

Geospatial Aspects of Maritime Boundary Delimitation in the Singapore Strait involving Indonesia, Malaysia and Singapore

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Key words: maritime boundary, delimitation, geodetic datum, geospatial, law of the sea, sovereignty

SUMMARY

Indonesia and Singapore have made a significant achievement regarding maritime boundary delimitation. Approximately 36 years after the first agreement was signed, the two neighbouring States finally agreed upon a new maritime boundary segment in the Singapore Strait. It took about four years for the two States to negotiate the boundary before it was finally signed in March 2009. Unlike the previous agreement signed in 1973, this new agreement specifies a geodetic datum to determine the coordinates of the maritime boundary between the two States. The use of specific geodetic datum is an advancement from a geospatial point of view.

This paper discusses the maritime boundary delimitation between Indonesia and Singapore with emphasis on its geospatial aspects. Furthermore, the challenges and opportunities in completing maritime boundaries in the Singapore Strait involving Indonesia, Singapore, and Malaysia will be analysed. Maritime claims of each State will be simulated based on the provisions of the United Nations Conventions on the Law of the Sea, 1982 (Law of the Sea Convention, LOSC). Several options of maritime boundary delimitation among the three States will be presented.

RANGKUMAN

Indonesia dan Singapura telah mencapai kemajuan berarti dalam hal delimitasi batas maritim antara keduanya. Sekitar 36 tahun setelah perjanjian batas maritim ditandatangani untuk pertama kali, kedua negara akhirnya menyepakati sebuah perjanjian segmen batas maritim baru di Selat Singapura. Negosiasi untuk mewujudkan perjanjian baru itu berlangsung sekitar empat tahun secara intensif sebelum akhirnya ditandatangani pada bulan Maret 2009. Berbeda halnya dengan perjanjian tahun 1973, perjanjian baru ini menyebutkan secara spesifik datum geodesi yang digunakan untuk koordinat titik-titik batas. Hal ini dipandang sebagai kemajuan dari sudut pandang geospasial.

Makalah ini membahas delimitasi batas maritim antara Indonesia dan Singapura dengan menekankan pada aspek geospasial. Selanjutnya akan dibahas juga perihal tantangan dan peluang dalam merampungkan delimitasi batas maritim di Selat Singapura yang melibatkan Indonesia, Malaysia dan Singapura. Akan dilakukan simulasi klaim maritim oleh masing-masing negara berdasarkan ketentuan dalam Konvensi PBB tentang Hukum Laut 1982. Makalahi juga akan menyampaikan opsi-opsi delimitasi batas maritim antara ketiga negara.

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1. INTRODUCTION

1.1 Indonesia-Singapore new maritime boundary agreement

On 10 March 2009, Indonesia and Singapore signed an agreement on a short segment of territorial sea boundary in the western side of the Singapore Strait (MFA Indonesia, 2009). The agreement was achieved after an intensive four year negotiation between the two States involving series of talks taking place in Indonesia and Singapore. This new agreement concerning maritime boundaries is the second one for Singapore and Indonesia. The first agreement between the two States was signed in 1973 delimiting the territorial sea between Singapore and Indonesia's Pulau Batam (Park, 1993), containing six turning points (point 1 to 6). Beyond these points, a significant portion of the maritime boundary has not been defined. In March 2009, under the new agreement, Indonesia and Singapore have managed to agree to three additional turning points, extending the segment a little further.

For Indonesia, this 2009 agreement is also the second one in the 21st century, after a continental shelf boundary segment with Vietnam was concluded in June 2003 (Act No. 18/2007). The boundary was negotiated with Vietnam for approximately 25 years before reaching agreement in 2003. Previously, in 1997, a maritime boundary line was agreed between Indonesia and Australia after the first maritime boundary signed between the two countries in 1971 (Prescott, 1997, and Prescott, 1993a). This indicates that maritime boundary negotiation is by no mean easy to conclude. This gives an idea of the complexity of negotiating maritime boundaries between States, particularly for Indonesia, which has to settle maritime boundaries with ten of its neighbours: India, Thailand, Malaysia, Singapore, Vietnam, Philippines, Palau, Papua New Guinea, Australia and Timor Leste.

It is worth noting that the existing boundaries between Indonesia and Singapore signed in 1973 does not specify geodetic datum (Abidin, et al, 2005). A geodetic datum is a reference onto which coordinates of position are expressed. Without a specific geodetic datum, coordinates of boundary points (latitudes and longitudes) are meaningless. Most importantly, this can bring difficulties in law enforcement. For instance, the absence of geodetic datum in a maritime boundary treaty will make border patrol teams unable to locate actual boundary lines in the field. Accordingly, it is impossible for the authorities to judge whether or not a vessel/boat has committed offences by crossing into another State's waters. In the 2009 treaty, this geodetic datum issue has been addressed by specifically defining a geodetic datum which is WGS84.

