EXPLORING TO THE OUTER LIMITS: SECURING THE RESOURCES OF THE EXTENDED CONTINENTAL SHELF IN THE ASIA-PACIFIC

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Abstract
Half of the world's coastal States have moved to secure jurisdictional rights over broad areas of continental shelf seawards of their 200 nautical mile limits. These extensive areas of what are often termed extended continental shelf offer considerable potential resource opportunities, notably with respect to various types of seabed energy resources, seabed minerals and marine genetic resources. This paper provides an overview of progress towards the establishment of outer continental shelf limits as well as with respect to seabed resource exploration within the Asia-Pacific region in particular. Future challenges concerning the resolution of overlapping claims to areas of extended continental shelf and concerning governing and managing resource-related activities in such areas are also highlighted.

1. Introduction

Recent years have witnessed an enormous expansion in the scope of maritime areas subject to jurisdictional claims on the part of coastal States. In particular this has occurred as coastal States located on broad continental margins have sought to secure their sovereign rights over continental shelf areas located seawards of their 200 nautical mile (nm) exclusive economic zone (EEZ) limits.[1] These extensive areas of what are often termed the "extended continental shelf" offer considerable potential resource opportunities, notably with respect to various types of seabed energy resources, seabed minerals and marine genetic resources. Indeed, extended continental shelf areas and the deep and ultra deep water plays that they comprise are set to offer the 'next frontier' for the oil and gas industry over the next 25 years. This is being facilitated by advances in drilling technology allowing for exploration to advance into ever deeper waters and further offshore.

[1] 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.

This paper builds on the contribution made by the authors at the ABLOS Conference in 2010 which served to highlight overlapping extended continental shelf submissions on a global basis.[2] The present paper narrows the focus to the Asia-Pacific region, providing an overview of progress towards the establishment of outer continental shelf limits. Extended continental shelf areas are considered to offer considerable potential resource opportunities, notably with respect to various types of seabed energy resources, seabed minerals and marine genetic resources. The paper provides a preliminary assessment of extended continental shelf resource exploration opportunities within the Asia-Pacific region. In this context it is worth noting that coastal States are increasingly offering exploration concessions at or beyond the 200 nautical mile limit. The paper goes on to highlight some of the key future challenges concerning securing extended continental shelf rights and resources, notably in terms of the challenges related to the resolution of overlapping claims to areas of extended continental shelf and concerning governing and managing resource-related activities in such areas.

2. Research Approach

Consistent with the approach taken in the authors' 2010 paper, the analysis presented here is fundamentally based on the information provided by coastal States in either their full submissions or submissions of preliminary information to the CLCS. This information was incorporated into the Fugro Global Law of the Sea (LOS) Database, developed and compiled by the first author of this paper.

This compilation database features: complete global coastlines and borders at 1:75,000 scale, global Landsat TM7 coverage (~2000-2005, 14.25m resolution), Etopo5/Etopo2/Etopo1 bathymetric raster images (2,000m), GEBCO1 bathymetric raster images (2,000m), seismic-derived sediment thickness (fine ~ offshore waters and coarse ~ onshore and offshore) raster images (2,000m), free-air gravity raster images (2,000m) and single-beam (c.24 million nautical miles of data) and multi-beam bathymetry at various resolutions together with the Fugro global cable database. The database also includes territorial sea baselines for all 155 coastal States and agreed maritime boundary delimitation lines, predominantly derived from official sources such as national gazettes. Where the location of territorial sea baselines was absent or otherwise unavailable they were hypothesized and, similarly, theoretical (strict) equidistance lines have been applied for all undelimited maritime boundaries. The database also incorporates information included in the submissions made to the CLCS as mentioned above.

This paper should be read in conjunction with the graphic compilations presented wherein full submissions are highlighted in green, submissions of preliminary information in orange and areas of actual or potential overlap in red. Whilst every effort has been made to ensure the accuracy of the graphics and that of the figures shown on them and quoted in this paper, it should be noted that they are generally not official figures but are instead an independent assessment. It is also worth noting that with respect to many preliminary submissions the precise extent of the areas of extended continental shelf subject to submission is as yet unclear. Whilst the analysis here is based on publically available information most notably that contained in the full submissions and submissions of preliminary information made by the States involved to the

[2] See, Van de Poll, R. and Schofield, C.H. (2010) 'A Seabed Scramble: A Global Overview of Extended Continental Shelf Submissions, Proceedings of the Advisory Board on the Law of the Sea (ABLOS) conference on *Contentious Issues in UNCLOS – Surely Not?*, International Hydrographic Bureau Monaco, 25-27 October 2010, available at, <http://www.gmat.unsw.edu.au/ablos/ABLOS10Folder/S8P3-P.pdf>.

