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ASIAN STUDIES

Re-framing the South China Sea: Geographical Reality and Historical Fact and Fiction

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Universiti Brunei Darussalam

Working Paper No.33

Institute of Asian Studies, Universiti Brunei Darussalam

Gadong 2017

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Abstract:

The 'labyrinth of detachable shoals' in the South China Sea presented mariners during the late-18th and early-19th centuries with a maritime area of considerable hazard that was best avoided. These same marine features now not only pose a problem for safe navigation within the South China Sea basin but have also challenged the minds of lawyers and politicians since the early-1980s. The basic geographical concepts and definitions of banks, cays, islands, reefs, rock, seamounts and shoals are being debated and often misinterpreted as the legal fraternity and political parties of littoral nation states dispute sovereignty claims and create potential flashpoints in this regional semi-enclosed sea. Indeed, since 12 July 2016, these features have been re-framed in the context of Article 121 of the 1982 UN Convention on the Law of the Sea.

Hydrographers from the western maritime powers, particularly, Britain, France, Spain and United States and those from Japan and to a minimal extent China had undertaken exploration and surveys and recorded and reported their findings on navigational charts and as narratives in journals and official documents since the early-1800s.

This current study, whilst alluding to these historical involvements of the national hydrographical agencies engaged in the waters of semi-enclosed South China Sea focuses on the period from about 1930 to 1980 on account of the contemporary political and security issues raised since the 1960s and the national policies of regional and external maritime powers.

The study centres on a geographical area commonly referred to on navigational charts and prose in various nautical publications as 'Dangerous Ground'. The area is also affectionately known as 'Archipelago of Reefs' and 'Reefs of the South China Sea'. This study examines the records and charts of the early hydrographic surveys and analyse the political and legal implications of the graphics and the uncertainty that has been brought to the fore by researchers of many disciplines. It offers description of the geographical marine features and bathymetry of the basin and the characteristics of the coastlines of the littoral states.

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Re-framing the South China Sea: Geographical Reality and Historical Fact and Fiction

Vivian Louis Forbes

INTRODUCTION

The Admiralty's Hydrographic Office (at times also referred to as the Hydrographic Department) of the Royal Navy of Britain had the resource, strategic interests and trade responsibilities to survey the oceans and seas of the world and delineate the boundaries of vast areas of the high seas. Indeed, the Royal Navy conducted the hydrographic surveys, and the Hydrographic Office produced the nautical charts.[1] This was particularly the case in the South China Sea. The information gleaned from these charts and additional knowledge gained from further surveys were then reproduced by the hydrographic authorities of several other nations, notably, Japan, Spain and the United States. Often there were hidden agendas in the information placed on these charts, mainly for strategic interests and naturally of concern to mariners.

For the '*Dangerous Ground*'[2] region (read, the Spratly Group) and perhaps further afield, for example, the Paracel Group, before 1936, the hydrographic surveys and the preliminary chart were principally derived from Admiralty's font of knowledge. If, however, for any reason, the British Admiralty chose not to circulate (promulgate) information that reported newly discovered dangers, or eliminated previously reported dangers, these amendments or corrections would not

[1] Day, A: *The Hydrographic Office* London: HMSO, offers a comprehensive history in his book. Additional literature on the history and role of UKHO is well documented.

[2] This is a reference to the 400 or more marine features (cays, islands, reefs and rocks) that are scattered over a vast area (nearly 620,000 sqkm) of the South China Sea. On small-scale maps and satellite-derived images they appear as specks on the ocean. Narratives of this regional sea will be found in the excellent and informative series titled *China Sea Pilot,* Volumes I, II and III, published by the Hydrographic Department, Taunton and the authoritative *Sailing Directions (Enroute) South China Sea* published by US Navy. There are various editions of each volume published over several decades. These volumes, together with the relevant charts, produced in the past and contemporary, have been consulted extensively for the preparation of this study especially with reference to the geographical and geophysical descriptions of the marine insular features and the seabed.

necessarily be made available to those who used or reproduced Admiralty charts. It is wise, at this point, to offer the definition given for the limits of the semi-enclosed sea which is the geographical focus of this study. Even the definition of this sea as a semi-enclosed body of water is debated between geographers and oceanographers on the one hand and the legal fraternity on the other hand.

Geographical Limits of the South China Sea

The geographical limits of the South China Sea basin are defined by the International Hydrographic Bureau (now Organisation) in their Special Publication 23 of 1953,[3] reproduced *verbatim*, as follows:

> **49 - South China Sea (*Nan Hai*)**
>
> *On the South*
>
> *The Eastern and Southern limits of Singapore and Malacca Straits (46) as far West as Tanjong Koolabu (1˚ 06′ N, 102˚ 58′ E) down the East coast of Sumatra to Lucipara Point (3˚ 14′ S, 106˚ 05′ E) thence to Tanjong Nanka, the Southwest extremity of Banka Island, through this island to Tanjong Berikat the Eastern point (2˚ 34′ S, 106° 51′ E), on to Tanjong Djemang (2˚ 36′ S, 107˚ 37′ E)in Billiton, along the North coast of this island to Tanjong Boeroeng Mandi (2˚ 46′ S, 108˚ 16′ E) and thence a line to Tanjong Sambar (3˚ 00′ S, 110˚ 19′ E) the Southwest extreme of Borneo.*
>
> *On the East*
>
> *From Tanjong Sambar through the West coast of Borneo to Tanjong Sampanmangio, the North point, thence a line to West points of Balabac and Secam Reefs, on to the West point of Bancalan Island and to Cape Buliluyan, the Southwest point of Palawan, through this island to Cabuli Point, the Northern point thereof, thence to the North west point of Busuanga and to Cape Calavite in the island of Mindoro, to the Northwest point of Lubang Island and to Point Fuego (14˚ 08′ N) in Luzon Island, through this island to Cape Engano, the Northeast point of Luzon, along a line joining this cape with the East point of Balintang Island (20˚ N) and to the East point of Y'Ami Island (21˚ 05′ N) thence to Garan Bi, the Southern point of Taiwan (Formosa), through this island to Santyo (25° N) its North Eastern Point.*

[3] The IHO Publication *SP* 23 of 1953 offers these defined limits which are for administrative purposes and are intended as political statements nor indeed as oceanographic and biogeographic boundaries.

On the North

From Fuki Kaku the North point of Formosa to Kiushan Tao (Turnabou t Island) on to the South point of Haitan Tao (25˚ 25′ N) and thence Westward on the parallel of 25˚ 24′ North to the coast of Fukien.

On the West

The Mainland, the Southern limit of the Gulf of Thailand (47) and the East coast of the Malay Peninsula.

In the context of this study, these are the limits that are adopted for this narrative. Within the prescribed limits the following littoral States, listed by their common form name, are: Brunei, China, Indonesia, Malaysia, the Philippines, Taiwan and Vietnam. About 50 per cent of China's coastline abuts the South China Sea and the western seaboard of the Philippines and Taiwan are washed by the waters of this semi-enclosed sea. The eastern seaboard of Peninsular Malaysia and the northern coasts of Sabah and Sarawak including the coast of Brunei front the South China Sea.

Scope of the Present Study

This study presents a brief description of the oceanographic characteristics of the South China Sea basin. It is an overview to the generalised natural important factors that brings to the fore, the rationale for the international attention given to this body of water since the 1950s and in particular since the introduction of the new law of the sea in the provisions of the 1982 *United Nations Law of the Sea Convention*.[4] This narrative includes the topics of the natural continental shelf and slope, in particular, the Mainland and Sunda Shelves; the nature of the sedimentation on the sea floor; the tides, tidal streams and surface currents; the geography of the Paracel and Spratly Groups; and seamounts, underwater volcanoes and salinity. A brief explanation of the history of hydrographic surveying and charting of the basin and the characteristics of the marine features are included herein. The study commences with the tectonic evidence supporting the creation and evolution of the South China Sea basin.

[4] The full text, in four languages, of the 1982 UN *Convention on the Law of the Sea* is available on the UN's website.

South China Sea Basin

Geography, Geology and Tectonics of the South China Sea

Marine waters around major land masses are typically shallow, lying over a natural continental shelf which may extend from a few kilometres to several hundred kilometres wide. The most landward portion is the littoral or inter-tidal zone where the bottom is subject to periodic exposure to the air. Water depth here varies from zero to several metres. Seaward of this the continental shelf slopes gently from the shore to depths of one to several hundred metres, forming the sub-littoral or shelf zone. Waters below low-tide mark in the continental shelf region are referred to as 'neritic'.

The extent, gradient and superficial geology of the continental shelf areas are determined by many factors, including levels of tectonic activity in the Earth's crust.[5] Every part of the earth's crust is in a continuous movement as evident in the numerous earthquakes that are experienced and recorded at various monitoring stations around the globe. Four major tectonic plates dominate the region. They are the Eurasian Plate, the Philippine Plate, the Pacific Plate and the Indo-Australian Plate.

Tectonic Evidence

From the Eocene (about 64 million years ago [mya]) to Miocene (25 mya) the Pacific oceanic plate sub-ducted north-westerly or westerly along the eastern side of the Kamchatka Peninsula through the Kurile, Japan, and Ryukyu chain of islands, and the Philippine Trench, bringing about successively, the opening of marginal sea basins in the southern Okhotsk Trough, the Sea of Japan, the South China Sea, and in the Okinawa Sea Trough. After the formation of the marginal seas there followed the development of the island arc volcanic, with the Miocene era serving as the main period of eruption. The Philippine and Taiwan chain have undergone a complicated tectonic evolution.

[5] Plate tectonic is a geological concept that describes the movement of the Earth's lithosphere. Geoscientists accepted the theory after the concepts of plate tectonics and seafloor spreading were developed in the late-1950s and early-1960s. See Alfred Wegener (1929) *The Origins of Continents and Oceans* and many others on this topic including Zhen Shao Huang (1997) 'Speed of Seafloor Spreading', *The Physics Factbook.*

In the Oligocene period (36 mya) the Pacific Oceanic plate sub-ducted westerly along the eastern side of Luzon Island to form an arcuate structure convexing towards the east. Since Miocene, the oceanic crust of the South China Sea has sub-ducted eastward along the Manila Trench and the eastern side of Taiwan Island. The opening of the South China Sea began in the early Tertiary (about 36 mya), while Borneo Island parted from the Asian continent due to sea-floor spreading. In the middle-Tertiary, the South China Sea continued opening, thus leading to the formation of the present N70˚E striking magnetic lineation.