1.2 Latest development in the Singapore Strait

Before an agreement was achieved by Indonesia and Singapore, a decision was made by the International Court of Justice (ICJ) concerning the sovereignty over three contested geographical features in the Singapore Strait: Pedra Branca (PB), Middle Rocks (MR) and

South Ledge (SL). Through its decision on 23 May 2008, the ICJ award PB to Singapore and MR to Malaysia. Meanwhile, the sovereignty over SL remains undecided (ICJ, 2008).

The 28-year sovereignty dispute over these three islands/rocks in the eastern entrance of Singapore Strait was brought to the ICJ in 2003 by Malaysia and Singapore. Public hearings were held in The Hague on 6-23 November 2007, where the two claimants presented their arguments. The ICJ decision was made by majority vote six months later. The reasoning of the court in making their determination may be debatable, but the decision is final and binding. This principle of binding acceptance of the final judgement was agreed prior to bringing the case before the court. The next important step is the delineation of maritime boundaries in the Singapore Strait in the aftermath of the ICJ decision. As previously mentioned, this will involve Indonesia, Singapore and Malaysia.

1.3 Maritime delimitation challenges in the Singapore Strait

It has been widely understood that the Singapore Strait is a busy shipping route (Ho, 2006 and Bateman et al., 2007) and one of the “most critical navigational bottleneck” of the world (Park, 1993). Therefore, the certainty of sovereignty and sovereign rights in the strait is undoubtedly important. Hence, the delimitation of maritime boundaries among three relevant parties: Indonesia, Singapore and Malaysia is indispensable. Singapore and Malaysia, through its Joint Technical Committee, have started the negotiation to define the sovereignty over SL and to delimit maritime boundaries between them. At the time of writing, the latest meeting was on 8 January 2010 in Singapore (Xinhua, 2010).

In the western side, a three-junction point has to be settled serving as a common point for Indonesia, Malaysia and Singapore. In the eastern side of point 6, lines have to be established to delimit sovereignty over maritime area between Singapore, between Indonesia and Malaysia and between Singapore and Malaysia (see Figure 2). In certain locations, other tree-junction points also need to be defined among the three neighbours (Park, 1993).

This paper discusses options and possibilities for Indonesia, Malaysia and Singapore to delimit their maritime boundaries in the Singapore Strait. The decision made by the ICJ concerning the sovereignty over PB, MR and SL will be taken into consideration, which is viewed to be facilitating the delimitation. This paper will also begin with an introduction to maritime claims pursuant to the International Law of the Sea and the principle of maritime delimitation. Two options of maritime boundary lines will be presented with analysis.

2. MARITIME CLAIMS AND DELIMITATION

Before stepping into the Singapore Strait case, it is worth understanding the principle of maritime claims and boundary delimitation. These following subsections describe how a coastal State can claim maritime area, and where maritime delimitation is required.

2.1 Maritime claims

The United Nations Convention on the Law of the Sea 1982 is the latest and most comprehensive convention on the law of the sea. The Convention entered into force on 16 November 1994 and has been ratified by 159 States plus one European Community (United Nations, 2009). LOSC established a number of maritime zones, each of which assigns

different exclusive rights and control to coastal States. The zones are territorial sea, contiguous zone, Exclusive Economic Zone (EEZ) and continental shelf. Each maritime zone is measured seaward from baseline, a reference from which limits of maritime jurisdictions are measured (LOSC, Art. 5, 7, 9, 10, 11, 12, 13, 47), with different breadth for each zone. The limit of territorial sea is 12 nautical miles (M) from baseline (LOSC, Part II), while contiguous zone is measured 24 M seaward from baseline (LOSC, Part II). EEZ's breadth is defined beyond territorial sea up to 200 M ((LOSC, Part V). Unlike other maritime zones, the breadths of which are specific in dimension, the breadth of continental shelf does not only depend on distance criteria. The outer limits of the continental shelf also consider the geology and geomorphology of seabed (LOSC, Art. 76). Accordingly, LOSC does not have a fixed value for the breadth of the continental shelf. However, the procedure to define the outer limits of continental shelf has been established by the United Nations Commission on the Limits of the Continental Shelf (CLCS) which serves as the official guidelines for coastal States (CLCS/11).

It has been observed that if all coastal States were to make their maximum maritime claims permitted by the LOSC, around 44.5% of the world's ocean could possibly fall under some form of national jurisdiction. This means that the remaining high seas would encompass approximately 55.5% of world's ocean surface (Pruett, 2004).

