]

Overall, therefore, as many as 85 coastal States may ultimately be in a position to make submissions for outer continental shelf rights to the

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31 See also: Decision of the eighteenth Meeting of State Parties, SPLOS/183 at <http://www.un.org/Depts/los/meeting_states_parties/SPLOS_documents.htm>.

32 See the Commission's website at <http://www.un.org/Depts/los/clcs_new/clcs_home.htm>.

33 Robert Van de Poll and Clive H. Schofield, "Exploring to the Outer Limits: Securing the Resources of the Extended Continental Shelf in the Asia-Pacific," paper presented at the 7th Biennial Advisory Board on the Law of the Sea (ABLOS) conference on *UNCLOS in a Changing World*, International Hydrographic Bureau Monaco, 3-5 October 2012.

34 *Ibid*.

35 *Ibid*.

36 It is worth noting that some of these States are more likely to make submissions than others. For example, Canada's preparations towards formulating a submission are known to be well advanced. Other States that appear to be hemmed in by the maritime entitlements of neighbouring States such as Peru may, nonetheless, opt to make submissions in due course. A submission from the USA presupposes that the USA will eventually become a party to LOSC.

Commission.[37] Additionally, the substantial number of preliminary submissions that have been made will in due course be replaced by full submissions, clarifying areas of extended continental shelf where there is currently some uncertainty.

At the time of this writing, the Commission had adopted 18 sets of recommendations on submissions over the period from 2002-2012.[38] The Commission has been constrained by the limited number of sub-Commissions that can be formed to consider each submission and formulate recommendations, although this issue is now being at least partially addressed through revised working practices on the part of the Commission. Other constraints include practical issues such as the provision of support facilities at the United Nations and in terms of funding for its members. These factors, coupled with the rigorous approach of the Commission to the examination of proposed outer continental shelf limits has meant that the rate of consideration of submissions is around two per annum. Given the 2009 surge in submissions with many more full submissions to come, it is clear that the Commission has a daunting backlog of work. At the Commission's current rate of progress several decades are likely to pass before final and binding outer limits to national continental shelf claims can be fixed for all States which have submitted claims.

4. Extended Continental Shelf Resources

Within these the continental shelf Coastal States exercise sovereign rights over continental shelf areas "for the purpose of exploring it and exploiting its natural resources."[39] Although these resources are necessarily remote from shore and often overlain by deep water, the extensive extended continental shelf areas subject to submissions to the CLCS are of increasing interest from a marine resource development perspective. This is particularly the case as offshore exploration and exploitation technologies have advanced significantly in recent years. Key emerging seabed resource opportunities in extended continental shelf areas include energy resources such as oil, gas, and gas hydrates as well as seabed minerals and marine genetic resources.

Oil and Gas

Extended continental shelf areas and the deep and ultra-deep water that they comprise are set to offer the "next frontier" for the oil and gas industry over the next 25 years.[40] As terrestrial, near-shore, and shallow water reserves are generally plateauing and declining, offshore hydrocarbon development in

[37] Van de Poll and Schofield, "Exploring to the Outer Limits."
[38] See: <http://www.un.org/Depts/los/clcs_new/commission_submissions.htm>.
[39] LOSC, Article 77(1).
[40] See, Van de Poll and Schofield, "Exploring to the Outer Limits".

deeper waters, as well as further offshore and in more hostile environments, has become more significant. This trend is underpinned and reinforced by escalating demand and thus elevated oil prices. While the drivers for deep water hydrocarbon exploration and development efforts may be somewhat offset by recent developments with respect to the exploitation of terrestrial shale gas and oil, serious concerns have been raised over the potential environmental impacts of their exploitations, including major increases in the release of greenhouse gases with dire potential consequences in terms of climate change.[41] These factors may impede the extraction of shale oil and gas from continental shelf areas in at least some jurisdictions.