Commission and a rigorous, geodetically robust approach has been applied, the calculations summarised here are necessarily preliminary in nature and are yet to be finalised. It is requested that the figures contained in this paper and accompanying presentation are not quoted without the permission of the authors.

3. Global Overview of Extended Continental Shelf Submissions

Of the192 United Nations member States, 155 are coastal states.[3] Among these coastal States, 78 have, at the time of writing (September 2012), made either full submissions or submissions of preliminary information as a prelude to making full submissions to the CLCS regarding extended continental shelf rights. In total, 100 extended continental shelf submissions have been deposited with the UN, comprising 61 full submissions and 39 preliminary submissions.[4]

These submissions collectively encompass an enormous area, of approximately 29,417,052 square kilometres.[5] This figure does not, it is important to note, include extended 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.

These submissions have given rise to numerous overlapping claims to the same areas of extended continental shelf covering an area of approximately 3,227,110 square kilometres.[6] Further, the process is not yet at an end as, a further seven more 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.[7]

Overall, therefore, as many as 85 coastal States may ultimately be in a position to make submissions for extended continental shelf rights to the Commission.[8]

4. Asia-Pacific Submissions

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3 The figure of 155 coastal States includes three States, Azerbaijan, Kazakhstan and Turkmenistan, whose only coastlines are those on the Caspian Sea. Arguably therefore, as the Caspian is not connected to the world ocean save via rivers and canals, this figure could be put at 152 coastal States. For the purposes of this analysis, the more inclusive figure of 155 coastal States is used.

4 Noting that a number of these submissions are joint or partial and these figures are inclusive of multiple partial submissions for different areas by some States.

5 It should be noted that the figures supplied herein have been refined and updated since 2010 when analogous figures were supplied. For example, the overall area encompassed by extended continental shelf submissions provided in 2010 was ~30,155,031km^2 as opposed to the figure of ~29,417,052km^2. This stems in part from coastal States revising their submissions, together with the impact of the recommendations of the CLCS. As such this paper, rather than that delivered at the 2010 ABLOS meeting, should be referred to.

6 This figure represents an increase as compared with that reported in 2010 of ~2,711,107km^2 indicating an increase in the number of overlapping submissions deposited with the CLCS.

7 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.

8 This analysis is founded on 2009 Fugro Global LOS Database as compiled by the first author of this paper based on notification and/or analysis.

For the purposes of this paper the term "Asia-Pacific" is taken to mean the broad geographical area bordering the Asian continent fronting onto the Indian Ocean, as well as the western Pacific Ocean including East and Southeast Asia. Some coverage of extended continental shelf issues pertaining to the Pacific Island States and Oceania is also included (see accompanying slides).

Accordingly, there are 51[9] coastal States within the overall Asia-Pacific Regional setting and covered by the present analysis, of which 41 are parties to LOSC.[10] Of 140 potential maritime boundaries in the region 51 have been agreed leaving 89 (or 63.6%) unresolved or in-dispute. This study focuses on 17 coastal States in the Asia-Pacific region, which have collectively made thirteen full submissions and four preliminary submissions to the CLCS.

These have been made by: Bangladesh (~102,069km^2), Brunei (~8,044 km^2 preliminary information ~ no map provided), China (preliminary information ~ no map provided), Federated States of Micronesia (two areas ~211,615km^2 preliminary information), India (two areas ~598,201 km^2), Indonesia (partial, ~4,547km^2), Japan (five areas, ~741,572km^2), Malaysia (joint with Vietnam (south), ~43,313km^2), Maldives (two areas, ~172,032km^2), Myanmar (~144,527km^2), Pakistan (~55,844km^2), Palau (three areas ~258,385 km^2), Papua New Guinea (two areas ~202,212 km^2), Philippines (partial, ~132,223km^2), Republic of Korea (preliminary information, ~18,636km^2), Sri Lanka (~1,726,787km^2), Vietnam (North), (~12,464km^2). In all, approximately 4,432,471 km^2 have been claimed for 16 of the 17 states reporting claimed areas.