2.2 Introducing maritime boundary delimitation

With such a geographical situation, it is hard to find that a coastal State that can claim a full suit of maritime zones without having overlapping claims with its neighbours. To be able to fully claim EEZ, for example, distance of a coastal State from its neighbours must be more than 2 times 200 M. For the case of continental shelf, the distance required may be even more. However, this situation does not impact the way the breadth of maritime zones are, theoretically, measured from baselines. Considering the geographical location of coastal States in the world and the configuration of their coasts, overlapping claims of maritime zones among coastal States is inevitable (see Figure 1). Accordingly, maritime boundary delimitation is required.

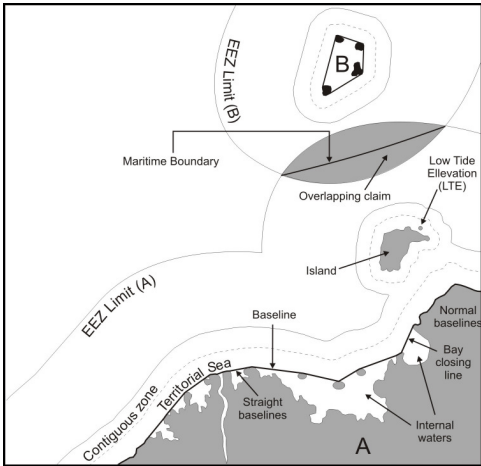


Figure 1 Principle of maritime boundary delimitation

The process of maritime boundary delimitation between two or more coastal States is governed by the principles and rules of public international law (Prescott and Schofield, 2005). International law provides the rules of the game explaining how maritime boundary delimitations should be established. Prescott and Schofield (2005) also assert that maritime boundary delimitation is usually resolved either through negotiation among affected parties or by submission of the case to the third party. This third party can be arbitrators, mediators, courts or tribunal such as ICJ and the International Tribunal for the Law of the Sea (ITLOS).

Figure 1 shows that overlapping claim takes place in EEZ and continental shelf because distance between State A and B is less than 400 M but is more than 24 M. Should the distance between those two neighbouring States be less than 24 M then their territorial sea will overlap one another. Figure 1 also illustrates that maritime boundary delimitation can be required for territorial sea, EEZ, or continental shelf, depending on the distance between States in question. In this regard, rules governing maritime boundary delimitation for those different zones are also different (see also Arsana, 2007).

It is not easy to tell the exact number of maritime boundaries in the world since there are different criteria and assumptions to judge whether or not, for example, a line segment qualifies a single boundary. As per February 2009, around 170 maritime boundaries have been agreed and approximately 365 maritime boundaries are yet to be settled (Pratt, personal communication, 2009). In the case of Indonesia, there are pending maritime boundaries in the Singapore Strait that require three States to be involved: Indonesia, Malaysia and Singapore. The following sections and subsections focus on the delimitation of maritime boundary in the concerned area.

3. METHODOLOGY

This paper focuses on the geospatial aspects of maritime boundary delimitation in the Singapore Strait. This section, with its subsections, describes data and software used in the research followed by steps and methods used in identifying possible options of delimitation for the three States.

3.1 Data and Software

The main geospatial data required for this delimitation exercise is the British Admiralty Chart (BAC) covering the geographical area the Singapore Strait. Detailed specification of the BAC is as follow:

1. Chart title: Singapore Strait: Eastern Part.
2. Chart number: BAC-3831.
3. Scale: 1:75.000.
4. Horizontal datum: WGS84.
5. Vertical datum: Lowest Astronomical Tides (LAT).
6. Coordinate System: Geography.
7. Coordinate coverage: 1°00'00'' N to 1°30'00' N and 104°00'00' E to 104°30'00'' E.

BAC is selected because it has been internationally recognised and is commonly used in international treaties. The last two treaties Indonesia signed with its neighbours (with Vietnam

in 2003 and Singapore in 2009) also use BAC. CARIS LOTS™, a specialised GIS-based software with maritime boundary delimitation functions, was used as an assisting tool in this research. CARIS LOTS™ also provides the world vector shoreline (WVS) data, which can be used together with BAC. The present research focuses on those particular features of CARIS LOTS™ related to the outer limits and boundaries for delimitation of maritime zones.

3.2 Pixel resolution and geo-registration process

Since it is a GIS software, CARIS LOTS™ can only work with digital data. Digital (scanned) BAC was obtained from the Indonesian National Coordinating Agency for Surveys and Mapping (Bakosurtanal). It has a resolution of 300 dpi ('dot per inch' or 'pixel per inch') with a scale of 1:75,000. Pixel resolution can be obtained using a simple formula as follows:

$$\text{Pixel resolution} = \frac{\text{scale factor}}{\text{image resolution}}$$

Provided that the scale of BAC is 1:75,000, and the image resolution is 300 *dpi*, where 1 inch equals 2.54 cm, then:

$$\begin{aligned}\text{Pixel resolution} &= \frac{75,000}{300 \text{ pixel per inch}} \\ &= 250 \text{ inch per pixel} \\ &= 6.35 \text{ m per pixel}\end{aligned}$$

Considering that maritime boundaries are usually depicted on a BAC with a scale of about 1:75,000 (or even smaller), pixel resolution of 6.35 meter is reasonable acceptable. This distance of 6.35 m will be represented by a distance of less than 1 mm in such a chart.