Three types of plate boundaries exist, with a fourth, mixed type, characterized by the way the plates move relative to each other. They are associated with different types of surface phenomena. The different types of plate boundaries are:

1. *Transform boundaries (Conservative)* occur where plates slide or, perhaps more accurately, grind past each other along transform faults. The relative motion of the two plates is either sinistral (left side toward the observer) or dextral (right side toward the observer). The San Andreas Fault in California is an example of a transform boundary exhibiting dextral motion.
2. *Divergent boundaries (Constructive)* occur where two plates slide apart from each other. Mid-ocean ridges (for example, Mid-Atlantic Ridge) and active zones of rifting (such as Africa's East African Rift) are both examples of divergent boundaries.
3. *Convergent boundaries (Destructive) (or active margins)* occur where two plates slide towards each other commonly forming either a subduction zone (if one plate moves underneath the other) or a continental collision (if the two plates contain continental crust). Deep marine trenches are typically associated with subduction zones, and the basins that develop along the active boundary are often called “foreland basins”. The sub-ducting slab contains many hydrous minerals, which release their water on heating; this water then causes the mantle to melt, producing volcanism. Examples of this are the Andes mountain range in South America and the Japanese island arc.
4. *Plate boundary zones* occur where the effects of the interactions are unclear and the boundaries, usually occurring along a broad belt, are not well defined, and may show various types of movements in different episodes.

The spreading stopped post-Pliocene, and so far the South China Sea tends to be shrinking. The entire south-eastern Asia including the island chains of Indonesia, New Guinea and the Philippines have been affected by the sub-duction of the oceanic crusts of the Indian Ocean from south to north, and of the Pacific Ocean from northeast to southwest. The Southeast Asia domain, which rides on the Eurasian Plate should be regarded as a transitional-type earth crust, that is, the continental crust is now in a process of rapid growth.

The South China Sea is a semi-enclosed water body, which forms part of the Pacific Ocean Basin.[6] This sea is about eighty per cent enclosed by land. It spans nearly 23˚of Latitude (that is, from the Equator to Taiwan, in Latitude 23˚ N. and extends from Longitude 103˚ to 122˚ E. It is the largest of the regional seas in the Pacific Ocean Basin. Its mean depth is just over 1,000 metres. The South China Sea basin is surrounded by the Chinese mainland to the north, the Strait of Taiwan to the northeast, the Philippine Archipelago to the east, the island of Borneo to the south and the Indo-China/Malay Peninsula to the west. There are hundreds of small islands in the South China Sea. With the exception of those islands situated close to the mainland shores of Borneo, China, the Philippines archipelago and Vietnam, these insular features are virtually all coral reefs.

The South China Sea can be divided at the 200-metre isobath into a peripheral continental shelf and a central basin. The continental shelf is a generally smooth, featureless surface, sloping very gently towards its outer edge. The Sunda Shelf, which lies between Vietnam and Borneo, also slopes gently towards its edge. The continental shelf of the basin is relatively wide only in the north, off China and northern Vietnam, and in the southwest, between Sarawak and Vietnam. In this vicinity are the group of islands, numbering about 200 features, are the Anambas and Natuna archipelagos. A central basin is encompassed by a well-defined continental slope. Here depths rapidly increase from 200 metres at the edge of the shelf to more than 1,000 metres, and in the north-eastern sector, to more than 3,000 metres.

The continental margins of the South China Basin to the north and west are considered geologically as passive margins. To the east lies the active Manila Trench system, while to the south the Reed Bank and other shoals separate the basin from an extinct subduction zone along the

[6] Strangely, the concept of the semi-enclosed as defined in the 1982 Convention, can be open to interpretation by the legal beavers if they take the definition too literately.

Sunda Shelf, Borneo and Palawan Islands.[7] The Basin has complicated structural characteristics[8] and is on the trend of the Tethyan-Himalayan extension and its intersection with the marginal Pacific domain.

The greater part of the South China Sea can be considered as a platform and is floored by Cambro-Ordovician rocks (Hainan Island) and older rocks Precambrian basement on Paracel (*Xisha*) Islands.[9] The geological evolution of the region has been investigated by Taylor and Hayes and Holloway.[10] Chen described eleven tectonic provinces[11] based on studies of the distribution of fault blocks by Zhang,[12] the nature of the crust based on seismic studies by Li[13] and magnetic anomalies by Chen and others,[14] as well as sedimentary characteristics.

For the purposes of the present study four of the 11 tectonic provinces are worthy of a brief description. Pratas (*Dongsha*) Fault Swell lies on the continental slope in the northern part of the South China Sea. It is separated from the oceanic basin to the south by a fault striking approximately in an east-west trend and is bounded on one side by the Zhujiang Estuary Depression. Paracel (*Xisha*) - Macclesfield (*Zhongsha*) Bank Uplifts are separated by an intervening small depression and lie in the central part of the South China Sea. Reed Bank (*Nansha*) Uplift is formed of three fault blocks of intervening depressions. Its basement is believed to be continental and is formed of Precambrian granite. The Central Oceanic Basin is bounded by marginal faults against the Pratas, Paracel (130 features) and Reed uplifts and the Manila Trench to the east. The accumulated bathymetric, geological and tectonic knowledge of the South China Sea Basin and the world oil crisis of the 1970s precipitated prospecting efforts in this basin.[15]

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7 Taylor, B. And Hayes, D.E. (1980) 'The Tectonic Evolution of the South China Sea Basin', *Geophysical Monograph* 23, 89; and Taylor, B. and Hayes, D.E. (1984) 'Origin and History of the South China Sea Basin', *Geophysical Monograph* 27, 23.
8 Ren, J.S. and others (1980) *The Geotectonic Evolution in China*, Science Press, Beijing.
9 Chen, Chin (1988) 'The Geology of the South China Sea', in *The Ocean Basins and Margins*, Nairn, A.E.M. and others (editors) Plenum Press, New York, 245-252.
10 Refer: Taylor and Hayes (1980, 1984: 23) and Holloway (1982: 1355) (1982) 'North Palawan Block, Philippines - its relation to Asian Mainland and Role in Evolution of South China Sea', *American Association of Petroleum Geologists Bulletin*, 66, 1355.
11 Chen, S.Q. and others (1981) 'Features of Gravity and Magnetic Anomalies in Central and Northern Parts of the South China Sea and their Geological Interpretation', *Scientia Sinca*, 24,1271.
12 An excellent study is offered by Zhang (1983).
13 A concise explanation is presented in Li, Z.W. (1984) 'A Discussion on the Crustal Nature of the Central and Northern Parts of the South China Sea', *Acta. Geophys. Sin.* 27, 153.
14 Explained by Chen and others (1981: 1271).
15 Suggested by Ji (1996: 4); and for that matter by many others as listed in these references.

__The South China Sea Basin__

As stated above, the South China Sea is a partially-enclosed body of water of Southeast Asia. It is a partly submerged land bridge joining the Asian and Australian continental landmasses (tectonic plates) at the Sunda Trench and Timor Trough. The geophysical structure in parts of the South China Sea basin is such to produce a region of earthquake and volcanic actively. Figure 1 depicts the direction of the movement of the plates. The South China Sea basin is atop the Asian plate which is adjacent to the Australasian and Pacific plates.

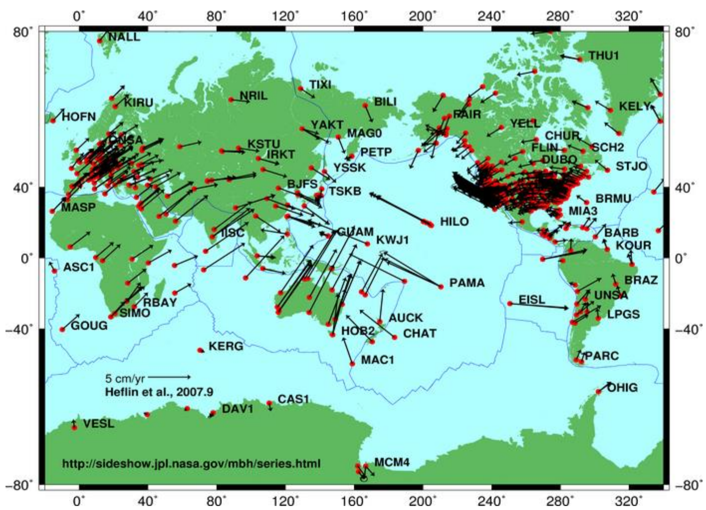

Figure 1. Global Tectonic Plates movements

Its maximum width – east-west extent – in the context of this study is about 935 nautical miles (M) which is measured along the parallel of Latitude 8° North from the west coast of Balabac Island to a point just north of Songkla, Thailand. One nautical mile (M), which is equivalent to about 1.85 kilometres is a unit of distance used in marine navigation and also in this essay unless otherwise indicated. The length, as with the breadth, varies throughout the basin, hence a good indication of the north-south alignment, is along the meridian of Longitude 115° E from Daxingshan Island to the coast of Brunei. The surface area is estimated at 1.09 million square nautical miles. The maximum depth of the basin is 5,248m at the western approaches on Mindoro Strait at about Lat.13°30’N., Lon. 119° 30’ E (as depicted on Chart 4508 (INT 108)). Within these geographical confines the South China Sea includes the bays, gulfs and straits (Figure 2).

Figure 2. The South China Sea Basin
Source: Present author's map extract

The structure of the seabed and that of the littoral makes the region a complex mix of terrestrial and marine features. Chains of high mountain ranges, deep trenches and troughs, deep sea basins and numerous coral islands form a complexity of phenomena. Nearly 40 per cent of the South China Sea basin comprises the Sunda Shelf which is widest, about 700M, along Lat. 15° N. In reality, the north-south extent may be considered to commence at the Equator and terminate just south of Taiwan.

This large body of water exerts a considerable influence, within this regional sea, upon the climate which is essentially tropical maritime throughout the year. The Philippine archipelago along the eastern boundary of the South China Sea provides a physical barrier to the strong current circulation of the Pacific Ocean. Bashi Channel to the north of Luzon Island is the only deep water (about 2,000 m) between the two water bodies. In the south, the South China Sea is connected to the Java Sea by the Karimata (Carimata) Strait, Gasper Strait and Banka Strait. (The Bahasa Malay equivalent to the word strait is *selat*).

The deep sea basin of the South China Sea with a maximum known depth of 5,030m lies along the axis of the sea north of a line from Cap Saint Jacques (10° 19'N, 107° 05'E) to Tanjong Baram (4° 36'N, 113° 58'E). The slope along the northwest boundary of the continental shelf is a gentle one falling to a depth of 1,803m over a mean distance of 100M, however, off Luzon and Palawan Islands, the slope is very steep and the shelf drops away to 1,830m within a distance of about 20M from the coast. The two large shallow areas within the deep sea basin, Maccesfield

Bank and the Paracel Group of islands and reef systems are in the vicinity of Lat.16 ° N., Lon. 113° E.