5. Asia-Pacific Overlaps

The above-mentioned submissions include substantial areas of extended continental shelf included in more than one submission. These potential overlaps between submissions are systematically illustrated in the graphics accompanying this paper. They can, however, be summarised as existing between Pakistan and India (~19km^2), Maldives and Sri Lanka (~9,426 km^2), Sri Lanka and India (~345,370 km^2), India and Bangladesh (~144,527 km^2), India and Myanmar (~121,070 km^2), Bangladesh and Myanmar (~100,235 km^2), Brunei and Malaysia& Vietnam (~8,044 km^2), Japan and Palau (~229,934km^2), Japan and China in the East China Sea,[11] Japan and the Republic of Korea (concerning the southern part of their joint development area in the East China Sea, ~18,636km^2), Federated States of Micronesia and Papua New Guinea (~193,760 km^2).

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9 This analysis is founded on 2009 Fugro Global LOS Database as compiled by the first author of this paper based on notification and/or analysis based on two of the regional compilations (that is, those for Asian and Oceania) as stored within the Fugro Global LOS database.

10 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, updated to 20 September 2011, available at <http://www.un.org/Depts/los/reference_files/status2010.pdf>.

11 This is despite the fact that the East China Sea is less than 400 nautical miles broad and the littoral States claim 200 nautical mile breadth exclusive economic zones. The preliminary submissions of both China and the Republic of Korea therefore relate to areas of continental shelf that are beyond 200 nautical miles from their own baselines but are within 200 nautical miles of Japan's baselines. See, Schofield, C.H. and Townsend-Gault, I. (2010) 'Choppy Waters Ahead in a "sea of peace, cooperation and friendship"?: Slow Progress Towards the Application of Maritime Joint Development to the East China Sea', *Marine Policy*, doi:10.1016/j.marpol.2010.07.004.

Additionally, possible future overlapping extended continental shelf issue may arise in the South China Sea if, indeed, any extended continental shelf exists in this area, between Brunei, China, Malaysia, the Philippines and Vietnam.[12] In all, potential overlaps encompass approximately 1,171,021 km^2, equating to 26.4% of extended continental shelf areas submitted involving 16 of the 17 States reporting claimed areas. These significant areas of overlap between submissions are likely to pose coastal States significant challenges with respect to finalizing their outer continental shelf limits, let alone accessing seabed resources within the areas of extended continental shelf concerned (see below).

6. New Resource Frontiers

Claims to maritime jurisdiction also often tend to be viewed in resource access terms. Indeed, part of the rationale and justification for the significant expenditure required to formulate extended continental shelf submissions has generally been strongly linked to the potential value of the marine resources contained within these remote areas of continental shelf.

With regard to the continental shelf, including areas of outer continental shelf, LOSC Article 77(1) provides that coastal States exercise sovereign rights over these areas "for the purpose of exploring it and exploiting its natural resources." Of particular interest to many coastal States, especially in the context of rising global energy security concerns is the possibility that extended continental shelf areas may hold considerable seabed hydrocarbon resources. The deep seabed also has the potential to offer a range of other biological and mineral resources exist which are increasingly being exploited, aided by considerable advances in technologies applicable to exploring deep sea areas. The following section highlights some of the potential extended continental shelf resource opportunities with particular reference to oil and gas, gas hydrates and, to a lesser degree, marine genetic resources. This section should be read in conjunction with the accompanying presentation graphic which serve to illustrate key resource opportunities and developments in this regard.

Deep and Ultradeep water oil and gas exploration
Offshore areas are an established and increasingly important source of non-living resources such as hydrocarbons, especially in the context of dwindling near and on-shore reserves, growing populations and generally, therefore, resource demands. Indeed, according to recent estimates by 2015, offshore oil production will account for 40% and gas will account for 35% of global oil and gas supplies (though not, it should be emphasised, reserves). This trend is likely to be reinforced in the foreseeable future as oil prices rebound in response to plateauing and declining production (especially but not exclusively from terrestrial oil fields) coupled with increasing demand.