Elevated oil prices coupled with advances in drilling technology allowed for exploration to advance in deep (that is, water depths in excess of 1,000 feet) and ultra-deep (over 5,000 feet) waters offshore.[42] Such deep water resource extraction has involved the drilling of deeper and deeper wells as well as significant innovations in the design of production platforms. In addition, geophysical exploration technologies have significantly enhanced the chances of success in deep seabed exploration and exploitation.[43]

It therefore appears likely that deep water exploration efforts are likely to increase substantially in the future. Indeed, the already "spectacular" growth of the deep water sector is predicted to continue with global capital expenditure on deepwater developments forecast at US$232 billion over the 2012-2016 period – a figure that is 90 per cent more than the amount spent in the preceding five years.[44]

Such exploration efforts are highly likely to extend beyond 200nm EEZ limits and into areas of extended continental shelf. While such areas have traditionally been of limited interest to oil companies, partly due to legal uncertainties where outer shelf limits have yet to be settled, this scenario is gradually changing as final and binding continental shelf limits are delineated and as States strive to assert their rights within extended continental shelf

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41 See, for example, Food & Water Europe, Friends of the Earth Europe, Greenpeace and the Health & Environment Alliance, *Position Statement on shale gas, shale oil, coal bed methane and "fracking,"* 24 April 2012, available at, <http://www.greenpeace.org/eu-unit/Global/eu-unit/reports-briefings/2012%20pubs/Pubs%202%20Apr-Jun/Joint%20statement%20on%20fracking.pdf>. Fiona Harvey, "Shale oil offers freedom and security – but it could be a trap," *The Guardian*, 15 November 2012, available at, <http://www.guardian.co.uk/environment/2012/nov/15/shale-gas-freedom-security-trap>.

42 The figures of 1,000ft (305m) for deep water and 5,000ft (1,524m) for ultradeep water are used by the United States government. See, for example, Richard McLaughlin, "Hydrocarbon Development in the Ultra-Deepwater Boundary Region of the Gulf of Mexico: Time to Reexamine a Comprehensive U.S.-Mexico Cooperation Agreement," 39 *Ocean Development and International Law* 1-31 (2008), at 1.

43 Paul L. Kelly, "Deepwater Oil Resources: The Expanding Frontier," pp.414-416 in *Legal and Scientific Aspects of Continental Shelf Limits*, Myron H. Nordquist, John H. Moore, and Thomas H. Heidar (eds), (Martinus Nijhoff Publishers, 2004): pp.414-416.

44 *Ibid*.

areas subject to submissions. Indeed, at least 13 countries around the world have "issued and/or are offering" offshore oil and gas exploration concession licenses beyond their respective countries 200nm EEZ limits.[45] These developments may arguably indicate not only a desire by coastal States to "stake their claims" to outer continental shelf areas, but, may also be symptomatic of a desire by coastal States to yield some return on their investment in terms of going to the expense of formulating submissions on outer continental shelf limits to the CLCS.[46]

Gas Hydrates

Gas hydrates are a non-traditional form of seabed hydrocarbons. They comprise ice-like crystalline solids formed from a mixture of water and natural gas, which are stable inside a particular pressure and temperature envelope. It has been conservatively estimated that on a global scale gas hydrates locked in the seabed encompass twice the carbon contained in known coal, oil and natural gas reserves.[47] Accordingly, gas hydrates are the most abundant grade of unconventional natural gas, and are estimated to have a larger resource base than all other grades combined.[48]

Gas hydrates are typically found either onshore in and below areas of thick permafrost, or, offshore, in the marine sediments of the outer continental margins. Gas hydrates that occur in the latter setting occur in deeper (500m+) waters likely to be consistent with areas of extended continental shelf.[49]

Gas hydrates offer an abundant potential energy resource, moreover, one that offers considerable merits as an alternative to "traditional" energy carriers.[50] However, significant technical obstacles exist to the exploitation of gas hydrates, leading them to be generally considered the most difficult and expensive of all unconventional gas resources to recover.[51] It has also been suggested that as methane has between 10 and 22 times more impact than carbon dioxide in causing climate warming, the uncontrolled release of

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45 Based on analysis of exploration licenses coupled with 200nm limits. See, Van de Poll and Schofield, "Exploring to the Outer Limits".

46 *Ibid*.

47 William Dillon, "Gas (Methane Hydrates – A New Frontier," U.S. Geological Survey, September 1992, available at, <http://marine.usgs.gov/fact-sheets/gas-hydrates/title.html>.

48 See, Nick A. Owen and Clive H. Schofield, "Disputed South China Sea hydrocarbons in perspective," *Marine Policy*, 36 (2012), 809-822, at p.813.

49 While gas hydrates may occur in water depths in excess of 300m, they predominantly occur in the depth range of 500-4,500m.