The Palawan Trough, with a mean depth of 2,200m, lies along the steep-sided continental slope off Palawan Island and northwest Borneo. The western side of the trough borders the extensive reef plateau of the Spratly Group of islands, islets, rocks and cays where there are deep water connections through the reef system to the South China Sea. The Spratly Group, comprising of 100 features – Archipelago of Reefs – broadly defined, extends some 360M in an east – west direction and about 270M in a north/south alignment.

This reef area, although often presented as a shallow region, is in fact a deep and level plateau. Water depths as indicated on the relevant charts of the region infer that an area of numerous reefs and islands rising form a plateau with depths of between 1,280m and 2,380m.

In the continental shelf region off Luzon, there are a number of relatively steep submarine canyons. These are evenly shaped and have a profile that is typical of mature river beds with a mean depth of 600m to 900m and depths from 730m to 1,650m. The heads of the canyons usually lie within one mile of the coast, with a mean depth of 90m over them.

Basins adjacent to continental margins, for example, the Andaman Sea, Sea of Japan and the South China Sea may be filled with several kilometres of continentally derived sediments which generally thin away from the Foot of the Slope into the basin.

Natural Continental Shelf and Continental Margin

Shelf regions support the marine communities most familiar to humans, and many of the marine resources of particular value to them. Although mangroves and coral reefs are two of the best known tropical coastal ecosystems, they dominate only a minor part of the world coastline: the former mainly in the deltaic or low-lying coastal plain and the latter only in the shallow waters when terrestrial sedimentation is very low. Soft-bottom habitats with sparse vegetation are probably the most wide-spread coastal marine ecosystem type, and virtually the entire seabed away from the coastline is covered in marine sediments.

The simplified bathymetry map (Figure 3) portrays the principal bathymetric features of the South China Sea basin. Since the map scale, size and format dictate the number of individual islands, reefs and other small features that can be labelled; the following prose refers to places that may not be named on the maps used for illustrative purposes in this study.

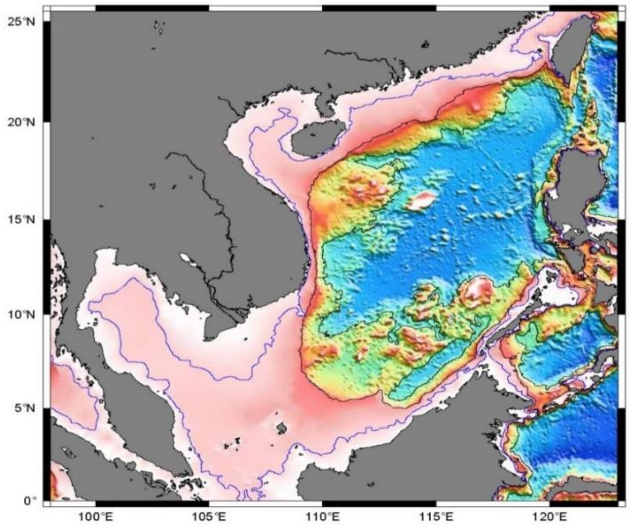

Figure 3. South China Sea Continental margin
Source: http://www.bing.com/images/search <accessed: 7 April 2017>

The natural continental shelf is depicted, in varying shades of pink in Figure 3, of the South China Sea Basin, the Sunda Shelf underlying the western South China Sea and including the Gulf of Thailand, the Java Sea, the Karimata Strait and the Straits of Malacca and Singapore; and includes the Mainland Shelf (off the coast of China) extending from the Taiwan Strait through to the Gulf of Tonkin.

Mainland Shelf

The Mainland Shelf between Hainan Island and Taiwan Island is as much as 150M wide and is relatively featureless with an even, gentle slope to the edge. Islands and banks (shallower waters) on the outer shelf include, from east to west, the Penghu Islands and Taiwan Bank at the southern approaches to the Taiwan Strait and St. Esprit Shoal, which is about 110M east of Hainan Island. The channel in the Taiwan Strait is between 60m and 80m deep, and the Hainan Strait channel is between 20m and 40m deep.

There are two large shallow areas within the limits of the deep sea basin, the Macclesfield Bank and the Paracel Islands and reef complex. The bank is a submerged atoll with a mean depth of 75m but over which a number of shallower patches exist. The Paracel Archipelago has an extensive group of low-lying islands and reefs (about 130 named features) with deep passages between them.

The shelf to the south of Hainan island is narrow (maximum width about 50M) with a steep gradient. The floor of the Gulf of Tonkin exhibits a central valley about 70m deep opening toward the mouth of the Gulf. The mainland shelf narrows along the bulge of southern Vietnam and its gradient steepens considerably. South of Cam Ranh Bay it broadens into the 215M-width Sunda Shelf.

Sunda Shelf

Sunda Shelf is the name given to the extension of the Asian continent which connects Asia with the islands of the Indonesia Archipelago; it supports the southern half of the South China Sea. Depths here do not exceed 183m (100 fathoms). The Sunda Shelf is intersected with river valleys similar to those found in the Java Sea. These valleys lead into a main stream aligned north/south from Natuna Archipelago to Karimata Strait.

The deep sea basin of the South China Sea, with a maximum known depth of 5,030m, lies along the axis of this sea north of a line from Mui Vung Tau (10° 19'N., 107° 05' E.) to Tanjong Baram (4°36' N., 113° 38' E.) To the south of this line the entire area is supported on the Sunda Shelf and thus has depths of less than 200m. To the north of this line the major portion of the region is contained in the South China Sea basin with depths in excess of 1,800m. In the northern area the Sunda Shelf is confined to the coastal regions, its width varying considerably due to the coastal configuration. Off the south coast of Vietnam the mean width of the shelf is about 12M but further north, off the coast of China, the width increases to approximately 150M.

More than 80 per cent of the global volume of river-borne sediment is deposited in the tropics (and an estimated 40 per cent of it by just two river systems: The Huang He or Yellow River and the Ganges-Brahmaputra). Both river systems are outside the scope of this regional study, however, it is worthy of mention in this context as there are relatively major river systems that deposit their sediments and water into the South China Sea, for example the Mekong River system and the Xijiang. This deposition of sediment is reflected in the extent of the shelf areas in parts of the tropics, and in high turbidity of coastal waters in monsoon regions. Most shelf areas in the tropics are overlain by sand and mud composed of sediment of terrestrial origin (terrigeneous deposits). The Xijiang and Mekong River systems and other major rivers from peninsular Malaya and northern Borneo discharge vast quantity of sediments into the South China Sea basin. The thickness of the sediments is a good indication of the potential hydrocarbon resources that may exist in the substratum of the seabed at the mouths of these river systems.

Continental Margin

The continental margin, from 200m to about 4,000m deep, consists of the continental slope and continental rise, in some places interrupted by flat terraces or benches. Between Hainan and Taiwan, the mainland Shelf descends to a terrace between 200m to 1,000m. It supports several island groups and shoals such as Pratas Island and Reef complex, Helen Shoal and Vereker Banks. This terrace is bordered by the continental slope and continental rise that slope gradually toward the deep ocean floor. Immediately southwest of Taiwan and south of Hong Kong, a secondary terrace, at between 2,000 and 3,000m depth east of the Pratas Islands occasional pinnacles that reach to within about 1,000m are present.

South of Hainan Island to about Lat. 15° 30’ N., the continental margin consists of a broad terrace at between 200 and 1,500m depth. Situated on this broad terrace is a shoal area between 200 and 1,000m deep extending from the coast of Vietnam and supporting the Paracel group; both terraces are almost separated from Hainan Island and the mainland Shelf by a large linear depression.

The separate Macclesfield Bank, which is entirely submerged, is situated southeast of the Paracel Group and west of Scarborough Reef, at the southwest corner of a 2,500-m-deep terrace. To the south and east of the terrace, the continental margin drops steeply to the deep ocean floor; a small linear depression separates the bank from a complex topography to the southwest. The margin to the east of the Paracel Group and to the north of the Macclesfield Bank consists of a normal slope and rise extending to the deep ocean floor.

Off the central Vietnam coast, the narrow shelf merges with the continental slope, which extends eastward to a 200M terrace at 2,500m. This area exhibits irregular bathymetry, with a central depression and small, 2000-m terraces at its eastern extremity. To the east, a narrow continental shelf separates the terrace from the deep sea floor. Immediately to the south are two more terraces, one at 200-1,000m and another at 1,000-2,500m, with two peaks off the eastern coast of Vietnam reaching to within 1,000m of the surface.

Further south, these terraces are separated from an area, that mariners refer to as 'Dangerous Ground' – for the mere fact of the existence of numerous reefs, sand cays, islets and islands – by a more normal slope and rise sequence, which in this vicinity of inconsistent bathymetry appears as an indentation of the deep sea floor between two shoal areas.[16] The Spratly Islands, comprise of over 100 insular features of varying character including a number of predominantly very small, naturally formed, islands, isles rocks and reefs and several submerged features that pose a danger to marine navigation.

The 'Dangerous Ground' is an area where the eastern rim of the Sunda Shelf gives way to an undulating terrace at about 200m extending over a 600M length and 280m width zone that supports numerous irregular shoals, hills and terraces. The shallowest terrace on the eastern rim of the Sunda Shelf supports numerous banks, for example, Alexandra and Prince of Wales; and shoals, including Vanguard Reef. To the southeast, Louisa Shoal is sited on another small terrace protruding from the shelf. An extension of this protrusion along the eastern edge of the Spratly Group supports a number of reef systems and banks. A depression at 1,800 to 2,000m separates these shallow terraces from the major shoal area to the north and east.

The central portion of the 'Dangerous Ground' zone comprises series of small plateaus at about 2,000m separated by depressions. The high areas support many cays and reefs that include Fiery Cross Reef and Nanshan Island. The extreme north part of the area is a 10,000sqM plateau at 1,000m upon which rests two shoals. The northern portion is about 85x65M in dimension within the 200-m isobath and includes Brown, Reed and Templar Banks. To the southeast an elongate, smaller terrace area less than 200-m deep that includes Carnatic Shoal; Sabrina Shoal sits on a promontory extending to the south this terrace. The continental slope descends steeply northward from Dangerous ground to merge with the deep ocean floor.

[16] The area of Dangerous Grounds is delineated on appropriate charts and aptly described by The Hydrographer, Hydrographic Department, Taunton (1982:148).