Improved technology is increasingly allowing economically viable exploration and exploitation of offshore oil and gas resources in more hostile conditions including deeper waters further offshore. Dramatic technological advances in the oil and gas industry in recent years, particularly in respect of exploration in deep (that is, water depths in excess of 1,000 feet) and

[12] Extended continental shelf areas only exist in the South China Sea if the South China Sea disputed islands are considered to be "rocks" within the meaning of Article 121(3) of LOSC, and are thus prohibited from generating continental shelf and exclusive economic zone rights. See, Bateman, S. and Schofield, C.H. (2009), 'Outer Shelf Claims in the South China Sea: New Dimension to Old Disputes', *RSIS Commentary* (Singapore: S.Rajaratnam School of International Studies (RSIS), 1 July).

ultradeep (over 5,000 feet) water offshore areas.[13] This has involved the drilling of deeper and deeper wells, for example in the Gulf of Mexico, as well as significant innovations in the design of production platforms and in terms of geophysical exploration technologies have significantly enhanced the chances of success in deep seabed exploration and exploitation.[14]

These developments, coupled with high oil prices prior to the onset of the global financial crisis (GFC) led to substantial growth in deep and ultradeep water drilling such that global deepwater production tripled from approximately 1.5 million barrels per day (b/d) to around 5 million b/d in the period 2000 to 2009. Prior to the *Deepwater Horizon* disaster in the Gulf of Mexico of 2010 deepwater production was predicted to rise to 10 million b/d by 2015.[15] Indeed, notwithstanding the *Deepwater Horizon* disaster and its aftermath, deep and ultra deepwater drilling for seabed hydrocarbons, is likely to increase significantly in the future. The key reason for this is that there is little indication of a sustained move away from global reliance on oil as the primary energy carrier driving the world economy. These mounting energy security concerns are especially pertinent in the Asia-Pacific region where many States are already highly dependent on imported petroleum resources. As oil supplies become increasingly constrained yet demand continues to spiral upwards, there is a high likelihood of increasing oil prices which, in turn, will reinforce the case for the exploration for and exploitation of unconventional oil reserves such as deep and ultra deepwater oil reserves.[16]

Although extended continental shelf areas have been generally considered to be of only limited interest to oil companies in the past, there have been indications that such areas may provide seabed oil and gas potential. For example, recent work by Geoscience Australia using advanced aeromagnetic surveys indicates the existence of significant petroleum potential in basins in at least three of Australia's ten areas of outer continental shelf: in the Great Australian Bight to the south, on the Lord Howe Rise to the east and on the Wallaby Plateau off Western Australia.[17]

Of particular note in this context, at present time, 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. These developments may arguably indicate not only a desire by coastal States to 'stake their claims' to extended continental shelf areas but 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.

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

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13 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.

14 Kelly, P.L. (2004) 'Deepwater Oil Resources: The Expanding Frontier', pp.414-416 in *Legal and Scientific Aspects of Continental Shelf Limits*, M.H. Nordquist, J.H. More, and T.H. Heidar (eds), (Martinus Nijhoff Publishers): pp.414-416.

15 Owen, N. and Schofield, C.H. (2010) 'Further and Deeper: The Future of Deepwater Drilling in the Aftermath of Deepwater Horizon Disaster', *International Zeitschrift*, Vol.6, no.3 (December 2010), available at <http://www.zeitschrift.co.uk/>.

16 *Ibid*.

17 Cleary, P. (2010) 'Finds fuel deep-sea oil rush', *The Australian*, 3 April 2010, available at <http://www.theaustralian.com.au/news/nation/finds-fuelbrdeep-seabroil-rush/story-e6frg6nf-1225849081371>.

particular pressure and temperature envelope. It has been 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. 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.[18]

They are a particularly attractive as a potential energy resource not only because of their abundance but also because they can deliver substantial energy with more limited release of greenhouse gas emissions than comparable 'traditional' energy carriers. For example, methane liberates around 45% more energy when burnt than heavy fuel oil. Further, burning one tonne of heavy oil generates 3.3 tonnes of CO_2 as compared with the 1.24 tonnes of CO_2 generated when one tonne of methane is burnt. Put another way, heavy fuel oil generates 2.66 times more CO_2 as compared to methane. Consequently there are significant potential advantages to substituting gas hydrates for heavy fuel oil.