A scanned BAC has to be geo-registered in order for the chart to have 'grounded' coordinates. In this process, several common points are required as control points. The points have to be identified as ground points which will serve as destination points on the ground, and the same number of points on the scanned image as the original points. Those pairs of points have to be identifiable and their coordinates have to be known in both system. In this geo-registration, latitude and longitude depicted in the BAC were used as ground coordinates. The quality of geo-registration can be assessed analytically using the RMS error and visually by assessing the conformity of the image and WVS provided by CARIS LOTS™.

3.3 Baselines definition

As previously mentioned, baselines are important in maritime claims and delimitation. In order to exercise maritime delimitation in the Singapore Strait, baselines of Indonesia, Malaysia and Singapore need to be defined. In this case, Indonesia is an archipelagic State which is entitled to employing archipelagic baselines (LOSC, Art. 47). Indonesia has also deposited the coordinates of its completed archipelagic baselines to the United Nations (United Nations, 2009). Accordingly, baselines used in this research for Indonesia are archipelagic baselines as listed in the Government Regulation No. 38/2002 and revised by the

Government Regulation No. 37/2008. Basepoints forming relevant baselines segment for the purpose of this delimitation are TD.192, TD.193, TD.194, and TD.195 listed in the Government Regulation No. 38/2002.

Meanwhile, Singapore is not an archipelagic State so it is not entitled to the use of archipelagic baselines. In addition, Singapore has never published any type of baselines to be recognised by the international community. Therefore, Singapore, in this case, uses normal baseline. As asserted by Beckman and Schofield (2009), if a State does not publish any type of baselines, then the State employs normal baselines. Apart from using normal baselines, Singapore can also use PB as a new basepoint relevant to its maritime claim. This is made possible since the sovereignty over PB has been decided by the ICJ through its decision on 23 May 2008 (ICJ, 2008).

Similar case for Malaysia, it uses normal baselines because it is not an archipelagic State and has never officially published any other type of baselines. Its normal baselines are along the coastline of Johor and also several small islands in the vicinity of Johor. Malaysia can also use MR as a new basepoint as it has been awarded to Malaysia by ICJ. Geographically speaking, MR may have a significant role in maritime delimitation between Singapore and Indonesia, and also for territorial sea delimitation between Malaysia and Singapore around PB and MR. Figure 2 illustrates relevant baselines in the delimitation of maritime boundary in the Singapore Strait and three geographical features.



Figure 2 Singapore Strait – baselines, basepoints and islands/rocks

3.4 Maritime Delimitation in the Singapore Strait

Singapore Strait is located between Malacca Strait to the west and South China Sea to the east. The Strait is around 105 km in length and 16 km in width (measured on BAC No. 3831). PB's maximum length is 137 m and its width is 60 m. It is around 8,560 m² during *low tide*, situated at 1°19'48" N and 104°24'27" E. The feature is located at a distance of 24 M from the nearest point of Singapore, 7.7 M from Johor (Malaysia) and 7.6 M from Pulau Bintan (Indonesia) (ICJ, 2008). Pedra Branca is a Portuguese word meaning "*white rock*". This might be the reason why Malaysians call it "*Batu Putih*" which means "white rock". A lighthouse called Horsburgh was built on PB between March and October 1851.

Close to PB are MR and SL. MR is around 0.6 M to the south of PB and consists of two small rocks which always appear during high tide, 0.6 to 1.2 meter above sea level. Those two rocks are 250 m from each other. Meanwhile, SL is a low tide elevation (LTE) which only appears during low tide at a distance of 2.2 M to the southwest of PB. The geographical setting of PB, MR, and SL is illustrated in Figure 2.

Considering the geographical setting and distance among these three States, they need to delimit their territorial sea since maximum distance separating them is no more than 24 M from each other. Article 15 of LOSC states that if there are two or more opposite or adjacent States with overlapping claim of territorial sea, "neither of the two opposite or adjacent States is entitled to extend its territorial sea beyond the median line" unless either State involved agrees otherwise, or due to the existence of "historic title or other special circumstances". In other words, a method acceptable for delimitation among these three States is median line or equidistance line, unless there are special circumstances. However, PB, MR and SL can be viewed as small islands/rocks that may cause disproportionate effect to the delimitation. This might be considered as 'special circumstance' leading to the retreat from the use of equidistance line.