Trench and Trough

The Palawan Trough, with its generally northeast-southwest alignment and maximum depth of 3,475m separates the 'Dangerous Ground' from the northwest Borneo continental slope. Further north, off northwest Palawan and the Calamain Islands, the continental margin is indented by several valleys that lead to the broad continental rise; the northwest valleys trend into the Manila Trench. The continental margin off west Luzon is narrow and steep, giving way to the 5,000m Manila Trench and its narrow northward extension before projecting to the deep sea floor. From central Luzon northward to the southern tip of Taiwan, however, a submarine ridge capped by a series of elongate plateaus shoaling to 1,500m separates the northward extension of the Manila trench from a prominent northeast trending tongue of the deep sea floor. The North Luzon Ridge to the east of the trench extension also connects Taiwan Island with the Batan and Luzon Islands.[17]

Sediments

Along the east coast of Peninsular Malaysia the seabed is covered by a vast quantity of sand which extends north from the Bangka Strait. This belt has a mean width of 40M opening to 100m northeast of Anambas Archipelago and then tappers to a 10-M strip in the northern sector of the region. Off the east coast of Peninsular Malaya in the vicinity of Lat. 4° N., there is a large mud patch. The outlying islands of the Anambas Archipelago are supported on a sand/mud bed and are bordered by coral. In the Gulf of Thailand the seabed is covered by mud and isolated patches of sand/mud, and sand and stone in the coastal regions.[18]

From the south tip of the west shore of Vietnam to Lat. 7° 30' N. the coast is fronted by a sand/mud strip varying in width from five to 40M. To the north of this latitude to the head of the Gulf, mud predominates in the coastal region with small isolated patches of sand and coral. In the outer approaches to Bangkok there is a comparatively large area of sand with a smaller area of sand and shell adjoining it. Along the east shore, bordering the coast of Cambodia, there is an extensive belt of sand/mud of mean width of 40M, with mud predominant close inshore. Around the islands in the southeast part of the Gulf, sand is the dominant sediment. In the main mud areas the seabed is generally soft and smooth.

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[17] Refer to *China Sea Pilot*, Vol. III relating to the seabed.
[18] Refer to *China Sea Pilot*, Vol. I relating to the physical features of the sea.

Along the coast of Vietnam, south of Lat. 12° N., the continental shelf is covered by sand which extends southward as a belt of 100M wide almost to the west coast of Borneo. Inshore of the sand belt, off the low-lying alluvial coast off the east tip of Vietnam, mud is the dominant sediment. In the waters of the Mekong River delta the bottom is sand/mud. Farther to the north there are isolated patches of mud and stone. Coral surrounds the islands and shallow areas dispersed over the sand belt. To the north of 12° N along the narrow coastal strip, rock is abundant on a mainly mud bottom with narrow sand strips fringing the shore.

On the wide shelf region supporting the Gulf of Tonkin and bordering the south coast of China, mud is the main constituent with sand/mud present in patches along the edge of the shelf. Across the southern entrance to the Gulf of Tonkin is an elongated patch of sand and mud, and fronting the south shore of the Gulf are narrow belts of sand and sand/mud. In the outer approaches to Haiphong, sand pre-dominates over the mud and there are large areas of sand and sand/mud. To the north of Hainan Island, the sea bed is covered by mud, but relatively large areas of sand lie along the edge of the shelf and isolated patches of stone and sand/mud are located on the bottom.[19]

Seabed

In the deep waters off the Sunda Shelf the seabed is covered with soft mud or ooze, providing a smooth sedimentary layer on the seafloor. The depth of the layer is not known but is probably similar to that of Pacific Ocean, which is estimated to be about 300m. Patches of sand, coral and rock surround the reefs and banks in the region. On the shelf, mud is still the dominant sediment, but is interspersed with large patches of sand and smaller patches of rock, stone and coral. A belt of sand, about 100m wide, extends north from Natuna Archipelago to the southern coast of Vietnam.

There is a widening belt of sand and mud off the coast of Sarawak and the northwest extremity of Borneo, This belt extends northwest to the southern group of Natuna Archipelago. There is an extensive mud strip inshore of this belt along the west coast of Sarawak, formed by the discharge of the rivers. Mud is extensive off the coast of west Borneo Island, but is replaced in the approaches to Karimata Strait by a predominantly sand bottom.

[19] Refer to *China Sea Pilot,* Vol. II.

A mud flooring extends along the northwest of Borneo Island and east through the Balabac Strait with offshore patches of coral and rock. The bottom is sand with frequent outcrops of coral and rocks, along the west coast of Palawan; in Palawan Passage the seabed is covered in mud. At the entrance to Manila Bay and along the south shore of that bay, sand, stone, and rock are present, but elsewhere mud from the deltaic deposition is found. Mud is also predominant north of Mindoro, but south of that island the bottom is sand, with interspersed patches of coral.

The steep coast west of Luzon and north of Manila Bay is fronted by rocky outcrops, islets and occasional coral reefs. The narrow coastal shelf is covered by sand or sand and mud, with mud becoming the dominant sediment.

Seamount and Guyot

A sea mount, which has more than 500m local relief, is differentiated from a guyot by the mere fact that the latter has a flat top, whilst the former may have a steep crest. Some sea mounts may rise as much as 3,000m above the adjacent ocean floor. These features are also associated with coral atolls. Both sea mounts and guyots originated as volcanoes having erupted beneath the ocean floor. They are generally circular in plan view; their slopes tend to be steeper than land volcanoes owing to the more rapid consolidation of the lava in sea water. The difference between the conical sea mount and the flat-topped guyot is due to the elevation of the guyot above sea level at some stage in its development during which period it suffered sub-aerial erosion, wave action and marine plankton; the top being truncated.

Table 1: Geographical Coordinates of Guyots in the South China Sea Basin

Geographical Co-ords		*Peak Depth (m)*	*Base Depth (m)*
15° 10`N	116° 20`E	1,456	3,840
15° 15`N	117° 45`E	803	3,658
15° 30`N	116° 10`E	914	3,840
16° 20`N	116° 45`E	73	3,658
17° 10’N	118° 40’E	429	3,000

Typically, sea mounts are flat top and may have a diameter of about ten to 12M and lie between 800 and 1,500m below the surface. An alternative suggestion for the origin of sea mounts is that they represent the submerged remains of coral atolls. The following table gives the reported positions and depths of several seamounts in the South China Sea.[20]

Submarine Volcanic Activity

The Indonesian and Philippine Archipelagoes are located in an area of high seismic activity. The only significance of this to ships at sea is the tsunami, or seismic sea wave. There waves are caused by earthquakes or submarine volcanic activity. When the tsunami's progress is constricted by bottom configuration or shoreline, the height of the wave increases rapidly and considerable damage may be done to ships in the vicinity or to adjoining shore installations and the coastline.[21]

Tidal Waves and Tidal Streams

Tides are mainly diurnal throughout the South China Sea. On the west coast of Luzon, north of Port Masinloc, and on the coast of Sarawak and Brunei, between Bintulu and Seria, there are stretches where there is seldom more than one tide a day. Throughout most of the area, the range of the tide is between one to 1.5m, however, there is a marked increase near the western end of Sarawak, where at Sungai Sarawak, it is as much as 3.6m.

Tidal bores may occur in certain rivers in Sarawak, for example, in the vicinity of the offshore reefs there are local tidal streams which set on to or away from the reefs on all sides. In the narrow channels through the reefs, these streams attain greater rates, but generally they are weak and during the strength of the seasonal currents they may be inappreciable.[22]

Currents

The movement of the surface water over the South China Sea is related, in general, to the monsoons, however, the relationship is complex and not direct. The main southwest setting current during the Northeast Monsoon (November to March) and the northeast setting current in the Southwest Monsoon (May to September) generally flow on the west side of the South China Sea. The direction of the water movement over this latter area is controlled to a large extent by the positions of eddies which occur in the South China Sea in most months and especially between the

[20] Refer to *China Sea Pilot*, Vols. II and III relating to seamount and guyots.
[21] Submarine volcanic activities. See *China Sea Pilot III* and the *Indonesian* and *Philippine Pilots*.
[22] Refer to *China Sea Pilot*, Vol. II and III, UK Hydrographic Office, Taunton.

Malay Peninsula and Borneo Island. Since these features are themselves controlled by varying oceanographic and meteorological conditions, both within and outside the South China Sea, it follows that the currents of this region display a high degree of variability both in direction and rate.[23]

Over the greater part of the South China Sea the currents are weak, the mean rates over most regions in most months are less than 0.5 knot (a Knot is a rate of speed; thus 2 knots represents 2 nautical miles distance covered in one hour). During the months when the monsoons are fully developed (July, August and December to February) the mean rates increase to between 0.5 and one knot. Currents of up to two knots may occasionally be experienced in any part of the area in any month and on rare occasions the current may flow at up to three knots, more especially between the Malay Peninsula and Borneo Island, and at four knots through some of the passages linking the South China Sea and the Sulu Sea.

The prevailing current pattern is affected, sometimes considerably, by the violent winds accompanying the passage of a Tropical Revolving Storm (TRS) (commonly referred to as cyclone or typhoon in this regional context). The current thus produced sets in a generally downward direction but is deflected to an extent which may vary between 20° and 45°. However, since the current is greatly dependent upon the length of time that he wind blows in a particular direction, as well as upon the wind strength, the current in most cases does not have time to become fully developed. It is estimated that at wind speeds of 40 knots and over, the wind needs to blow in the same direction for over 48 hours to produce the maximum current. Thus it is only with slow-moving typhoons/cyclones that strong current, which may exceed 2 knots, are encountered. When a typhoon is located in the vicinity of a coast, still higher speeds may be produced due to the piling-up of water against the adjacent coast.

Salinity

The salinity of the area is extremely variable and is in direct contrast to the uniform sea surface temperature experienced in the western sector of the South China Sea. In general, water masses of low salinity form at the surface and high salinity water of oceanic origin is found in deeper water.

[23] Each of the aforementioned publications offer an excellent account of the ocean currents with relevant maps and tidal stream information collectively for the entire basin.

Excessive rainfall and river run-off result in the formation of oceanic water into the area and provides high salinity masses. Between these two masses, a large area of mixed water is formed. These different water masses are transported by the monsoonal currents to and fro such that many regions are alternately filled with waters of different origin resulting in large seasonal variations of salinity.

The sources of low salinity in this basin are the mouths of the major rivers: the Mekong in Vietnam is a typical example where the discharge from the river has a greater influence on the salinity than the actual rainfall.[24]

Density

The density of water is computed from temperature and salinity readings with corrections to allow for the effect of pressure. Thus corrections in either the value or distribution of temperature or salinity will automatically change the density of the water. In the southern half of the South China Sea, south of Lat. 11° N., where the annual variation of sea surface temperature is small, the density of the sea water is largely governed by variation in salinity but in the northern part of the basin, where there is a relatively large variation of sea surface temperature, changes in salinity have little or no influence on the density.[25]

Elaboration of Geographical Features

In recent years, considerable concern has been expressed at the indiscriminate and unregulated naming of undersea features which often get into print in articles submitted to professional journals, or on ocean maps and charts, without any close scrutiny being made concerning their suitability, or even whether the feature has already been discovered and named.