It should also be noted that gas hydrates are typically found in two different types of geological settings, that is, either onshore, in and below areas of thick permafrost or, offshore, in the marine sediments of the outer continental margins. The offshore setting where hydrates are liable to occur is directly applicable to extended continental shelf areas, as the gas hydrates are seen to occur in a narrow zones, which parallels the sea floor in deeper (500m+) offshore waters.

The commercial production and exploitation of gas hydrates does, however, face significant challenges. Indeed, key technical barriers have yet to be overcome. Gas hydrates are therefore considered the most difficult and expensive of all unconventional gas resources to recover, which would imply that all other unconventional gas resources (including tight gas, coal bed methane, and shale gas resources, for example). Such alternative gas resources are therefore likely to be developed in preference, thereby pushing the place of gas hydrates in the supply market beyond the foreseeable future.[19]

That said, major oil and gas companies are presently actively engaged in developing solutions to the technical obstacles to the commercial recovery of gas hydrates. Should these 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. While deep sea minerals such as polymetallic nodules have been under consideration since at least the 1960s, more recently advances have occurred in relation to the collection and utilisation of minerals such as phosphorites, evaporates and polymetallic sulphides.[20]

Although the exploitation of some of these resources does not appear to be commercially viable at present, this situation may well change over time as requirements and prices change and technologies develop. Current efforts to exploit sea floor massive sulphide deposits in the Bismarck Sea off Papua New Guinea illustrate the potential for such novel developments in the

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

19 *Ibid*.

20 Schofield and Arsana, 2009:.51-54.

Pacific island States.[21] 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.[22] Analogous interest in seabed mining, including on areas of extended continental shelf, has been expressed by States such as the Federated States of Micronesia, Japan, Kiribati and Palau (examples provided in accompanying graphics).

Marine genetic resources from the deep

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 "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."[23] These sedentary living resources of the outer continental shelf, including marine genetic resources, may also prove to have considerable value which, to date, remains largely untapped.

The potential in terms of marine genetic resource derived from extended continental shelf areas is underscored by the fact that around 1,000 new marine natural products are reported annually.[24] This points to how biodiversity-rich yet under-explored and thus little known the oceans are. Indeed, the number of ocean-dwelling species has been estimated at around 10 million – a figure 50 times greater than the number of marine species reported thus far. In this context deep water areas, including extended continental shelf areas, hold particular promise as they are likely to host unique extremophiles and also because these areas are least explored, notwithstanding considerable advances in technologies applicable to exploring deep sea areas made in recent decades.[25] This is illustrated by the fact that of over 30,000 marine natural products reported since the 1960s, less than 2% derive from the deep sea organisms.[26]

Future Challenges

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

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 extended continental shelf boundaries remains a key challenge for the coastal States involved as this task is beyond the purview of the Commission.[27] With respect to realising the marine resource opportunities and benefits potentially arising from

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21 Regarding developments in seafloor polymetallic massive sulphide mining see Herzig, P.M. (2004) 'Seafloor Massive Sulfide Deposits and Hydrothermal Systems', pp.431-456 in *Legal and Scientific Aspects of Continental Shelf Limits*, M.H. Nordquist, J.H. More, and T.H. Heidar (eds), (Martinus Nijhoff Publishers).

22 Bashir, M. (2011) 'Deep sea mining lease granted, *The Post-Courier*, 19 January 2011, available at <http://www.postcourier.com.pg/20110119/news03.htm>.

23 LOSC, Article 77(4).

24 Skropeta, 2011: p.217.

25 *Ibid*., p.221.

26 *Ibid*.

27 In keeping with LOSC, Article 76(10) the Commission's recommendations are specifically without prejudice to the delimitation of continental shelf boundaries.

rights over areas of extended continental shelf, this is likely to be compromised by overlapping jurisdictional claims. For instance, in the Asia-Pacific region in excess of 26% of the extended continental shelf areas in question are subject to overlapping submissions. This is the case because this scenario deprives commercial entities such as international oil and gas companies of the fiscal and legal certainty that 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. Similarly, significant oceans governance challenges arise with respect to extended continental shelf areas, even where no overlapping claims exist.

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