Options of delimitation have been explored using different configurations of baselines and technical and legal considerations. Boundary lines are drawn from Point 6, taken from the 1973 agreement as the starting point. Options of delimitation in the Singapore Strait are discussed in Section 4, Result and Discussion.

3.5 Issues of South Ledge

It is interesting to observe that ICJ did not make a final decision on SL. The decision merely declares that the LTE belongs to the State in the territorial waters of which it is located. This indicates that territorial sea claims by Singapore and Malaysia have to be analysed first to define the sovereignty over SL.

In order to define the territorial sea that 'contains' SL, delimitation between Indonesia and Malaysia will be performed by ignoring SL. These options of delimitation will help the definition of the sovereignty over SL. After the definition of sovereignty, further delimitation between Indonesia and Malaysia or between Singapore and Malaysia or between Indonesia and Singapore can be performed by taking SL into consideration. This issues of sovereignty over SL will influence the options of delimitation in Singapore Strait as discussed in Section 4, Result and Discussion.

3.6 Three-Junction Points in the Singapore Strait

Three-junction points or TJPs are common points connecting maritime boundary lines between Indonesia and Singapore (The Geographer, 1974), between Indonesia and Malaysia (The Geographer, 1970), and between Malaysia and Singapore. Relevant TJPs among the three States will be the intersection among three boundary lines: Indonesia-Singapore, Indonesia-Malaysia, Malaysia-Singapore. At some stages, Indonesia, Malaysia and Singapore will need to conduct a negotiation to define the TJPs among them.

4. RESULT AND DISCUSSION

Beckman and Schofield (2009) conducted studies concerning maritime delimitation in the Singapore Strait and provided options of maritime boundaries.¹ Similarly, in April 2009, Bakosurtanal issued a Map of the Republic of Indonesia (Peta NKRI) depicting Indonesia's forward position concerning maritime boundaries, including those in the Singapore Strait. This current study also considers options proposed by Beckman and Schofield (2009) and tentative maritime boundaries depicted in Peta NKRI 2009.

4.1 The use of different baselines

Indonesia, being an archipelagic State, can use its archipelagic baseline in boundary delimitation. However, it is evident that in many maritime delimitation agreements, archipelagic baselines are not given full effect in maritime delimitation. Consideration is only given to basepoints constructing the baseline. This, for example, can be observed from the seabed boundary between Indonesia and Thailand in the Malacca Strait and Andaman Sea signed on 17 December 1971 (Prescott, 1993b). Accordingly, many boundary lines are constructed using basepoints along the coast during low tide without giving full effect to baselines constructed by those basepoints. This is one of the reasons for exploring options of using both archipelagic and normal baselines for Indonesia in this study. Meanwhile Malaysia and Singapore use normal baselines since they are not archipelagic States and have not published any type of baseline other than normal baselines.

The use of two different baselines for Indonesia results in different options of boundary line, especially in the area south of Malaysia peninsula. The use of archipelagic baselines generate a relatively straight line, while the use of normal baselines cause the boundary line to curve inward towards Indonesia (Pulau Batam and Bintan), generating a space of maritime area between the two options (see Figure 4). Even though there is possibility for Malaysia to ask Indonesia to use normal baselines, it seems that Indonesia will most likely prefer archipelagic baselines. It has two strong reasons: a) Indonesia has been recognised as an archipelagic State and has also deposited its completed archipelagic baselines to the United Nations and b) giving a full effect to the archipelagic baselines is clearly more advantageous for Indonesia.

4.2 Pedra Branca, Middle Rock and South Ledge

The weight given to PB, MR and SL is another issue in maritime delimitation in the Singapore Strait. An important thing to deal with is the status of PB, whether or not it is an

¹ The first Author of this paper provided technical assistance in dealing with mapping aspects of the research conducted by Beckman and Schofield (2009).

island according to the LOSC, Article 121. Should PB be considered as an island, it is entitled to a full suit of maritime jurisdictions. However, there will always be possibility for Indonesia, for example, to argue that this small island should not be given full effect in maritime delimitation because it may cause disproportionate effect (Beckman and Schofield, 2009).

As in the case of MR, it might be reasonably acceptable to consider it as a rock that is still entitled to a territorial sea. In delimiting maritime boundaries between Malaysia and Indonesia to the south of MR, Indonesia might view that the small rock should not be given full effect, while it maintains the use of archipelagic baselines. Meanwhile, it does not matter which State will be awarded SL (either Malaysia or Singapore), it is a low tide elevation, to which Indonesia may prefer not to give full effect in maritime delimitation. This view is confirmed by tentative maritime boundary lines in the Singapore Strait depicted in Peta NKRI 2009. It seems that the boundary line has been constructed by giving PB, MR and SL only very limited weight. However, it is not easy to quantify accurately the effect/weight given to them, provided that the scale of Peta NKRI 2009 is too small for such analysis. The map does not even show where MR and SL are (see Figure 3).