In order to remedy this situation and to bring the geographical names of undersea features to a better standardization, the IHO, at its 13th I.H. Conference (May 1987) and the IOC, at its 14th Assembly (March 1987) adopted similar motions on this subject.[26] International concern for naming undersea features is limited to those features entirely or mainly (more than 50 per cent)

[24] Refer *China Sea Pilot*, Vol. I.
[25] Refer to *China Sea Pilot*, Vols. I, II, III.
[26] The IHO and International Oceanographic Commission at their respective meetings in 1987 agreed to standardise the naming of underwater features.

outside the external limits of the territorial sea, not exceeding 12 nautical miles from the baselines, in agreement with the 1982 United Nations Convention on the Law of the Sea (The 1982 Convention). "Undersea feature" is a part of the ocean floor or seabed that has measurable relief or is delimited by relief.

The coastline (shoreline) must be a representation of the high water mark or the line of mean sea level where there is no appreciable tide or change in water level. In tidal waters where there is a beach the coastline is the landward limit of the beach and therefore corresponds approximately to the high water mark of the highest tides.

Natural topographic features shown on charts are grouped under four headings: relief, land drainage (including ice/glaciers), vegetation and volcanic activity. The types of features charted and the distance inland to which they are shown will vary with chart scale, type of terrain availability of source data and possibly adequacy of aids to navigation. The significance to the mariner must be judged by the requirements of both visual and radar navigation and other means of detection such as echo sounding and wide-bean side-scan laser to detect below the surface features such as reefs and rocks and islets and sand cays.

Island, Low Tide Elevation (LTE) and Rock

Three Articles of the 1982 Convention on the Law of the Sea are re-produced verbatim, hereunder, that are considered relevant in the geographical characteristics of the insular features when re-framing of the South China Sea debate of territoriality and sovereignty. They are Articles 13, 60 and 121.

Article121

Regime of islands

1. An island is a naturally formed area of land, surrounded by water, which is above water at high tide.

2. Except as provided for in paragraph 3, the territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of this Convention applicable to other land territory.

3. Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf.

Article 121 of the 1982 Law of the Sea Convention infers that there are four geographical criteria for an insular feature to qualify 'legally' as an island are identified: an island must be "naturally formed"; be an "area of land"; be "surrounded by water"; and, must also be "above water at high tide".

Article 6 of the same Convention offers explanations for the terms 'atolls', and 'fringing reef' and Article 13, the vital provision relating to insular features, provides an elaboration of 'low-tide elevation' that has caused much confusion in the debate of determining the location of territorial sea basepoints for the purpose of creating a datum for measuring the width of the territorial sea of a coastal and/or island state.

Article 13

Low-tide elevation

1. A low-tide elevation is a naturally formed area of land which is surrounded by and above water at low tide but submerged at high tide. Where a low-tide elevation is situated wholly or partly at a distance not exceeding the breadth of the territorial sea from the mainland or an island, the low-water line on that elevation may be used as the baseline for measuring the breadth of the territorial sea.

2. Where a low-tide elevation is wholly situated at a distance exceeding the breadth of the territorial sea from the mainland or an island, it has no territorial sea of its own.

The "naturally formed" aspect of Article 121(1) functions to disqualify artificially constructed 'islands' and artificial structures such as platforms constructed on features that are not themselves above high-tide such as submerged shoals or low-tide elevations as emphasised below, in Article 60(8).

Article 60

Artificial islands, installations and structures in the exclusive economic zone

1. In the exclusive economic zone, the coastal State shall have the exclusive right to construct and to authorize and regulate the construction, operation and use of:

(a) artificial islands;

(b) installations and structures for the purposes provided for in Article 56 and other economic purposes;

(c) installations and structures which may interfere with the exercise of the rights of the coastal State in the zone.

2. The coastal State shall have exclusive jurisdiction over such artificial islands, installations and structures, including jurisdiction with regard to customs, fiscal, health, safety and immigration laws and regulations.

3. Due notice must be given of the construction of such artificial islands, installations or structures, and permanent means for giving warning of their presence must be maintained… **[and]** Appropriate publicity shall be given to the depth, position and dimensions of any installations or structures not entirely removed.

4. The coastal State may, where necessary, establish reasonable safety zones around such artificial islands, installations and structures in which it may take appropriate measures to ensure the safety both of navigation and of the artificial islands, installations and structures.

5. The breadth of the safety zones shall be determined by the coastal State, taking into account applicable international standards…

6. All ships must respect these safety zones and shall comply with generally accepted international standards regarding navigation in the vicinity of artificial islands, installations, structures and safety zones.

7. Artificial islands, installations and structures and the safety zones around them may not be established where interference may be caused to the use of recognized sea lanes essential to international navigation.

8. **Artificial islands, installations and structures do not possess the status of islands. They have no territorial sea of their own, and their presence does not affect the delimitation of the territorial sea, the exclusive economic zone or the continental shelf.** {Emphasis added}

Hydrographic Surveying and Charting

Between the late 1690s and 1826, the English East India Company undertook extensive hydrographic surveying of the coastline and waters of South East Asia and as far north as the Strait of Formosa, and during 1826 within the Bay of Hai (Bohai, or Po Hai).[27] [Refer Annex I, below]

During the second half of the 19th century British Admiralty nautical charts came to achieve both pre-eminence and to some extent general preference as navigational tools.[28] As a result, a number of countries with more pressing local hydrographic commitments entered into

[27] Dawson (1885); Day (1967).
[28] Day, Archibald Sir (1967) *The Admiralty Hydrographic Service*, 1795-1919, London: H.M.S.O., 378. Ritchie, G.S. (1967) *The Admiralty Chart*, London: Hollis and Carter, 385.

reproduction licence arrangements with the Admiralty's Hydrographic Department.[29] The national hydrographic agencies entering into a reprographic agreement with the British Admiralty (BA) could publish British charts under their own imprint by giving due acknowledgement on their chart to the Admiralty. The attached extract from Findlay's masterpiece of 1878[30] perhaps offers an apt rationale for the frenzy of hydrographical surveying and charting activities in the South China Sea from about 1778 to 1940s.

> The China Sea is perhaps the locality where hydrography has made the greatest changes of late years. Up to 1862 the charts of this great highway exhibited a labyrinth of detached shoals, scattered about without order or connection, laid down from the isolated observations of zealous officers of the East India service, many of which are now of difficult recognition, from the vague manner of their announcement. The increasing importance of the China commerce, and the advance in sailing powers of the ships employed in it, caused this great sea to be much more frequented than in former years. Since the year above named, Commander Reed, with a moderate staff, in H.M.S. Rifleman, has examined the outer line of dangerous shoals which limit the two great channels…
>
> Source: *Indian Archipelago, China and Japan Directory*, by AG Findlay, 1878

Between 1800 and 1928 most of the publicly available hydrographic information concerning the South China Sea was derived from British surveys initiated by the English East India Company (EEIC) and succeeded by the Admiralty Hydrographic Department. This was logical, since the Royal Navy had the ambition, resources, strategic interests and trade responsibilities to survey, chart and delineate zones of jurisdiction of such a large area of the high seas. Two charts that were important as an aid to marine navigation in this semi-enclosed seas were BA 1263 (general chart) and BA 2660B (regional chart). These charts were re-produced by the US Hydrographic Office (USHO) and the Imperial Japanese Navy (IJN). The former's chart was numbered 799 of 1875; latter's product was numbered 529A of 1900. Major corrections and amendments to BA 2660B would normally be generated by the British Admiralty, however, if the Admiralty chose not to circulate information that reported newly discovered dangers, or eliminated

[29] Hydrographic Department (1938) *Admiralty Manual of Hydrographic Surveying*, London: H.M.S.O., 385.

[30] For a true appreciation of the work of the former mariners, hydrographers and cartographers involved in surveying, charting and documentation of the nautical information of the region see A.G. (1878) *Indian Archipelago, China and Japan Directory*, London: Richard, Holmes Laurie. For the 19th centuries there are works with a more modern outlook. Recommended is Horsburgh (1817). Rosser and Imray (1866) cover the latter part of the 19th century.

previously reported dangers, these amendments would not be available to those who used or reproduced Admiralty charts.[31]

Although the British Admiralty was the principal source for hydrographic surveys in the South China Sea, and to a limited extent in some cases, terrestrial surveys, other countries, notably Japan, Spain and USA contributed information. Some examples of specific hydrographic work undertaken by the officers and crew of the ships plying the seas of East and Southeast Asia are mentioned here.[32,33]

In the 1860s the HMS *Rifleman* examined Loai Ta Island and Reefs, North Danger and Tizard Bank and Reefs. During 1888, HMS *Rambler* did an extensive survey around and inside Tizard Bank. On 23 October 1888, BA chart No. 1201 was published titled Reefs in the South China Sea on which were plans of the above mentioned reefs. This chart was re-produced, with permission, by Japan as IJN Chart No 451 on 29 May 1900 and by USA as USHO chart No. 2786 in November 1911.[34]

In the 1920s, from a strategists' perspective, the informative document 'Report of Results of an Examination by the Officers of the HMS *Rambler*' was published in March 1889 which contained useful hydrographic data. The Royal Navy knew a great deal of Tizard Bank – the hydrographer was requested to resurvey North Danger Reef as the first stage of a search for a suitable fleet anchorage, and an area from Trident Shoal to Tizard Bank in a north-south alignment was surveyed.[35]

By 1925 the Spratly Group had become such an area of strategic interest initially to Great Britain, and subsequently to Japan, with the United States of America also taking a belated

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[31] Hancox, D. and Prescott, J.R.V. (1995) 'A Geographical Description of the Spratly Islands and Account of Hydrographic Surveys amongst those Islands', *Maritime Briefing*, 1, 6, IBRU, Durham.
[32] Dzurek, D.J. (1985) 'Boundary and Resource Disputes in the South China Sea' *Ocean Yearbook*, No. 5 University of Chicago, Chicago; and Dzurek, D.J. (1996) 'The Spratly Islands Dispute: Who's on First', *Maritime Briefing*, 2,1, International Boundaries Research Unit, Durham.
[33] Dalrymple**,** Alexander (1770) *An Historical Collection of the Several Voyages and Discoveries in the South Pacific Ocean*, London: East India Company; Dalrymple**,** Alexander (1772) *A Collection of Charts and Memoirs*, London: Honourable East India Company. London: EEIC.
[34] Hancox, D. and Prescott, V. (1997), *Secret Hydrographic Surveys in the Spratly Islands,* Kuala Lumpur, Maritime Institute of Malaysia.
[35] Dawson**,** L.S. Commander (1885) *Memoirs of Hydrography*. Two Parts (Part One – 1750-1830; Part Two-1830-1855) A facsimile reprint, published by Cornmarket Press, London 1969.

strategic interest in the area. In 1928, HMS *Iroquoius* was ordered to survey 'the uncharted area off the west coast of Palawan'[36] (see Figure 4).