For example, methane liberates around 45 per cent more energy when burnt than heavy fuel oil.

51 See, Owen and Schofield, "Disputed South China Sea hydrocarbons in perspective," 813.

methane from gas hydrate structures (for instance from Arctic regions as a consequence of global warming) poses considerable environmental risks.[52]

Despite these challenges, there has been considerable interest in the development of gas hydrates in recent years leading to efforts to overcome the technical issues associated with their commercial recovery. For example, in May 2012 natural gas was successfully extracted from a methane hydrate structure located on the North Slope of Alaska and replaced with a mixture of carbon dioxide and nitrogen.[53] While this represented a small-scale "proof of concept" experiment, it nonetheless suggests that the exploitation of gas hydrate resources may not be as far out of reach as has until recently generally been thought. Should these or similar efforts prove to be successful, the hydrates located within national jurisdiction, both within and beyond the 200nm limit are likely to be a focus for future exploration efforts.

Seabed Mining

Oil and gas reserves do not constitute the only minerals that can be extracted from the seabed. The sea floor has long been the source of materials such as aggregates for building construction and land reclamation, and valuable resources such as diamonds and both precious and base metals (such as gold and tin) from placer deposits in marine sediments. These developments have, however, predominantly related to near-shore areas.[54] Further offshore deep sea minerals such as polymetallic nodules have been under consideration since at least the 1960s. Recent advances in exploration and extraction technologies have, however, resurrected hopes of the commercially viable recovery of a range of resources from the seabed. These include seafloor massive suphide (SMS) deposits, ferromanganese nodules and crusts, cobalt-rich crusts and phosphates as well as the polymetallic nodules mentioned above. Such deposits also have the potential to contain rare earth elements, something that is likely to enhance their attractiveness as targets for seabed resource development.[55]

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[52] Dillon W. (1992), "Gas (Methane Hydrates – A New Frontier," U.S. Geological Survey, September 1992, available at, <http://marine.usgs.gov/fact-sheets/gas-hydrates/title.html>. See also, D. Shelander, J. Dai, G. Bunge, D. McConnell and N. Banik, "Predicting Gas Hydrates Using Prestack Seismic Datain Deepwater Gulf of Mexico," AAPG E-Symposium, 11 February 2010, available at, <http://www.pttc.org/aapg/predictinghydrates.pdf>.

[53] See, United States Department of Energy (2012), "U.S. and Japan Complete Successful Field Trial of Methane Hydrate Production Technologies," 2 May 2012, available at, <http://energy.gov/articles/us-and-japan-complete-successful-field-trial-methane-hydrate-production-technologies>.

[54] That said, such operations can take place in relatively deep waters. For example diamond mining company De Beers undertakes sea floor mining operations off the Namibian coast in waters of 90-140m depth. See, De Beers, "Marine Mining," available at, <http://www.debeersgroup.com/Operations/Mining/mining-methods/Marine-Mining/>.

[55] See, for example, Jim Hein, "Prospects for Rare Earth Elements from Marine Mineral," *ISA Briefing Paper*, 02/12, May 2012, available at,

Perhaps the most advanced project is that related to the exploitation of sea floor massive sulphide deposits in the Bismarck Sea off Papua New Guinea. Indeed, Papua New Guinea granted the world's first deep sea mining lease to Nautilus Minerals Inc. for the development of the *Solwara 1* project in January 2011.[56] This project, billed as the world's "first seafloor gold mine," involves the exploitation of high grade seafloor massive sulfide deposits (SMS) and hydrothermal sulfide systems in 1,600m of water in the Bismarck Sea. Indicated resources for *Solwara 1* have been put at 870,000 tonnes of ore containing 6.8 per cent copper and 4.8 grams per tonne of gold, while inferred resources have been put at 1,300,000 tonnes of ore containing 7.5% copper and 7.2 grams per tonne of gold, together with zinc and silver components.[57] The *Solwara 1* project has, however, apparently run into serious difficulties as a consequence of commercial disputes over funding the development, coupled with concerns over social and, particularly, environmental impacts.[58]

Such developments illustrate the potential for such novel developments among the Pacific island States more generally.[59] Interest in seabed mining, including on areas of outer continental shelf, has been expressed by States such as the Federated States of Micronesia, Japan, Kiribati and Palau . Analogous developments in relation to areas within the international seabed area (the Area), such as the Clarion-Clipperton Zone in the Equatorial North Pacific Ocean and in the Central Indian Basin of the Indian Ocean,[60] are also proceeding. Areas of continental shelf subject to national jurisdiction, both within and beyond the 200nm EEZ limit, are likely to be attractive areas for development in this context, especially as outer continental shelf limits are progressively confirmed and finalised.