Figure 3 Tentative territorial sea boundary in the Singapore Strait according to Peta NKRI 2009

Meanwhile, Beckman and Schofield (2009) also provide another option that Indonesia may prefer PB, MR and SL to be enclaved and are given only 3 or 6 M territorial sea as illustrated in Figure 4. This consequently generates an option where those three features will secure a pocket of territorial sea in the Singapore Strait. However, this proposal might be challenged by Singapore as it has made clear that it claims 12 M territorial sea, instead of 3 or 6 M, as declared in a press release made by Ministry of Foreign Affairs, Singapore on 15 September 1980 and was reasserted in another press release concerning ICJ’s decision to award sovereignty of PB to Singapore (MFA Singapore, 2008).

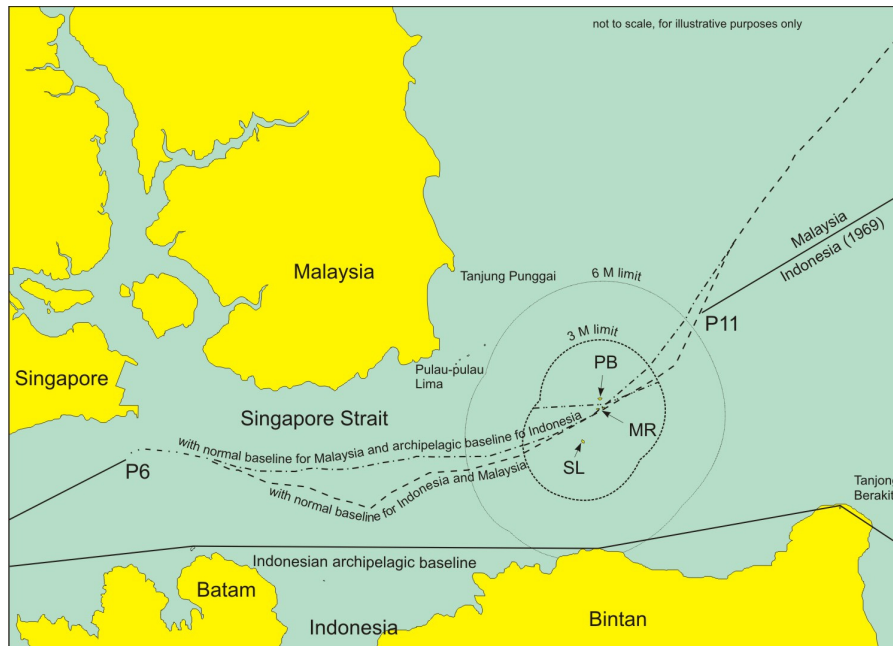


Figure 4 Maritime boundary options in the Singapore Strait

4.3 EEZ option for Singapore

Having generated a strictly equidistant line by giving full effect to all geographical features and baselines, it is identified that there is possibility for Singapore to claim EEZ from PB. This will only be made possible, however, if PB is officially recognised as an island according to LOSC Article 121 and not merely a rock. Strictly equidistant lines among the three States in the region possibly form a triangle area of EEZ for Singapore to the north east of PB, beyond its territorial sea. By assuming PB is entitled to a 12 M territorial sea, the triangle of EEZ may account for around 160 square kilometres (geodetic), based on a calculation on BAC-3831 assisted by CARIS LOTS™. This would mean that PB will secure a pocket of territorial sea and a pocket of EEZ.

However, the EEZ option for Singapore might not be seen acceptable to Indonesia because PB is only a small island/rock, which should not cause disproportionate effect in maritime claims and delimitation. In addition, PB may not satisfy requirements to be recognised as an island according to LOSC Article 121 (Bernama, 2008). Should PB be merely considered a rock that cannot “sustain human habitation”, the maximum claim that it can make would be 12 M territorial sea. It does not matter whether PB is an island or rock, Indonesia does not consider it in maritime delimitation. This can be inferred from Peta NKRI 2009 depicting tentative boundary lines ignoring PB in the Singapore Strait.

4.4 Geospatial aspects

The 1973 agreement between Indonesia and Singapore does not specify geodetic datum. However, the 2009 agreement seems to have addressed the issue by mentioning WGS84 as the datum. This standard will, ideally, be followed by future maritime agreements in the Singapore Strait. The certainty of geodetic datum will help authorities in defining the actual boundary in the field, as usually mandated by the agreements. For practical reasons, a

mechanism of locating lines or points identified in the 1973 agreement out in the field is required because the agreement did not specify any geodetic datum. In relation to this, Abidin et al (2005) proposed a mechanism in transforming existing geodetic datum of Indonesia's maritime boundaries into WGS84. This global datum of WGS84 is preferred because it is compatible to modern navigation technology such as GPS. Accordingly, the use of modern technology will help users of the Singapore Strait to navigate in the strait without crossing State borders unintentionally. In addition, it will also assist authorities in conducting law enforcement with the help of modern navigation technology.