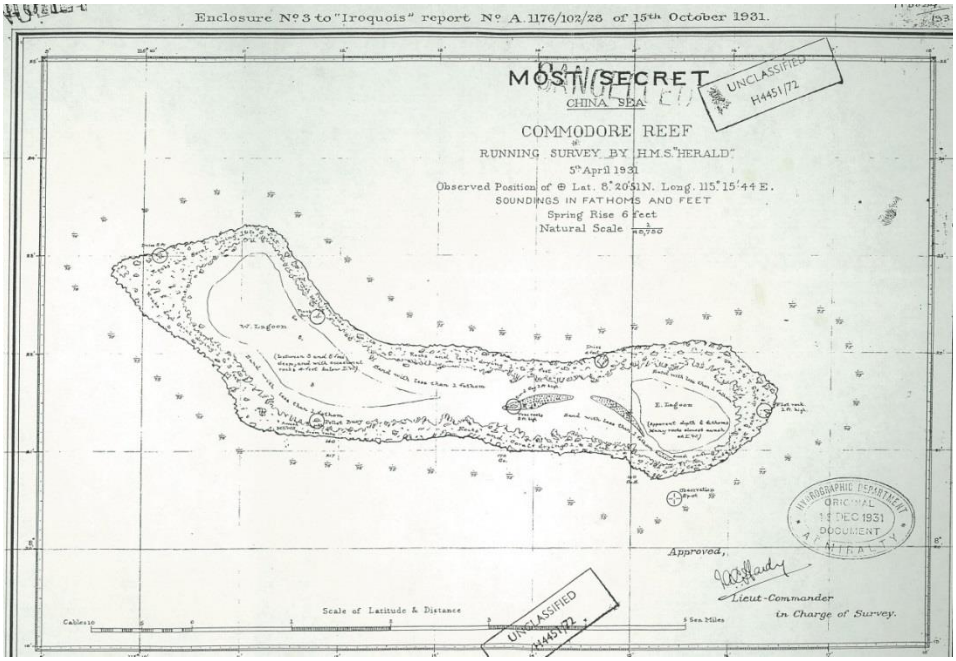

Figure 4. One of many reef systems surveyed (1931) and charted by UKHO

The French declaration of ownership of Spratly Island and Amboyna Cay in 1930 was principally intended as a warning to Japan. However, this news was ill-received by the government of Britain. Indeed, it strengthened the resolve of the government and the Hydrographic Office. It was recognised that British Admiralty charts and publications were used widely and internationally and the Hydrographer answered to a wider community than just the Royal Navy itself.

Such was the importance of the Admiralty's HO that a particular bulky folio of 1930-38 was titled 'Sovereignty over Spratly Island and Amboyna Cay'. The Directorate of Naval Intelligence in conjunction with the Hydrographer had taken note of Japan's growing assertiveness in both China (mainland) and the South China Sea. Japan's naval expansion was perceived as a serious threat to British interests. By late-1930 the British Admiralty decided to undertake a major survey operation in the dangerous Ground in 1931.[37]

[36] Day, Archibald Sir, (1967) *The Admiralty Hydrographic Service*, 1795-1919, London: H.M.S.O., 378; and, De la Ronciere, Monique (1965) 'Manuscript Charts by John Thornton, Hydrographer of the East India Company (1669-1701), *Imago Mundi*, Vol. 19, pp. 46-50.
[37] Based on observation and research undertaken by the present author at UKHO Archives and the National Archives, UK and the British Library London, and the French National Archives over many years.

For the Spratly Group area before 1936, the surveys and base charts were essentially derived from the British Admiralty work. However, the survey records and fleet charts of the two principal hydrographic authorities, which could disprove the existence of numerous features in the Archipelago of Reefs, were to be classified as secret, by the national hydrographic agencies of Japan and United Kingdom.[38]

The working chart referred to as Reefs in the South China Sea depicted that numerous previously reported dangers or features were non-existent, when compared with features shown on current editions of publicly available charts including BA 2660B of 28 May 1925; USHO 792: 28th Ed, 1923; and IJN 529A: 21 December 1926; and the French Service Hydrographique de la Marine (SHOM) 4946; 4th Ed., 1929.[39]

In 1932, SHOM published chart 5691. The geographical coverage portrayed on this chart extended from Saigon out to *Ile du Tempete* (Spratly Island) and *Caye d'Amboine* and included Laad (Ladd) Reef and *Croix de Fiery* (Fiery Cross) as named features. Some 66 years earlier, the Admiralty's HO had carried out surveys in the area that the French conducted their hydrographic surveys. During 1933 the SHOM continued surveys in the region concentrating on Itu Aba and Namyit Islands and Tizard Bank. When the SHOM's ship Astrolabe arrived at Itu Aba her officers found Japanese fishing interests from Taiyo Kogyo K.K. of Takao, the port of Kaohsiung, Taiwan (formerly Formosa). Evidence of guano mining on the island was quiet obvious. The survey sketch plan of Ile Itu Aba, dated 10 April 1933, submitted by *Astrolabe*, depicted Japanese activity concentrated on the south-western extremity of the island, with the '*pavillon Francaise*' established on the island's north-eastern end.

Japanese commercial interest in the South China Sea was established on the western perimeter of the Spratly Group, particularly at Itu Aba (or *Nagashima* as Japanese officials referred to the island). In addition to guano mining on the island there was Japanese fishing presence at Itu Aba, principally engaged in bonito or tuna fishery. Japanese naval authorities were aware of the

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[38] Forbes, V.L and Commander Zulkifli Ibrahim (Ret.) (2011) 'Hydrographical Surveying and Chartering of the Coastline of Malaysia: an Historical Perspective to 1958', *MIMA Bulletin* Vol. 18 (2).
[39] Forbes**,** V.L. and Hercock, Marion (2007) 'Charting the Way to Empire: The Hydrographic Office', in Etherington, Norman (Ed.) *Mapping Colonial Conquest* Australia and Southern Africa, Perth: UWA Press, pp. 11-40.

hydrographic survey activity undertaken by the Admiralty's HO inferred in a report published in 1937.

Japanese strategic considerations in the South China Sea were with respect to hydrocarbon resources in Borneo and naval fleet movements in the basin. Japan's military strategists had their own long-term plans for the South China Sea, the Japanese Hydrographer's programme for 1936 and 1936 included surveys in both Paracel and Spratly Group.

The Japanese naval survey ship *Katsuriki*, arrived at *Tizato Tai* (Tizard Bank) with instructions to survey North Danger Reef, Tizard bank and minor features in the Spratly Group. Japanese naval authorities were more interested in the possibilities Tizard bank offered as a submarine base than as a major fleet anchorage which Britain had been seeking. After establishing a base unit at Tizard Bank *Katsuriki* proceeded to North Danger Reef (*Hokken Sho*) which was carefully examined so as to ascertain four principal entrances into the lagoon to provide data for safe submerged entry of submarines.

On completion of *Katsuriki*'s surveys of North Danger Reef the ship's command was ordered proceeded to examine channels into the anchorage off Itu Aba. Hydrographic surveys to east and north of Tizard Bank were made and charts produced at a medium scale suitable for navigating passages through the Dangerous Ground. Japan's strategic plans viewed the Dangerous Ground from a different perspective from Britain's search for secret routes. Japanese hydrographic survey examinations initially concentrated upon a northern approach into Tizard Bank, with a southern exit towards Borneo Island being searched out as a second phase of operations.

In July 1936, the Japanese Hydrographic Department produced a new general chart, No. 810, South China Sea on a scale of 1:4 000 000. This new chart provided as little new information as the 1935 revision of BA chart 2660B. The Japanese version of the chart raised questions as to existence of a number of named features that appeared on charts produced by the other authorities. Japanese naval surveyors continued their work in the Area during 1937 especially around Tizard Bank and towards the Area's central region.

Japanese examinations of the marine features in the Spratly Group were not full-scale surveys, and were described as sketch surveys both on working plans and on the Japanese secret chart 525. During the 1937 survey season British and Japanese teams met face to face, leaving neither party much room to do anything other than acknowledge that each was intruding into French-claimed territory.

A new chart by Japanese Hydrographic Department, No. 460, of the Paracel Islands was published in October 1936. Chart No. 758 of Balabac Strait was published in August 1936 together with a new chart of northern Palawan Passage, No 757, in February 1937.

Hydrographic surveys of the Dangerous Ground by Japan's authority were concerned with finding safe routes (sea lanes of communications) to strategic points outside *Shinnan Gunto*. Any special chart of *Shinnan Gunto* should ideally connect to Balabac and Mindoro Straits to the eastwards, Borneo to the south and the main or central route through the South China Sea.[40]

Japanese surveys in the area continued in 1938 and during that year the Japanese Hydrographic Department produced three secret charts: No. 521 on 14 March; No. 522 on 27 April; and No. 523 on 29 November. Japanese military forces took control of Itu Aba, North Danger Reef and Spratly Island in March 1939. The entire region of *Shinnan Gunto* (New South Archipelago) came under the authority of the Governor-General of Taiwan, as announced in the Official Gazette of 18 April 1939. The Japanese Foreign Ministry did not announce the southern expansion policy formally until June 1940.

The Japanese Navy needed surveyed routes from Tizard Bank to Balabac Strait, Brunei Bay, Mindoro Strait and the South China Sea, north and east of Tizard Bank. It was on these routes that Japanese surveyors concentrated their efforts.

Japanese naval strategic plans were predicated upon having an active base in the Dangerous Ground which could support surface ships and submarines. As most Japanese naval long-range reconnaissance was performed by sea-planes it followed that any atoll or islands which offered a base for surface ships or submarines, would be quite suitable for sea plane operations. Tizard Bank and Itu Aba was adequate for Japanese strategic purposes as it was located in reasonable proximity to trade routes and usual navigational tracks in the South China Sea and Palawan passage.