Marine Genetic Resources

In addition to mineral and other non-living resources contained in the seabed and subsoil of the outer continental shelf, coastal States also have sovereign rights over "living organisms belonging to sedentary species," defined as

<http://www.isa.org.jm/files/documents/EN/Pubs/BP2.pdf>.

56 Mohammad Bashir, "Deep sea mining lease granted, *The Post-Courier*, 19 January 2011, available at <http://www.postcourier.com.pg/20110119/news03.htm>.

57 See, Nautilus Cares website at, <http://www.cares.nautilusminerals.com/SubSeaEnvironment.aspx?npath=1,6>.

58 Catherine Wilson, "Environmental Uncertainties Halt PNG Deep Sea Mining", *The Jakarta Globe*, 21 December 2012, available at <http://www.thejakartaglobe.com/international/environmental-uncertainties-halt-png-deep-sea-mining/562974>.

59 Regarding developments in seafloor polymetallic massive sulphide mining see Peter M. Herzig, "Seafloor Massive Sulfide Deposits and Hydrothermal Systems," pp.431-456 in *Legal and Scientific Aspects of Continental Shelf Limits*, Myron H. Nordquist, John .H. Moore, and Thomas H. Heidar (eds), (Martinus Nijhoff Publishers, 2004).

60 For maps detailing areas of exploration as well as information on contractors and reserved areas see the International Seabed Authority (ISA) website at, <http://www.isa.org.jm/en/scientific/exploration>.

"organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil." [61] These sedentary living resources of the outer continental shelf, including marine genetic resources, may also prove to have considerable value.

Give their extent, covering approximately 72 per cent of the surface of the planet, coupled with their rich biodiversity, the oceans offer great potential in terms of marine living resources including marine-derived genetic resources. Areas of extended continental shelf offer potential for such resources. Indeed, the oceans as a whole are home to a greater diversity of major animal groups (phyla) than the terrestrial environment (28 marine phyla versus 11 terrestrial phyla). Not only have the oceans been estimated to account for 95 per cent of the Earth's biosphere but it has also been suggested that they remain 95 per cent unexplored.[62] This helps to explain why around 1,000 new marine natural products are reported annually.[63] This is especially relevant to deep water areas, as illustrated by the fact that of over 30,000 marine natural products reported since the 1960s, less than 2 per cent derive from the deep sea organisms.[64]

Marine biota (plants and animals) therefore represent a relatively untapped resource offering developmental potential for a range of valuable applications. In the context of marine genetic resources and biotechnology, marine species and microorganisms that have evolved to exist in exist in extreme environments, so-called "extremophiles," are of particular interest. Organisms living here have adapted to survive in the complete absence of light, in conditions of extremely high pressure, in either low or very high (for example in the vicinity of a hot water vent) temperatures, or in environments characterised by extreme salinity or acidity. Such environments and habitats include the deep sea, as well as in the vicinity of seamounts, hydrothermal vents, methane seeps, including on the extended continental shelf.

While this suggests enormous potential, significant challenges and limitations exist in realising this potential. In particular major obstacles exist with respect to securing adequate supply of marine natural products. Similarly, problems arise in terms of either trying to cultivate the organisms concerned with a view to scaling-up production of the raw materials required or, alternatively in terms of synthesising marine-derived biotechnology products at reasonable cost.[65] Consequently, examples of the commercialisation of

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61 LOSC, Article 77(4).

62 See, for example, the *Rio Ocean Declaration*, p.6, available at <http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/pdf_Rio_Ocean_Declaration_2012.pdf>.

63 Danielle Skropeta, "Exploring Marine Resources for New Pharmaceutical Applications," pp.211-224 in Warwick Gullett, Clive H. Schofield, and Joanna Vince (eds), *Marine Resources Management*, (LexisNexis Butterworths, Australia, 2011), p.217.

64 *Ibid*., p.221.