Another geospatial aspect to be taken into consideration is the use of straight line types for the agreement. Technically, there are more than one type of straight line that can be used such as geodesic, loxodrome, or chord line. A clear definition of line types used to connect points (baseline, boundary lines) in an agreement is important since each line can be significantly different compared to the other (Arsana and Sumaryo, 2008). Over a long distance, the differences can accumulate significantly. In this case the same two turning points can generate different lines depending on type of lines used to connect the two points.

5. CONCLUDING REMARKS

The success of Indonesia and Singapore in establishing maritime boundaries through the series of negotiations is an example of good bilateral relationship. Similarly, the decision of ICJ on the sovereignty over the three disputed geographical features: PB, MR, and SL is also a good achievement by Malaysia and Singapore. All of these may facilitate the completion of maritime delimitation in the Singapore Strait involving Indonesia, Malaysia and Singapore.

Geospatial analysis has been conducted to exercise maritime delimitation in the Singapore Strait. It has been identified that the three States in the region have to delimit their territorial sea, and potentially EEZ. Different options of maritime boundaries may be achieved depending on, among others, baselines used in the delimitation. Indonesia, in this case, is entitled to the use of archipelagic baseline, while Singapore and Malaysia use normal baselines. However, Singapore and Malaysia can use the newly-secured PB and MR for their basepoints, respectively. In addition, options of delimitation can also be achieved by giving different weight to small geographical features (i.e. PB, MR and SL). While Singapore and Malaysia might prefer to give full effect to them, Indonesia might view that full effect may cause disproportionate affect to their maritime boundaries. This seems to be one of the issues that will be discussed intensively by the three States in the future negotiations.

Notwithstanding the fact that maritime delimitation in the Strait of Singapore is far from automatic, this is the time for prioritising the process. Negotiation process started by Malaysia and Singapore should subsequently involve Indonesia. In the end, the final and binding maritime boundaries in the Singapore Strait have to be agreed upon by the all three States: Indonesia, Malaysia and Singapore. This is a scientific study that does not consider political aspects of the case. This is aimed at providing alternative methods of delimitations that might be considered by Indonesia, Malaysia and Singapore in negotiating their maritime boundaries. The final and binding agreement will, however, exclusively be decided by the three States involved.

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REFERENCES

- Abidin, Hasanuddin Z., Sutisna, S., Padmasari, T., Villanueva, K. J. and Kahar, J., 2005, Geodetic Datum of Indonesian Maritime Boundaries: Status and Problems, *Marine Geodesy*, 28:4, pp. 291- 304.
- Act No. 18, 2007 on Ratification of the Agreement Between The Government Of The Republic Of Indonesia And The Government Of The Socialist Republic Of Vietnam Concerning The Delimitation Of The Continental Shelf Boundary, 2003 [Pengesahan Persetujuan Antara Pemerintah RI Dan Pemerintah Republik Sosialis Vietnam Tentang Penetapan Batas Landas Kontinen, 2003], 15 March 2007. Available at <<http://www.djpp.depkumham.go.id/inc/buka.php?czoyNDoiZD0yMDAwKzcmZj11dT E4LTIwMDcuaHRtIjs=>>>.
- Arsana, IMA. and Schofield, C., 2009, Extending Indonesia? Opportunities and Challenges Related to the Definition of Indonesia's Extended Continental Shelf Rights, in Cribb, R. and Ford, M. (eds) *Indonesia Beyond the Water's Edge*, Singapore ISEAS Publications.
- Arsana, IMA. and Sumaryo, 2008 Geospatial Aspects of Indonesia's International Maritime Boundaries in Relation to Border Management [Aspek Geospasial Batas Maritim Internasional Indonesia dalam Pengelolaan Wilayah Perbatasan], Seminar and Workshop on "Border Area Management", Yogyakarta, Universitas Pembangunan Nasional "Veteran".
- Arsana, IMA., 2007, *International Maritime Boundaries: A Technical and Juridical Perspective [Batas Maritime Antarnegara: Sebuah Tinjauan Teknis dan Yuridis]*, Yogyakarta, Indonesia, Gadjah Mada University Press.
- Beckman, R., and Schofield, C., 2009, Moving Beyond Disputes Over Island Sovereignty: ICJ Decision Sets Stage for Maritime Boundary Delimitation in the Singapore Strait, *Ocean Development & International Law*, 40:1, 1-35.
- Bernamea, 2008, Singapore's Bid To Claim Territorial Sea Around Batu Puteh Unlawful, Says Legal Expert, Kuala Lumpur. Available at <http://www.bernama.com/bernama/v3/news_lite.php?id=348052>.
- CLCS/11, 1999, Scientific and Technical Guidelines of the Commission on the Limits of the Continental Shelf.
- Ho, J.H., 2006, The Security of Sea Lanes in Southeast Asia, *Asian Survey*, Vol. 46, No. 4 (Jul. - Aug., 2006), pp. 558-574, United States of America, University of California Press.
- ICJ, 2008, Sovereignty over Pedra Branca/Pulau Batu Puteh, Middle Rocks and South Ledge (Malaysia/Singapore). International Court of Justice (ICJ), the Netherlands. Available at <<http://www.icj-cij.org/docket/files/130/14492.pdf>>.