Before the start of the Pacific War, Japan produced a number of charts of the South China Sea in the IJN series until September 1944. The Japanese Maritime Safety Organisation (JMSA)

[40] See Hancox and Prescott; see Notes 32 and 35, above.

thereafter continued the work until October 1959. A chart of Palawan and Approaches portraying the dangerous ground east of Meridian 117° East to Palawan, published on 5 August 1968 was available to the Japanese Navy from 1971. Japan naval planning viewpoint of hydrographic surveying in the basin was to find safe navigation routes from Itu Aba towards the southern ports and passageways – straits – in the Indonesian and Philippine archipelagos. Although a general survey of the reefs and atolls in the Dangerous Ground, for use as secondary anchorages was desirable, it was not essential because Japan's main development was Itu Aba.

The Imperial Japanese Navy was not searching for a fleet anchorage or secrecy of the island as an anchorage. Here would be a launch pad for simultaneous attacks aimed at the Philippines, Borneo and Malaya – part of the grand plan of Hemisphere of Co-Prosperity.

Between 1942 and 1955, as a result of the end of the Pacific War, hydrographic information in published form was in circulation. Copies of most Japanese secret charts of the South China Sea were in the hydrographic offices of the Australian, British, Chinese, and the United States. The re-constituted Republic of China Navy, based in Taiwan, began publication of charts of Dangerous Ground, derived from previously secret Japanese charts.

The Japanese Navy had planned and developed considerably bigger and longer range submarines than its European counterparts and perhaps on an equal footing with the United States. The new submarines of the Japanese brought with them demands for different, more bathymetrically oriented hydrographic information and charts. By mid-1944 a number of Japanese Navy's secret charts were beginning to fall into Allied hands.

The Work of the United Kingdom Hydrographic Office

During the first Chinese War of 1839-42, when Captain Elliot, R.N. was Chief Superintendent, British trade in China fell back under Chinese pressure to the island of Hong Kong which was formally ceded to Britain in 1841, when the five treaty ports – Canton, Amoy, Foochow, Ningbo, and Shanghai – were opened to European trade. Naval activity against pirates in the South China Sea was also in progress while 'Rajah' Brooke was establishing position in Borneo and Sarawak; here Capt. Belcher in the *Samarang* was an active participant (refer to Annex II).

Admiral Sir John Barrow was much averse to the chance of irritating the Chinese by keeping the navy's ships 'prowling in their waters' but the Admiralty Board according to a letter from Admiral Beaufort to Sir William Parker, Commander-in-Chief, China, 31 January 1843, the Board clearly saw the concession to trade in certain of the Chinese harbours, most logically and absolutely conveys with it the right of freedom of navigation to those harbours, and consequently the right to ensuring British traders from dangers by surveying. Captain Ross had spent many years surveying the south coast of China he never witnessed any symptoms of jealousy from the citizens of China. This was a fortunate opportunity of extending the British Admiralty's hydrographic knowledge of the coast and seas off China but more importantly enhance trade with China. Other captains, for example, Captain Dawson undertook surveys using HMS Rifleman in the South China Sea in 1866 and HMS *Rambler* in SCS in 1896. HMS *Waterwitch* was on China station, off the Shantung Promontory, and in the approaches to Hong Kong until 1908, when the disturbed state of China caused her diversion, to the Straits Settlements, Singapore, Port Swettenham, and the Malacca Strait. HMS Merlin was in the South China Seas from 1910 to 1914, under various commanders, engaged in surveying the entire north and west coast of Borneo and while at Hong Kong in 1913, undertook a re-survey of the harbour.[41] [Annex III]

The exceptional hydrographic surveys, cartography and data recording and information collecting of UKHO since the mid-1770s on the coastal zone, seas of East Southeast Asian Seas and elsewhere are acknowledged. Indeed, much of this unique work was consulted extensively in 2014 to 2016 as the South China Sea territorial and sovereignty dispute was being discussed by academics and at international fora and at governmental levels nationally, regionally and at the international court of arbitration.

PCA's Award of 12 July 2016

A brief comment is necessary at this stage to illustrate how the South China Sea has been re-framed in 2016. A brief analysis of the submission made to the Permanent Court of Arbitration's (PCA) decision of 2 July 2016 is now offered. It is based partly on a submission relating to the geographical characteristics and status of certain insular features of the South China Sea. From the reports, submissions and hearings the Award's findings deemed that there were seven 'high tide

[41] See Notes 39 and 40, above, for accounts of hydrographic surveys and charting in South East Asian Seas and further afield.

features' – read islands – that were entitled each to a territorial sea; however, were not entitled to an EEZ. They were: Cuarteron Reef, Fiery Cross Reef, Scarborough Reef (all oceanic atolls); Given Reef and Itu Aba (on Tizard Bank) and Johnson South Reef and Mc Kennan Reef part of the Union Reef system). Twenty-one insular features were identified as 'low-tide elevations – that is, each were not above water at high tide, for example, to name a few here; they are Hughes Reef, Mischief Reef, Second Thomas Shoal and Subi Reef.[42][43]

The authors'[44] of the submission stated objective was to provide a critical assessment of the insular features of the Spratly Group that would present an appropriate categorisation of the features and thus their capacity to generate jurisdictional claims to maritime zones. Their report considered the geographical characteristics of insular status, namely the features that are termed, islands, isles, reefs and rocks, shoals and banks – all those naturally-formed submerged and terrestrial features that are named on the charts of the South China Sea. [Annex IV list the features that are deemed as LTEs and others as "rocks above high-tide level].

To those interested parties of the South China Sea dispute and especially the Governments of the littoral States the decision of the PCA was received with both shock and surprise. Based on their assessment and findings the following points re-framed the whole debate of claims and counter-claims. The Award inferred that:

1. No historical evidence China had exercised exclusive control.
2. No legal basis for China to claim historic rights
3. None of the features claimed by China capable of generating an Exclusive Economic Zone only a Territorial Sea.
4. Chinese law enforcement vessels had "unlawfully created a serious risk of collision when they physically obstructed Philippine vessels"; and Vietnamese boats!
5. China "caused severe harm" to coral reefs and violated its obligation to preserve and protect fragile ecosystems.
6. China violated its obligation to preserve and protect fragile ecosystems.

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[42] See The AWARD of 12 July 2016, PCA Case No 2013-19 On the Matter of the South China Sea Arbitration
[43] See Final Transcript Day 2 – Merits and Remaining Issues of Jurisdiction and Admissibility at the PCA Case No 2013-19, heard on 25 November 2015.
[44] Schofield, Clive, Prescott, J.R.V. and van de Poll, Robert, March 2015, Report to PCA of 'An Appraisal of the Geographical Characteristics and Status of Certain Insular Features in the South China Sea'.

7. Chinese authorities were aware that Chinese fishermen had harvested endangered sea turtles, coral and giant clams "on a substantial scale" and have not fulfilled their obligations to stop these actions.

Points 8 and 9 intentionally omitted here.

10. China's land reclamation and construction of artificial islands is "incompatible with the obligations on a state during dispute resolution proceedings".
11. China had breached Philippines' sovereign rights in South China Sea.

An assessment of each of the features of the Spratly Group was undertaken by the authors of the Report. For example, the island of Itu Aba, which goes by as many as eight names, sits atop Tizard Bank has the company of Namyit Island to the south and Gaven Reef to its southwest and Eldad and Petly Reefs to its east; these features and reef system semi-enclose a lagoon of depths in the order of 77 fathoms (or about 150 metres). Itu Aba meets the requirements of Article 1121(1) in that it is naturally formed feature, composed of land, surrounded by water and elevated above the high tide level (see Figures 5 and 6).

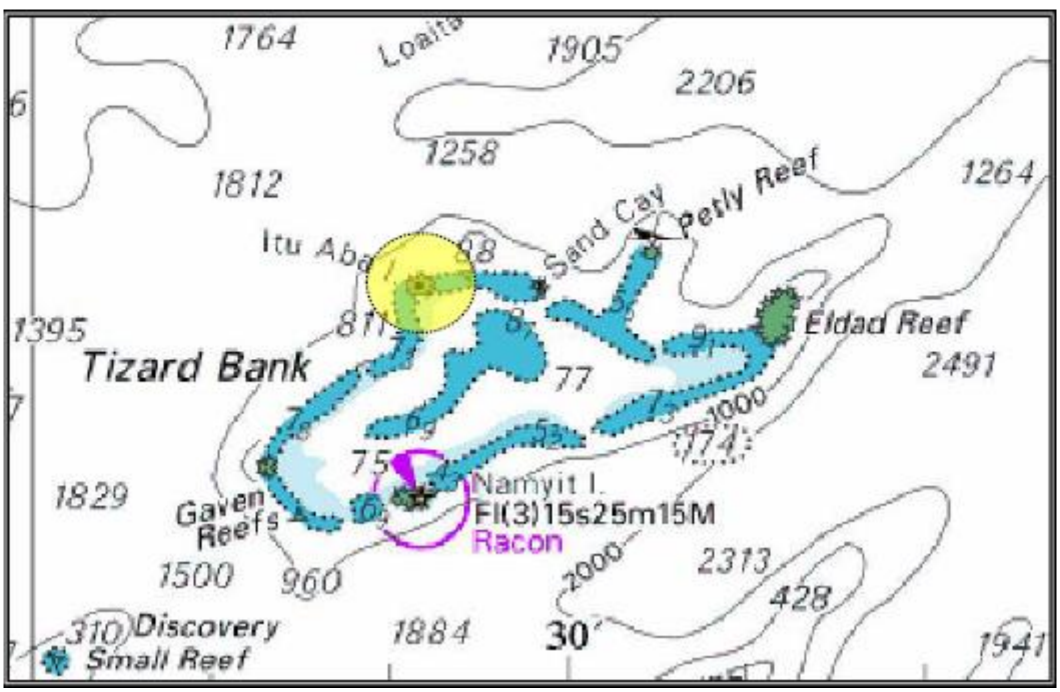

Figure 5: An extract of Chart 3483 showing Tizard Bank, UKHO, December 2013

Figure 6: A satellite-derived image of Itu Aba Island.

On the issue of the jurisdictional zones that the features may claim it was forwarded that: Itu Aba Island and all the features must be treated in the same manner as provided in Article 121(3) 'rock' and accord it no more than 12-M territorial sea. Fourteen features were identified as being pertinent to their classification as an island capable of generating claims to an EEZ and continental shelf rights. Generally, the Report inferred that although most of the 'islands' fulfilled the requirements of Article 121(1) in that were naturally formed feature, composed of land, surrounded by water and elevated above the high-tide level; and were vegetated and personnel living on the them; in the strictest legal sense, they should be treated in the same manner as Article 121(3) 'rock' and be accorded no more than a 12-M territorial sea, as they had no permanent indigenous population and that on these features there was evidence of meaningful economic activity ongoing or in the past.