65 *Ibid*., pp. 217-219.

marine biotechnology products are few and far between although a few examples do exist.[66]

5. Securing the Resources of the Extended Continental Shelf: Prospects and Challenges

While some progress has been made in the finalisation of outer continental shelf limits, it is clear that much remains to be done. Indeed, as noted above, overlapping outer continental shelf claims encompass seabed areas of approximately 3,227,110 square kilometres.[67]

These overlaps give rise to multiple "new" outer continental shelf boundaries and, it would appear, a proliferation in potential outer continental shelf boundary disputes. The resolution of these disputes and the delimitation of outer continental shelf boundaries remains a key challenge for the coastal States involved, as this task is beyond the purview of the Commission.[68] With respect to realising the marine resource opportunities and benefits potentially arising from rights over areas of outer continental shelf, this will likely to be compromised by overlapping jurisdictional claims. This is because the existence of overlapping claims deprives commercial entities such as international oil and gas companies of the fiscal and legal certainty they require in order to invest the billions of dollars necessary to undertake offshore exploration, let alone development, activities in such remote areas necessarily far from shore locations.

While practice with respect to the delimitation of outer continental shelf boundaries, and thus the resolution of overlapping claims to outer continental shelf areas, is limited, early indications are that the approach to delimitation within and beyond 200nm limits will not be dissimilar. This is supported not only by past State practice but by the International Tribunal on the Law of the Sea (ITLOS) Judgment in the *Bay of Bengal Case* between Bangladesh and Myanmar.[69] In that case, Bangladesh argued unsuccessfully that geophysical factors constituted relevant circumstances that should

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66 For example, in terms of marine-derived drugs, two (Prialt® a painkiller based on cone snail venom peptide omega-conotoxin derived from *Conus magnus*, and Yondelis®, an anticancer agent derived from sea squirt (trunciate) metabolite ecteinascidilin-743 from *Ecteinascidia turbinate*) have been approved for use while over 20 were undergoing clinical trials. *Ibid*., p.211 and 214-215.

67 See, Van de Poll and Schofield, "Exploring to the Outer Limits".

68 As noted above, in keeping with LOSC, Article 76(10) the Commission's recommendations are specifically without prejudice to the delimitation of continental shelf boundaries.

69 Dispute Concerning Delimitation of the Maritime Boundary between Bangladesh and Myanmar in the Bay of Bengal (Bangladesh/Myanmar), International Tribunal for the Law of the Sea (ITLOS), Case no.16, Judgment, 14 March 2012, available at, <http://www.itlos.org/fileadmin/itlos/documents/cases/case_no_16/1-C16_Judgment_14_02_2012.pdf > [hereinafter *Bay of Bengal Case*].

influence the course of the maritime delimitation line both within and beyond the 200nm limit. Instead, the Tribunal deemed that coastal geography was the dominant consideration for both the EEZ and extended continental shelf boundaries delimited.[70] The outcome of this case suggests that outer continental shelf delimitation will proceed on substantially the same basis as delimitations within the 200nm "inner" continental shelf/EEZ limit.

Similarly, significant oceans governance challenges arise with respect to outer continental shelf areas, even where no overlapping claims exist. It is worth observing that although much of the debate relating to the outer continental shelf has been concerned with the process by which States can secure their rights over continental shelf areas located seaward of their 200nm limits, this is only the beginning. Once outer continental shelf areas are secured, considerable management and oceans governance responsibilities and challenges with respect to these remote, subsurface seabed areas under national jurisdiction are likely to arise.[71] Coastal States are, however, in a position to draw for inspiration. On the rapidly increasing experience of the International Seabed Authority in the development of its Mining Code for activities in the Area Regional approaches may also prove advantageous, as illustrated by the recent drafting of a regional legislative and regulatory framework for deep sea minerals exploration and exploitation for the Pacific ACP (African Caribbean Pacific) States.[72] These developments offer some positive prospects for the future, though daunting surveillance, regulation and enforcement challenges remain with respect to securing the resources of extended continental shelf areas.

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70 *Ibid*., para. 322.

71 See, for example, Joanna Mossop, "Protecting Marine Biodiversity on the Continental Shelf beyond 200 Nautical Miles," *Ocean Development and International Law* 38 (2007)

72 Secretariat of the Pacific Community (2012) *Pacific-ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation*, July 2012.