- IHB, 2006. A Manual on Technical Aspects of the United Convention on the Law of the Sea, Special Publication No 51, 4th edition, Monaco, International Hydrographic Organization (IHO).
- MFA Indonesia, 2009, Press Release: The Signing of The Treaty Between The Republic of Indonesia and The Republic of Singapore Relating to The Delimitation of The Territorial Seas In The Western Part of The Strait of Singapore, Jakarta, 10 March. Available at <http://www.deplu.go.id/_layouts/mobile/PortalDetail-PressReleaseLike.aspx?l=en&ItemId=c148acb8-88c6-4e24-9dd3-352ec9cd90c2>.
- MFA Singapore, 2008. Ministry of Foreign Affairs Press Statement: International Court of Justice Awards Sovereignty of Pedra Branca to Singapore, 23 May 2008. Available at <http://app.mfa.gov.sg/pr/read_content.asp?View,10195,>.
- Park, C., 1993, Indonesia-Singapore in Charney J.I. and Alexander L.M. (eds) International Maritime Boundaries, pp. 1049-1056, the Netherlands, Martinus Nijhoff Publishers.
- Pratt, M., 2009, Personal communication with Dr. Martin Pratt on 13 February 2009. Martin Pratt is the Director of Research of the International Boundary Research Unit (IBRU) University of Durham, UK.
- Prescott, JRV. and Schofield, C., 2005, The Maritime Political Boundaries of the World, Second Edition, Martinus Nijhoff Publishers.
- Prescott, JRV., 1993a, Australia-Indonesia (Seabed Boundaries) in Charney J.I. and Alexander L.M. (eds) International Maritime Boundaries, pp. 1195-1205, the Netherlands, Martinus Nijhoff Publishers.
- Prescott, JRV., 1993b, Indonesia- Thailand (Malacca Strait and Andaman Sea) in Charney J.I. and Alexander L.M. (eds) International Maritime Boundaries, pp. 1445-1463, the Netherlands, Martinus Nijhoff Publishers.
- Prescott, JRV., 1997, The completion of marine boundary delimitation between Australia and Indonesia, Geopolitics, Vol. 2 No. 2, pp. 132 – 149.
- Pruett, L. 2004. Area Calculations of the Claims and Potential Claims to Offshore Jurisdictional Zones and High Seas, unpublished data derived from the August 2003 Edition of the Global Maritime Boundaries Database, General Dynamics, Herndon, VA, USA, in Prescott, V. and Schofield, C. 2005. The Maritime Political Boundaries of the World, 2nd edition, Martinus Nijhoff Publishers.
- S. Bateman, J. H. Ho, and M. Mathai, 2007, Shipping Patterns in the Straits of Malacca and Singapore: An Assessment of the Risks to Different Types of Vessel, Contemporary Southeast Asia 29, pp 309–332, at 325.
- The Geographer, 1970, Continental Shelf Boundary: Indonesia –Malaysia, Limit in the Seas, Department of States, The Geographer, Washington D.C.
- The Geographer, 1974, Territorial Sea Boundary: Indonesia – Singapore, Limit in the Seas, Department of States, The Geographer, Washington D.C.
- United Nations, 1982, United Nation Convention on the Law of the Sea 1982, Montego Bay, Jamaica.
- United Nations, 2009, Chronological lists of ratifications of, accessions and successions to the Convention and the related Agreements as at 06 November 2009. Available at <http://www.un.org/Depts/los/reference_files/chronological_lists_of_ratifications.htm>.
- United Nations, 2009, Deposit of a list of geographical coordinates of points of the Indonesian Archipelagic Baselines based on the Government Regulation of the Republic of

Indonesia Number 38 of 2002 as amended by the Government Regulation of the Republic of Indonesia Number 37 of 2008, Law of the Sea Bulletin No. 69. Xinhua, 2010, Singapore, Malaysia meet to settle island dispute, available at <http://news.xinhuanet.com/english/2010-01/08/content_12776298.htm>.

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