Eight features were determined to be wholly or partially within a 12-M limit in conformity of Article 13(1). Two submerged features, Macclesfield Bank and Reed Bank were determined to be below-water atoll and a tablemount or large seabank, respectively. Scarborough Reef (or Shoal) or 'rock' is a likely candidate for transformation into an artificial island as the South China Sea dispute sharpens.

China and other countries have engaged in significant land reclamation on disputed features in the Spratly Archipelago since the 1970s transforming reefs into artificial islands. China's construction of an airstrip on Fiery Cross Reef in 2016 is only one of seven features that has been transformed into an artificial island. Four other claimants had already built airfields on insular features that were refashioned and which the States control in the Spratly Group. Those airfields are on Itu Aba Island, occupied by Taiwan; Spratly Island, occupied by Vietnam; Thitu Island, occupied by the Philippines; and Swallow Reef, occupied by Malaysia. Vietnam has undertaken large-scale reclamation on 20 or more maritime features in the Spratly Group and built on them a considerable amount of fixed facilities such as harbor basins, airstrip, missile bases, office buildings, barracks, hotels and lighthouses. It is alleged that the Philippines has constructed an airport and dock at Thitu Island. Brunei is the only claimant that does not currently have operational air bases in the Spratly Group.

Summary

This narrative has intentionally avoided any mention of specific sovereignty and territoriality claims in the South China Sea; rather its focus was on the natural and physical composition of the basin and in the historical context, the surveying and charting of the sea and seabed of the South China Sea and the littoral. The narrative also alludes to the important points brought to the fore in Merits, Reports and Submissions that was submitted to the PCA in which the geographical characteristics of insular features of the basin were discussed, and in particular, the legal basis on which the allocation of maritime zones might apply to each of the features examined under the terms of reference.

The debate on the South China Sea has been re-framed since the sovereignty dispute reared its ugly head and caused a geopolitical tidal wave in this regional sea. The provisions of the 1982 Convention and in particular, the Regime of Islands contained in Article 121, definition of Low-Tide Elevation in Article 13 and the provisions for Artificial Islands, installations and structures, within the context of contemporary international law, has created extensive debates and left open to conjecture as to interpretation of each concept and the jurisdictional limits that each are entitled to claim. Artificial islands, installations and structures are not entitled a jurisdictional zone.

The political divisions and maritime zones depicted on a new map of the South China Sea will portray substantial ‘High Sea’ pockets and circles of 12-M depicting a zone of territorial sea around “rocks that are above high-tide level”. It is possible that there will be overlapping claims until such time as the claimant States resolve their differences and work towards effective management of the maritime space and the exploitation and harvesting marine biotic and mineral resources.

ANNEX I

Charts of the South China Sea by principal National Hydrographic Authorities

1620 *(circa)*	Ma Yuan-I's *Wu Pei Chin*
1821	Horsburgh's Chart of the South China Sea
1859	British Admiralty Chart 2659 *Bruit River to Calamian Island*
1864	China Sea Directory
1867	BA Chart 2660B China Sea – Southern Portion, Eastern Sheet
1838	Chart No. 865 *Carte de la Mer de Chine*
1840	Spanish version of chart 'Dangers in the China Sea'
1843	Marine Board of India's Explanatory Memorandum titled: *Dangers in China Sea not shown or differently placed on Horsburgh Chart of the China Seas* – Edition of 1840
1859	BA Chart 2559 *China Sea Sheet II- South East*
1868	BA 2660B *China Sea, Southern Portion-Eastern Sheet*.
1875	USHO charts 796, 797, 798, 799 equivalents to BA 2660 and 2661
1887	BA 1263 *South China Sea* – Scale 1:4,840,000 published 30 May
1925	BA 2660B published as a 7th Edition on 25 May.
1936	BA 2660B equivalents were USHO 799 and IJN 529A
1977	JNSA chart 2006 was adopted as International chart 508
1983	BA 1263 published on 14 January as a 7th Ed.
1987	BA 1263 withdrawn on 25 September and replaced with BA 4508

ANNEX II

Chronology of Hydrographic Surveys and Charting in the vicinity of Peninsular Malaya and Northern Borneo

Period	Ship's name	Area of survey
1600 – 1784	Ships of the EEIC	Within the seas of East and South East Asia
1795 – 1798	*Providence*	China Seas (may include the southern sector).
1807 – 1840	*Investigator*	Ship of the Honourable East India Company
1819 – 1824	Various ships	Operations off Singapore and Malacca
1823 – 1830	Various ships	Operations off Sarawak
1842 – 1847	*Samarang*	China Seas, especially off north Borneo
1879	*Waterwitch*	Malacca and north Borneo
1881	*Flying Fish*	Northeast coast of Borneo
1883	*Magpie*	Dent Haven, Sabah
1884	*Waterwitch*	North coast of Borneo
1884 – 1885	*Magpie*	Malacca Strait, off Perak River
1886 – 1891	*Rambler*	Northeast coast of Borneo
1891 – 1894	*Ergeria*	Northwest coast of Sabah
1901	*Waterwitch*	Engaged in boundary negotiations
1904 – 1905	*Rambler*	Amoy, China; Labuan, Gaya Island, Jesselton
	Waterwitch	Mirs Bay, Wangkia Bay, Shantung Promontory
1906	*Waterwitch*	Swatow, Hong Kong approaches
1907	Waterwitch	Magnetic observations at Amoy and Hong Kong
1907 – 1909	*Merlin*	Marudu Bay, Kudat Harbour and Tawau
1909 – 1911	*Waterwitch*	Malacca and Singapore Straits
1909 – 1911	*Merlin*	Ambong Bay to Sampanmangio
1912	*Waterwitch*	East coast Malay Peninsula and Straits of Singapore
1913	*Merlin*	Hong Kong Harbour; Tutong to Labuan, Borneo.
1914	*Merlin*	Brunei Bay and Vernon Bank
1922	*Merlin, Dampier*	Johor Strait
1924 – 1925	*Iroquois*	East coast of Peninsula
1933 – 1935	*Endeavour*	West coast of Malaya and Thailand
1946	*Sharpshooter*	Johore Strait
1949 – 1960	*Dampier*	Waters off North coast of Borneo, Johore Strait

ANNEX III

The *Rifleman* searched carefully for the dangers supposed to exist to the eastward of Pulo Sapatu, but without success. The Rawson Shoal was marked on the charts as a doubtful danger about 20 miles E.S.E. of Pulo Sapata. It was hereabouts the *Christopher Rawson* was supposed to have struck. But bearing in mind that the accident occurred in the middle of the night, when the ship was running under double-reefed topsails before a strong N.E. monsoon, and that she went down a few minutes after striking, the crew having barely time to save their lives by taking to the boats, it was manifestly impossible under such circumstances to calculate the position of the shoal with any degree of certainty; it must have been a matter of mere conjecture.

It happened that the gunner's mate of the Rifleman belonged to the Christopher Rawson when she was lost. Overhearing him speak of the wreck in the passage out from England, Lieutenant Reed questioned him as to the circumstances. He asserted that they had seen no land before the vessel struck, but shortly after they had taken to the boats (which were running before the wind) an island was seen upon the starboard quarter about 4 or 5 miles off. If this statement be true, the vessel could not have been lost in the position shown in the charts, for Sapatu is only little visible from the bridge of the Rifleman at a distance of 22 miles.

The *Rifleman* steamed about the position of the *Rawson* a whole day, but could find no appearance of danger. The soundings upon the spot were 162 fathoms, with similar depths around it. H.M.S. *Saracen* also passed over this spot some years ago and saw no danger. It has also been passed over by many other vessels with the same result.

ANNEX IV

1. These features can therefore be classified as islands within the meaning of Article 121(1) of the 1982 Convention; however, due to their characteristics based on the provisions of Article 121(1) they are deemed as '**rocks above high-tide level**'.

Itu Abu Island	10° 23' N	114° 21' E	Tizard Bank
Commodore Reef	11° 05' N	115° 01' E	
Thitu Island	11° 03' N	114° 17' E	Thitu Reefs
Swallow Reef	07° 22' N	113° 50' E	
West York Island	11° 05' N	115° 01' E	
Northeast Cay	11° 28' N	114° 21' E	N Danger Reef
Spratly Island	13° 00' N	111° 55' E	
Southwest Cay	12° 00' N	114° 20' E	N Danger Reef
Loaita Island	10° 40' N	114° 25' E	Loaita Bank
Mariveles Reef	08° 00' N	114° 15' E	Ardasier Bank
Namyit Island	10° 11' N	114° 22' E	Tizard Bank
Nanshan Island	10° 45' N	115° 49' E	Nanshan Group
Sand Cay	10° 23' N	115° 29' E	Tizard Bank
Sin Cowe Island	09° 52' N	114° 19' E	Union Bank

2. The following 18 features have been determined to be **Low-Tide Elevations**. That is, features which are submerged at high tide and dry at low tide, in keeping with Article 13 of the 1982 Convention. The features are as follows:

Alison Reef	08° 51' N	114° 00' E	
Ardasier Reef	07° 38' N	113° 56' E	
Collins Reef	09° 46' N	114° 15' E	London Reefs
Cornwallis South Reef	08° 47' N	114° 11' E	
Dallas Reef	07° 38' N	113° 53' E	
Discovery Great Reef	10° 04' N	113° 51' E	
Eldad Reef	10° 21' N	114° 42' E	Tizard Bank
Gaven Reefs	08° 52' N	114° 13' E	Tizard Bank
Investigator Shoal	08° 07' N	114° 29' E	
Ladd Reef	08° 41' N	111° 40' E	
Landsdowne Reef	09° 48' N	114° 24' E	
McKennan (Hughes) Reef	09° 55' N	114° 29' E	
Mischief Reef	09° 56' N	115° 32' E	
Petly (or Petley) Reef	10° 24' N	114° 35' E	
Second Thomas Shoal	09° 44' N	115° 52' E	
Subi Reef	10° 55' N	114° 04' E	
Tennent (Pigeon) Reef	08° 51' N	114° 39' E	
Whitsun Reef	10° 00' N	115° 21' E	

(The names that are in bold type have been determined to be wholly or partially within a 12-M limit)

3. These features were confirmed as 'Submerged' and therefore have NO capacity to generate claims to maritime jurisdiction. They are:

Macclesfield Bank	15° 50' N	114° 20' E	
Reed Bank	11° 20' N	116° 50' E	
Scarborough Reef (Shoal)	15° 08' N	117° 46' E	(Nay, it is a 'rock'!)

Source: An adaptation of 'An Appraisal of the Geographical Characteristics and Status of Certain Insular Features in the South China Sea' produced by Schofield, C. and others, for the PCA Case of 2013 to 12 July 2016.